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Impact of Shoulder Pathology on Individuals with Distal Radius Fracture: A Mixed Methods Study

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The Impact of Shoulder Pathology on Individuals with Distal Radius Fracture

by

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Abstract

The purpose of this convergent parallel mixed methods study was to expand the understanding of the impact of shoulder pathology on individuals with distal radius fracture (DRF). This included describing the population that had shoulder pathology, comparing participants who had shoulder pathology with participants who did not, and exploring their experiences. The occupational adaptation model guided this study. Recruitment for this study included 45 patients post DRF. Each participant completed a short questionnaire after informed consent was obtained which asked demographic information such as age, gender, race, date of injury, and if the dominant hand was fractured. Over 9 weeks, all participants were intermittently assessed for shoulder pathology at each follow-up visit by their hand surgeon. At 5-7 weeks, another questionnaire collecting demographic information, employment and work status, and fracture status was given to all participants. Each participant also completed the Quick Disabilities of the Arm, Shoulder, and Hand; Tampa Scale of Kinesiophobia-11; visual analog scale; and compensatory mechanism checklist from the Adelaide questionnaire. Of the 45 participants in this study, 16 presented with shoulder pathology. Of the participants who presented with shoulder pathology, seven were interviewed for the qualitative strand. At the end of the study, data analysis of the quantitative and qualitative strands was performed. Descriptive statistics were used to describe the demographics, patient characteristics, and clinical factors of the population who had shoulder pathology concurrent with a DRF. A Mann Whitney U test was used to determine if participants with shoulder pathology had significantly worse function, higher kinesiophobia and pain, and more use of compensatory mechanisms than do patients with no shoulder pathology. Data analysis of the qualitative strand included immersion into the qualitative data by listening to each audiotaped interview, rereading the transcripts, memoing,

reflecting on the preunderstanding bracketed at the beginning of the study, organizing the statements into codes and developing themes. Finally, a merged analysis was performed using a side by side comparison to compare results of the quantitative and qualitative strands. Data analysis for the quantitative strand found that 35.6% of the sample presented with shoulder pathology including diagnoses of subacromial impingement syndrome, shoulder stiffness, and shoulder pain. Of the participants who presented with shoulder pathology, 37.5% were due to the fall and 62.5% were due to compensation or disuse. The average number of days to develop shoulder pathology after the DRF was 42.6 days. Participants who had shoulder pathology concurrent with a DRF had significantly more pain intensity and significantly more use of the avoid activity compensatory mechanism than did participants who had a DRF only. Data analysis for the qualitative strand produced four themes that emerged from the primary research question: What is the lived experience of having shoulder pathology at the same time as a DRF? Those themes included: It's difficult to perform occupations and changes had to be made; There is fear and uncertainty; The impact of pain; Tried to be normal but couldn't. Mixed methods analysis found that participants who had shoulder pathology concurrent with a DRF described high levels of pain that affected their ability to move and use their injured upper extremity for occupations. High pain intensity required the use of more compensatory mechanisms including avoiding activity more. Participants with shoulder pathology described emotions including fear and caution when performing activity or moving the injured upper extremity. Participants described difficulties performing a wide variety of occupations and used a variety of compensatory mechanisms to perform occupations. Participants described a desire to function normally again but were hesitant to perform occupations, especially if they felt that doing so would cause pain or reinjury.

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Chapter 1: Introduction

Shoulder pathology in individuals with distal radius fracture (DRF) has never been explicitly examined in the literature. Often times, shoulder pathologies present during the rehabilitation process post DRF and are first observed by the treating therapist rather than the attending physician. Factors that could cause injury to the shoulder include injuring the shoulder at the same time as experiencing a DRF (Chiu & Robinovitch, 1998; Hsu, Chou, Lou, Huang, & Chou, 2011), using a sling for support post injury (Laseter & Carter, 1996; Weinstock, 1999), having an inability to use the upper extremity due to pain (Pomeroy et al., 2011; Raghavan, 2015), poor positioning of the upper extremity (Laseter & Carter, 1996; Weinstock, 1999), and compensation by the shoulder due to lack of motion in the wrist and forearm (Ayhan, Turgut, & Baltaci, 2015; Bulthaup, Cipriani, & Thomas, 1999). Studies exploring complications following DRF have primarily examined physician-reported complications (Cooney, Dobyns, & Linscheid, 1980; Glowacki, Weis, & Akelman, 1996) or complications related to having specific surgical procedures performed (Bentohami et al., 2014; Jiang, Phillips, Levitz, & Benson, 2014; Johnson et al., 2014; Lutz, Yeoh, MacDermid, Symonett, & Grewel, 2014; Rozental, Beredjiklian, & Bozentka, 2003; Sharma et al., 2014; Wichlas, Haas, Disch, Machó, & Tsitsilonis, 2014). One study has explored patient reported complications after a DRF and found that 38% of patients complain of complications that are considered nondiagnostic such as pain and stiffness (McKay, MacDermid, Roth, & Richards, 2001). McKay et al. (2001) did not specify where the pain or stiffness was located in the affected upper extremity of patients in their study; they did note that these patients reported complications that did not fall into any recognized diagnostic categories. Based on the McKay et al. (2001) study, there is a high percent of patients complaining of

complications that are not recognized in the literature. It is of interest to further understand patient-reported complications post DRF.

Background of the Problem

DRFs are one of the most common fractures seen by physicians (Chung & Spilson, 2001; O'Neill, Cooper, & Finn, 2001) with 17% of fractures seen in the ER being DRFs (Court-Brown & Caesar, 2006). DRFs are most common among young men between 12 to 19 years of age and older women age 50 or older with the highest percentage aged 50-65 (Court-Brown & Caesar, 2006). In the younger population these fractures are due to high energy trauma, but in the older population these fractures are the result of low energy trauma (Diaz-Garcia, Oda, Shauver, & Chung, 2011). A high energy trauma may be the result of an industrial accident, motor vehicle accident, or high height fall; a low energy trauma may be the result of a disease which has affected the integrity of the bone such as osteoporosis (International Society for Fracture Repair, 2015). A common mechanism for injury in a DRF is a fall on an outstretched, dorsiflexed hand (Nellens, Kowalski, & Chung, 2012) classified as either low energy trauma or high energy trauma based on the height of the fall, age, or if osteoporosis is present.

Complications Following a DRF

In studies that explore physician-reported complications post DRF, complication rates reported after DRF vary from 6%-80% (McKay et al., 2001). Complications and rate of complications vary based on the type of fracture (Cooney et al., 1980), whether or not a surgical intervention was performed (Lutz et al., 2014; Sharma et al., 2014), the type of fixation that was used (Rozental et al., 2003; Wichlas et al., 2014), whether or not malunion occurs (Glowacki et al., 1996), and comorbidities of patients (Jiang et al., 2014).

The most common physician-reported complications after DRF include nerve compression, surgical site infection, complex regional pain syndrome, tendon ruptures, and tendonitis (Bentohami et al., 2014; Johnson et al., 2014; Lutz et al., 2014; McKay et al., 2001). Physician-reported complications tend to be characterized by diagnosis, while patient-reported complications are related to symptoms that impair their function (McKay et al., 2001). Therefore a surgeon and patient may vary in how they define a complication. This is important because patient-reported complications such as shoulder pain may be ignored in the literature because physicians do not consider it a complication; however, shoulder pain can have an impact on function.

The complication of developing shoulder stiffness after a DRF is considered a minor complication by some physicians (Cooney et al., 1980), but one study reported 20% of their sample having shoulder pathologies after a DRF (Atkins, Duckworth, & Kanis, 1990). The study by Atkins et al. (1990) indicates that shoulder pathologies are occurring frequently in the DRF population and consideration by physicians to acknowledge shoulder pathology as more than a minor complication is warranted. Further, in the researcher's clinical practice, patients who present with shoulder pathology after a DRF frequently complain of the negative impact on their daily function. Functional limitations experienced by individuals with DRFs have been reported in multiple studies (Beaulé et al., 2000; Bialocerkowski & Grimmer, 2004; Dekkers & Nielsen, 2011; Dekkers & Søballe, 2004; MacDermid et al., 2003; Mehta, MacDermid, Richardson, MacIntyre, & Grewal, 2015a; Nellans, Kowalski, & Chung, 2012; Nielsen & Dekkers, 2013; Ydreborg, Engstrand, Steinvall, & Larsson, 2015). Additionally, shoulder stiffness and pain can impact activities of daily living (ADLs) such as dressing, combing hair, reaching to a back pocket, or fastening a brassiere (Chung, Huong, Kim, & Oh, 2013; Leggin & Iannotti, 1999;

Lippitt, Harryman, & Matsen, 1993; Neviaser & Neviaser, 2011; Richards et al., 1994). The impact on daily function of experiencing a DRF and shoulder pathology independent of each other has been thoroughly examined in the literature. However, the impact on daily function of having both a DRF and shoulder pathology concurrently has not been studied.

Compensation at the Shoulder After a DRF

Literature shows that limited wrist mobility can result in compensation at the shoulder and excessive loading of the shoulder complex (Ayhan et al., 2015; Ayhan, Unal, & Yakut, 2014; Bulthaup et al., 1999; Burtner et al., 2003; Chan & Chapparo, 1999; King, Thomas, & Rice, 2003; May-Lisowski & King, 2008; Mell, Friedman, Hughes, & Carpenter, 2006; Murgia, Kyberd, & Barnhill, 2010). Although some studies have looked specifically at changes in joint motion at the shoulder (Ayhan et al., 2015; Ayhan et al., 2014; Chan & Chapparo, 1999; King et al., 2003; May-Lisowski & King, 2008; Murgia et al., 2010), other studies have used electromyography to study muscle activity changes (Bulthaup et al., 1999; Mell et al., 2006; Yoo, Jung, Jeon, & Lee, 2010). When a person has limited wrist mobility during functional activities, joint motion of the scapula (Ayhan et al., 2015) and glenohumeral joints are increased (Ayhan et al., 2014; Chan & Chapparo, 1999; King et al., 2003; May-Lisowski & King, 2008), and electromyography studies show increased muscle use of the deltoid, rotator cuff, upper trapezius (Mell et al., 2006), biceps, triceps, pectoralis major, and trapezius (Bulthaup et al., 1999).

Wrist immobilization may cause increased use of proximal joint muscles which could cause fatigue and predispose proximal joints to injury (Bulthaup et al., 1999). Further, altered scapular kinematics such as increased scapular internal rotation and upward rotation, seen in patients with a DRF 6-8 weeks postoperatively, can contribute to the development of secondary

musculoskeletal pathologies of the shoulder (Ayhan et al., 2015). Although literature supports that limited wrist mobility can result in excessive loading at the shoulder complex which in turn can cause shoulder pathology, no studies have been performed that have examined biomechanical changes to the shoulder complex in patients who have actually developed shoulder pathology post DRF. There is currently no evidence that has examined how shoulder pathology manifests itself in patients post DRF. Further, no studies have examined the use of compensation to perform functional activities in this population.

Predictors to Functional Outcomes After a DRF

Many studies have examined factors that can predict functional outcomes after a DRF, however, most studies investigated radiographic predictors. In studies that have examined comorbidities, results show that patients who smoke, have diabetes, hypertension, depression (Ring et al., 2006; Wilson et al., 2014; Yeoh et al., 2016), and osteoporosis (FitzPatrick, Casemyr, Zurakowski, Day, & Rozental, 2012; Hollevoet & Verdonk, 2003; Roh, Lee, Noh, Oh, et al., 2014b) have poorer functional outcomes after DRFs. Other patient factors such as lower socioeconomic status (Chung, Kotsis, & Kim, 2007; Paksima, Pahk, Romo, & Egol, 2014), injury compensation (MacDermid, Donner, Richards, & Roth, 2002; MacDermid, Richards, & Roth, 2001), higher self-reported pain (Souer, Lozano-Calderon, & Ring, 2008), and increased age (Chung et al., 2007; Roh, Lee, Noh, Oh, et al., 2014a, 2014b) predicted poorer functional outcomes after a DRF. More recently, literature has supported that important predictors to upper extremity disability are catastrophic thinking (Das De, Vranceanu, & Ring, 2013; Roh, Lee, Noh, Oh, et al., 2014a) and kinesiophobia (Das De et al., 2013; Lövgren & Hellström, 2012; Parr et al., 2012; Söderlund & Åsenlöf, 2010). Catastrophic thinking is an excessive and negative orientation toward pain (Osman et al., 2000), and kinesiophobia is the fear of movement

(Picavet, Vlaeyen, & Schouten, 2002). Psychological factors such as catastrophic thinking and kinesiophobia will be discussed in greater detail later in the literature review.

Literature shows that specific patient factors such as osteoporosis (FitzPatrick et al., 2012; Hollevoet & Verdonk, 2003; Roh, Lee, Noh, Oh, et al., 2014b) and kinesiophobia (Das De et al., 2013; Lövgren & Hellström, 2012; Parr et al., 2012; Söderlund & Åsenlöf, 2010) can impact functional outcomes after a DRF. These patient factors are specifically being discussed because they are a focus of this study. Evidence also supports that developing complications can lead to poorer functional outcomes (Sharma et al., 2014). However, there is no literature describing patient factors or functional outcomes of the population that has shoulder pathology concurrent with a DRF. Understanding how functional outcomes differ between the population who has shoulder pathology, and the population who does not, may provide valuable information about the impact shoulder impairment can have on daily function. Further, the important role of psychological dysfunction, specifically kinesiophobia, in recovery after DRF requires further investigation. It is important to understand if fear of moving the injured upper extremity is characteristic of individuals who develop shoulder pathology after a DRF. Kinesiophobia has not been examined in individuals who experience shoulder pathology concurrent with DRF.

Rehabilitation After a DRF

There is currently no best practice protocol for rehabilitating patients following a DRF (Handoll & Elliot, 2015; Valdes, Naughton, & Michlovitz, 2014). In examining protocols which have been studied, some protocols include active range of motion to the shoulder (Christensen, Kunov, Hansen, Christiansen, & Krasheninnikoff, 2001; Krischak et al., 2009; Michlovitz & Festa, 2011) although other protocols do not include any range of motion to the proximal joints of the upper extremity (Souer, Buijzi, & Ring, 2011; Wakefield & McQueen, 2000). The results

of a systematic review on treatment protocols after DRF indicated that there was insufficient evidence to establish the most effective interventions to use in the treatment of DRFs (Handoll & Elliot, 2015). Recent studies have suggested that patients can regain the same function with a home program as they can attending therapy after a DRF (Christensen et al., 2001; Krischak et al., 2009; Souer et al., 2011; Wakefield & McQueen, 2000). However, these studies eliminated patient complexities that require skilled interventions by a therapist (Handoll & Elliot, 2015; Valdes et al., 2014) such as digit stiffness (Valdes et al., 2014). Although Valdes et al. (2014) felt that studies excluded patient complexities such as digit stiffness, the systematic review by Handoll and Elliot (2015) concluded that symptoms such as finger stiffness and edema were most likely included in the trials investigating effectiveness of treatments post DRF. Examining the contributing factors to the development of shoulder pathology after a DRF may reinforce the role of occupational therapy in rehabilitation of clients with DRFs and enable therapists and physicians to establish protocols that include screening for shoulder pathology, early active range of motion to the shoulder, and instruction on how to use the affected upper extremity for daily activity while avoiding overuse of the shoulder.

Statement of the Problem

In order to improve the protocols used in rehabilitation of individuals post DRF, more information about the phenomenon of shoulder pathology in individuals with DRF was needed. Unfortunately, shoulder pathology after a DRF is considered a minor complication by some physicians (Cooney et al., 1980), and its incidence has been reported in only one article (Atkins et al., 1990) but studies support that it can occur due to injuring the shoulder at the same time as experiencing the DRF (Chiu & Robinovitch, 1998; Hsu et al., 2011), having an inability to use the upper extremity due to pain (Pomeroy et al., 2011; Raghavan, 2015), using a sling for support

post injury (Laseter & Carter, 1996; Weinstock, 1999), and compensation by the shoulder due to lack of motion in the wrist and forearm (Ayhan et al., 2015; Bulthaup et al., 1999). Although very little attention has been given to the phenomenon of shoulder pathology in individuals with DRF, it is frequently seen in clinical practice, and its impact on function can be extraordinary. If both therapists and physicians are to be more aware of the impact of shoulder pathology after a DRF, research needed to be performed in order to describe characteristics of this patient population including patient demographics, work status, fracture status, comorbidities, functional outcomes, and health status. Further, the experiences of this patient population and the meanings that they ascribe to those experiences required further inquiry. To date, there is no qualitative research that has explored the experiences of this population. There is no literature that has described this population's ability to perform daily activities or function within their roles in society. There is no evidence that this population has experiences that are different from the experiences of individuals who have a DRF only.

Relevance

The purpose of this convergent parallel mixed methods study was to expand the understanding of the impact of shoulder pathology in individuals with DRF. This included describing the DRF population that had shoulder pathology, comparing participants who had shoulder pathology with participants who did not, and exploring their experiences. This study contributed to the field of Occupational Therapy by examining how this population performed and participated in daily occupations, and fulfilled roles in the community. In addition, this study examined psychological components, such as kinesiophobia, to understand how fear of moving impacted functional use of the upper extremity. The use of compensatory mechanisms was studied and the role of compensation in development of shoulder pathology was examined.

Last, this study explored the lived experience of having shoulder pathology concurrent with a DRF. In-depth interviews uncovered the impact shoulder pathology had on function and psychological well-being.

Elements

Quantitative Research Questions

1. What demographics, patient characteristics, and clinical factors describe the population who had shoulder pathology concurrent with a DRF?
2. Are there differences in functional outcome scores (as measured by the Quick Disabilities of the Arm, Shoulder, and Hand) between patients who had shoulder pathology concurrent with a DRF and patients who had a DRF only?

   Hypothesis: Patients who had shoulder pathology concurrent with a DRF have significantly worse functional outcome scores than do patients who had a DRF only.
3. Are there differences in kinesiophobia scores (as measured by the Tampa Scale of Kinesiophobia-11) between patients who had shoulder pathology concurrent with a DRF and patients who had a DRF only?

   Hypothesis: Patients who had shoulder pathology concurrent with a DRF had significantly worse kinesiophobia scores than did patients who had a DRF only.
4. Are there differences in pain levels (as measured by a visual analog scale) between patients who had shoulder pathology concurrent with a DRF and patients who had a DRF only?

   Hypothesis: Patients who had shoulder pathology concurrent with a DRF have significantly worse pain scores than did patients do who had a DRF only.
5. Are there differences in the number and type of compensatory mechanisms (as measured

by the compensatory mechanisms checklist of the Adelaide questionnaire) used between patients who had shoulder pathology concurrent with a DRF and patients who had a DRF only?

Hypothesis: Patients who had shoulder pathology concurrent with a DRF use a higher number of compensatory mechanisms than do patients who had a DRF only.

Qualitative Research Question

1. What is the lived experience of having shoulder pathology at the same time as a DRF? What is it like living with your injury?
    a. Has your injury affected your ability to perform the activities that you do every day? If so, how?
    b. Has your injury affected your ability to fulfill your roles with family, community, or other groups? If so, how?
    c. Has your injury affected your ability to perform your job? If so, how?
    d. Can you describe how you feel when you try moving or using your injured arm?
    e. Do you have pain? If so, can you describe your pain? How does pain effect your day? How does pain effect your ability to do what you need or want to do?
    f. Have you had to change the way you do things since your injury? If so, can you describe what has been different or how you have had to change how you do things?

Mixed Methods Questions

1. How do the qualitative interview results coincide with the results of the visual analog scale; compensatory mechanisms checklist; Quick Disabilities of the Arm, Shoulder, and Hand; and Tampa Scale of Kinesiophobia-11?

2. How do the qualitative interview results elaborate on the results of the visual analog scale; compensatory mechanisms checklist; Quick Disabilities of the Arm, Shoulder, and Hand; and Tampa Scale of Kinesiophobia-11?
3. To what extent do the results of the visual analog scale; compensatory mechanisms checklist; Quick Disabilities of the Arm, Shoulder, and Hand; and Tampa Scale of Kinesiophobia-11 disagree with the qualitative interview results?
4. When comparing the results of the qualitative interview data with the quantitative instrument data, what information emerges that expands the understanding of the phenomenon of having shoulder pathology concurrent with a DRF?

Definitions of Terms

Shoulder Pathology

For the purpose of this study, the term shoulder pathology was used to describe only musculoskeletal conditions of the shoulder. Shoulder pathology was defined as rotator cuff tendonitis/subacromial impingement syndrome, adhesive capsulitis, shoulder stiffness, and shoulder pain.

Conceptual—Includes only musculoskeletal conditions of the shoulder. Shoulder pathology was defined as rotator cuff tendonitis/subacromial impingement syndrome, adhesive capsulitis, shoulder stiffness, and shoulder pain.

Operationally—While the participant was in the care of the hand surgeon and occupational therapist, the shoulder was examined at each follow-up visit to establish that a shoulder pathology was present or not present. When symptoms of shoulder pathology were present in a participant, the hand surgeon diagnosed the shoulder pathology. Diagnosis of shoulder pathology included clinical tests performed by the hand surgeon. In order for the

participant to be diagnosed with a shoulder pathology, the individual must meet the criteria below.

Rotator cuff tendonitis/subacromial impingement syndrome—Presence of positive Neer impingement test and/or Hawkins Kennedy impingement test. Pain at the anterior or lateral shoulder during shoulder elevation. Weakness during manual muscle testing to the rotator cuff muscles. Interview with the participant to clarify that shoulder pain occurred at the same time as the DRF or after the DRF. All shoulder symptoms had to occur at the time of the fall or have developed after the DRF.

Adhesive Capsulitis—P Presence of shoulder pain with contracture of the glenohumeral joint. Interview with the participant to clarify that shoulder symptoms occurred at the same time as the DRF or after the DRF. Contracture of the glenohumeral joint motion included the criteria that both active range of motion and passive range of motion are limited especially in external rotation. Further, complaints of high pain when passively moving the joint was criteria for a diagnosis of adhesive capsulitis. All shoulder symptoms had to occur at the time of the fall or developed after the DRF.

Shoulder stiffness—Restriction of glenohumeral joint motion when compared to the noninjured shoulder. Complaint from participant is that the shoulder feels stiff, not painful. Interview with the participant to clarify that shoulder pain occurred at the same time as the DRF or after the DRF. A diagnosis of shoulder stiffness was differentiated from adhesive capsulitis because there were no complaints of high pain intensity when passively moving the glenohumeral joint. All shoulder symptoms had to occur at the time of the fall or have developed after the DRF.

Shoulder pain—Complaints of pain in the shoulder either at rest or with shoulder motion. Pain levels varied from 1/10 to 10/10. Interview with the participant to clarify that shoulder pain occurred at the same time as the DRF or after the DRF. This diagnosis was given if the participant had complaints of pain but did not fall under any of the other diagnostic categories. All shoulder symptoms occurred at the time of the fall or developed after the DRF.

Functional Outcome

For the purpose of this study, the term functional outcome was used to describe a participant's ability to function in everyday life. Functional outcome is defined as measurement of a participant's physical limitations in performing the usual human tasks of living, including both functional and behavioral symptoms (American Medical Association, 2014).

Conceptual—Included the participant's ability to perform ADLs; instrumental activities of daily living (IADLs); fulfill roles with family, community, and other groups; and perform job responsibilities.

Operational—The score on the Quick Disabilities of the Arm, Shoulder, and Hand (QuickDASH, see Appendix A) was used to quantify functional outcomes.

Kinesiophobia

For the purpose of this study, kinesiophobia was used to describe a participant's fear of movement of the injured upper extremity. Kinesiophobia is defined as the fear of movement (Picavet et al., 2002).

Conceptual—Included the participants' fear of movement, fear of pain, and overall fear of their medical condition.

Operational—The score on the Tampa Scale of Kinesiophobia-11 (TSK-11, see Appendix B) was used to quantify kinesiophobia.

Pain Intensity

For the purpose of this study, pain intensity was used to describe a participant's level of pain in the affected upper extremity. Pain intensity was recorded as the level of pain the participant had during activity.

Conceptual—Included the participant's best estimation of the level of pain in the affected upper extremity during all daily activities including ADLs, work activities, and leisure activities.

Operational—The Visual Analog Scale (VAS, see Appendix C) was used to quantify pain intensity.

Compensatory Mechanisms

For the purpose of the study, compensatory mechanisms were used to describe mechanisms or strategies a participant used to assist or aid in performing a daily activity. Compensatory mechanisms are defined as mechanisms that are used when activity limitations are present in order to decrease the difficulty of performing a task (Bialocerkowski, 2008).

Conceptual—Included avoiding the activity, performing the activity with two hands, holding a jar between the legs, taking rest breaks when performing the activity, using a wrist brace when performing the activity, doing the activity with one hand, changing the way the item is lifted or gripped, and taking longer to perform the activity.

Operational—The number of compensatory mechanisms from the compensatory mechanisms checklist of the Adelaide questionnaire (see Appendix D) used to perform the activities in questions 1-5 of the QuickDASH was added up. This total score was used to quantify compensatory mechanisms.

Explanation of Variables

Independent Variables

Participants with a DRF only were placed in the DRF only group if they did not present with shoulder pathology 9 weeks post DRF. This group included participants who had been diagnosed with a DRF by a hand surgeon. Participants with a DRF who had shoulder pathology concurrent with a DRF were placed in DRF concurrent with a DRF group after presenting to the hand surgeon with shoulder pathology. The group included participants who had been diagnosed with a DRF by a hand surgeon and also diagnosed with shoulder pathology by a hand surgeon. For each participant who presented with shoulder pathology, the date the shoulder injury started and the shoulder diagnosis were recorded by the hand surgeon.

Demographic Dependent Variables

1. Age was reported as the participant's chronological age at the time he or she was enrolled in the study.
2. Gender was reported as either male or female.
3. Race was reported as Caucasian, African American, Hispanic, or other for each participant. Each participant self-identified his or her race.
4. A caregiver was defined as a person who is paid or unpaid that provided assistance with ADLs and IADLs. For each participant it was documented if he or she currently had a willing and able caregiver providing assistance by reporting yes or no.

Employment and Work Status Dependent Variables

1. A productive role was defined as the role the participant assumes in his or her daily life. Productive role capacity was defined as the capacity to which a participant can perform his or her productive role. Productive role was reported using the categories of: paid

employment, homemaker, volunteer, and student. Within each category, the capacity to which the participant could fulfill that role was reported by either full, modified, unable to perform, or not applicable.

2. Workers' compensation was defined as a form of insurance providing wage replacement and medical benefits to employees injured in the course of employment. Workers' Compensation was reported by indicating if the participant is or is not receiving workers' compensation.

Fracture Status Dependent Variables

1. Injured side was defined as the side of the body that the DRF occurred and was reported as right or left.
2. Injured side is the dominant side was defined by if the side where the distal radius occurred is the dominant side and was reported as yes or no.
3. Surgery was defined by if the participant required surgical reduction of the distal radius. This decision was made by the treating hand surgeon and was recorded as yes or no.
4. Time from onset of fracture was defined as the length of time since the participant's fracture occurred and was reported as the number of days since the fracture occurred.
5. Sling use was reported by if the participant used a sling, yes or no.
6. Days in sling was reported by the number of days the participant used a sling.

Heath Status Dependent Variables

1. Complex Regional Pain Syndrome (CRPS) was reported based on if the participant had been diagnosed with CRPS by a treating physician (yes/no).
2. Osteoporosis was reported based on if the participant had been diagnosed with osteoporosis by a treating physician (yes/no).

Outcome Measure Dependent Variables

1. Number of compensatory mechanisms was reported as the number of compensatory mechanisms used from the Adelaide questionnaire Compensatory Mechanisms Checklist to perform the ADLs on the QuickDASH questions 1-5.
2. Pain intensity was reported as the participant's current perceived level of pain in the affected upper extremity on a scale from 1 to 10.
3. Kinesiophobia was reported as the score on the TSK-11.
4. Functional Outcome was reported as the score obtained on the QuickDASH outcome measure.

Rationale and Need for the Study

There was a strong need to examine the complication of shoulder pathology concurrent with a DRF because this complication is frequently overlooked by both therapists and physicians and can cause patients additional pain and functional impairment. Exploring the impact of shoulder pathology on an individual will help therapists to better understand how this complication impacts functional outcomes, pain, and psychological well-being. This phenomenon is poorly understood in the literature and the functional and psychological difficulties this population faces have never been examined.

Assumptions

1. After suffering a DRF, a proportion of patients will report shoulder pathology.
2. All treatment given to patients by the occupational therapist(s) will be common treatment techniques used for the treatment of DRFs. No experimental treatments will be used.

Summary

In summary, shoulder pathology may occur after a DRF (Atkins et al., 1990), due to injuring the shoulder at the same time as experiencing the DRF (Chiu & Robinovitch, 1998; Hsu et al., 2011), using a sling for support post injury (Laseter & Carter, 1996; Weinstock, 1999), having an inability to use the upper extremity due to pain (Pomeroy et al., 2011; Raghavan, 2015), poor positioning of the upper extremity (Laseter & Carter, 1996; Weinstock, 1999), and compensation by the shoulder due to lack of motion in the wrist and forearm (Ayhan et al., 2015; Bulthaup et al., 1999). The complication of developing shoulder stiffness after a DRF is considered minor by some physicians (Cooney et al., 1980); however, in one study over one third of participants post DRF complained of shoulder complications (Atkins et al., 1990) that would be considered nondiagnostic such as pain and stiffness (McKay et al., 2001). Patient factors such as diabetes, hypertension, depression, osteoporosis, and kinesiophobia are predictors to poorer functional outcomes in the DRF population and could potentially be representative in the population that experience shoulder pathology concurrent with a DRF. This population is poorly described in the literature in that there is no research describing their characteristics such as patient demographics, work status, fracture status, comorbidities, functional outcomes, and health status or any qualitative description of what it is like to experience this phenomenon.

The need for rehabilitation after a DRF has recently been disputed. Studies have recently reported that patients get the same results performing a home exercise program as they do attending occupational therapy or physical therapy after a DRF (Christensen et al., 2001; Krischak et al., 2009; Souer et al., 2011; Wakefield & McQueen, 2000). These studies eliminated patient complexities that require skilled interventions by a therapist (Handoll & Elliot, 2015; Valdes et al., 2014). The complication of having shoulder pathology concurrent with a

DRF could be considered a patient complexity that requires skilled intervention by an occupational or physical therapist for both early diagnosis and treatment. The results of this study will assist therapists in understanding why screening of the shoulder is important post DRF. Results from this study will also assist physicians in understanding the importance of early referrals to rehabilitation and what characteristics individuals have who develop shoulder pathology. This study will further contribute to the literature by documenting that shoulder pathologies do occur after a DRF and can occur at the time of the fall or due to compensation or disuse.

Chapter 2: Review of the Literature

The purpose of this literature review was to provide information about the theoretical framework for the research study, identify studies that support the research topic, identify what is known and unknown about the research topic, and establish areas of interest and constructs. This chapter includes an extensive review of the literature describing the population who has experienced a DRF. Because there is no literature describing the population who has shoulder pathology concurrent with a DRF, applicability of the current research is explored. Lastly, the quantitative instruments used in the literature are critiqued, and the methodological underpinnings of the qualitative strand are discussed.

Historic Overview: The Occupational Adaptation Model

The Occupational Adaptation (OA) model (Schkade & Schultz, 1992, Schultz & Schkade, 1992) was selected as the theoretical framework for this study. The OA model is grounded in occupational adaptation, referring to how the concepts of occupation and adaptation are integrated in a single phenomenon within a patient (Schkade & Schultz, 1992). In the OA model, occupations are defined as activities that require active participation, have meaning to the person, and have a tangible or intangible output (Schkade & Schultz, 1992; Schultz & Schkade, 1992). An example of a tangible output would be preparing a meal and then eating that meal whereas an example of an intangible output would be doing yoga and experiencing a feeling of relaxation. Adaptation refers to the change in the functional state of a person as a result of desire for mastery over occupational challenges (Schkade & Schultz, 1992). The OA process depicts how a person can respond adaptively to an occupational challenge leading to mastery of that occupation (Schkade & Schultz, 1992). The three OA process elements are comprised of the

person, the occupational environment, and the interaction of the two as they come together in occupation (Schkade & Schultz, 1992).

Person

Evaluation of the OA process in a person includes looking at the subsystems of the person, the occupational environment, role expectations, and adaptive capacity (Schultz & Schkade, 1992). In the OA model, the person is made up of sensorimotor, cognitive, and psychosocial systems (Schkade & Schultz, 1992). One assumption of the OA model is that the sensorimotor, cognitive, and psychosocial subsystems are present and active for an occupational response (Schkade & Schultz, 1992). However, each subsystem can be active to varying degrees based on a particular occupational challenge (Schkade & Schultz, 1992). For example, to watch TV, an individual's psychosocial subsystem would be less active than his or her sensorimotor and cognitive subsystem. Some individuals may have deficits within their subsystems or subsystems that are less active. For example, an individual may have sensorimotor problems such as decreased strength or cognitive problems such as impaired short-term memory. A psychosocial problem may be lack of motivation. Deficits within a subsystem can become barriers to occupational performance (Schkade & Schultz, 1992). Deficits to the psychosocial subsystem such as depression, (Ring et al., 2006; Wilson et al., 2014; Yeoh et al., 2016), and deficits to the sensorimotor system such as high pain (Cowie, Anakwe, & McQueen, 2015; Mehta et al., 2015a; Nielsen & Dekkers, 2013; Swart, Nellans, & Rosenwasser, 2012) can become barriers to function after a DRF. This study explored how deficits in person subsystems impacted individuals with shoulder pathology concurrent with a DRF.

Occupational Environment

The OA model defines the occupational environment as the contexts in which occupations occur and include the contexts of work, play and leisure, and self-maintenance (Schkade & Schultz, 1992). Each occupational environment requires a person to perform an occupation that is satisfying to self and therefore results in an occupational response (Schkade & Schultz, 1992). The occupational environment also consists of physical, social, and cultural subsystems, each contributing to the nature of a particular occupational environment (Schkade & Schultz, 1992). The physical subsystem includes inanimate objects in the environment, the social subsystem includes the people that are present who influence the environment by their predispositions, attitudes, and actions, and the cultural subsystem reflects the way the physical and social subsystems come together to serve the purpose of the occupational environment (Schkade & Schultz, 1992). Further, the cultural subsystem includes the procedures, methods, rituals, values, and constraints immersed in the work, play and leisure, or self-maintenance contexts (Schkade & Schultz, 1992).

Participation in occupation was not directly observed in the participants' homes for this study. However, the occupational environment was explored through questionnaires and interviews. This provided insight into how the participant was functioning in his or her environment. This exploration into the occupational environment included understanding how the participant was able to function within the physical, social, and cultural subsystems and how dysfunction within those subsystems impacted participation in work, play and leisure, and self-maintenance contexts. Although no study has objectively examined the ability of a patient to function in his or her own occupational environment post DRF, many studies have used questionnaires and interviews to understand the difficulties patients face functioning in various

contexts (Dekkers & Nielsen, 2011; Dekkers & Søballe, 2004; Nielsen & Dekkers, 2013). The inability to be productive within the environment is a main complaint for patients post DRF (Dekkers & Nielsen, 2011; Dekkers & Søballe, 2004; Nielsen & Dekkers, 2013), and many patients use compensatory mechanisms 8-9 weeks post DRF in order to function within their own environment (Bialocerkowski & Grimmer, 2004). This study will help us understand what barriers the participants encountered within their environments and if they had to compensate in order to successfully perform their desired occupations. Understanding how participants respond adaptively to an occupational challenge will assist in understanding how participants successfully function within their environments.

Role Expectations

Occupational challenges occur within a person's occupational role and carry with them certain expectations (Schkade & Schultz, 1992). For example, a mother may be expected to provide meals to her family, and the occupation of cooking a meal could become an occupational challenge after an injury. Therefore, a person's occupational roles, and the environment in which they occur, create a source of demand for the person (Schkade & Schultz, 1992). After a DRF, patients who had higher occupational demands and higher self-reported disability were more likely to lose time from work (MacDermid, Roth, & McMurtry, 2007). In this study, productive roles for each participant were examined through questionnaires and included exploring what role each participant had and their ability to perform that role. After a DRF, there are significant role limitations due to physical problems in the upper extremity (Golec et al., 2015). Middle age adults experience significantly greater role dysfunction than do younger adults and older adults, most likely due to multiple role expectations of this age group (Morris, 2000). Interviewing participants gave the opportunity to further examine the ability of each

participant to perform his or her occupational roles within his or her environment and assisted in understanding how shoulder pathology concurrent with a DRF impacted certain roles and to what extent those roles are impacted.

The Process Flow

In the OA model, the OA process begins with an occupational challenge followed by the perception of the person of both internal and external expectations for occupational performance (Schkade & Schultz, 1992).

> Based on these perceptions, the person generates an occupational response, evaluates the outcome, and integrates feedback from the response for subsequent use. At the same time, evaluation and feedback integration functions are taking place in the occupational environment element. The process is repeated as another occupational challenge emerges. (Schkade & Schultz, 1992, p. 833)

The desire for mastery when performing an occupational challenge results in adaptation (Schkade & Schultz, 1992).

Subprocesses of the Occupational Adaptation Framework

Adaptive response generation subprocess. The adaptive response generation subprocess is the response generated by the occupational challenge and role expectations perceived by a person (Schkade & Schultz, 1992). The adaptive response generation subprocess is the first subprocess and is followed by the adaptive response evaluation subprocess, and the adaptive response integrative subprocess (Schkade & Schultz, 1992). It is characterized by both an adaptive response mechanism and an adaptive gestalt (Schkade & Schultz, 1992).

Adaptive response mechanism. The adaptive response mechanism determines the type of adaptive energy the person will use by selecting from a repertoire of adaptive response modes

and adaptive response behaviors (Schkade & Schultz, 1992). Adaptive energy consists of a focused, higher awareness level that can be depleted more quickly and a lower, more sophisticated, creative level that requires less energy to operate (Schkade & Schultz, 1992). This study explored compensatory mechanisms and the adaptive energy used to perform those compensatory mechanisms through questionnaires and interviews. Information obtained helped to explain how participants used focused, higher awareness level compensatory mechanisms by taking longer to use the affected extremity for occupation or how they were using lower, sophisticated, creative level compensatory mechanisms by using the nonaffected upper extremity for occupation. Understanding the specific compensatory mechanisms being used in this population can assist in identifying what adaptive energy patterns may put patients more at risk for developing shoulder pathology.

When presented with an occupational challenge, persons may respond by using existing modes even when they are not appropriate for the task (Schkade & Schultz, 1992). For example, Bialocerkowski (2002) found that 17% of patients with wrist disorders compensate during hygiene activities by taking a longer time to complete the task. Taking longer to complete a task would be considered a primary adaption level, and failure to produce relative mastery outcomes at this level would encourage new behaviors to develop (Schkade & Schultz, 1992). Adaptive response behaviors include hyperstability (primitive), hypermobility (transitional), and blended mobility and stability (mature, Schkade & Schultz, 1992). Hyperstabilized or primitive behaviors in the sensorimotor system are seen through frozen postures (Schkade & Schultz, 1992). Hypermobile or transitional behaviors are seen through high levels of motion without clear goal direction (Schkade & Schultz, 1992). Blended mobility and stability or mature behaviors are seen through coordinated motions (Schkade & Schultz, 1992). No studies have

examined where compensatory mechanisms used after a DRF fall within the adaptive response categories. However, qualitative studies have found that the frequency and type of compensatory mechanisms used after a wrist disorder are dependent on the type of activity performed (Bialocerkowski, 2002; Bialocerkowski & Grimmer, 2004). For example, after DRF patients may use a variety of compensation mechanisms in order to perform their daily activities, and these strategies may fall within more than one adaptive response behavior. This study examined the compensation strategies used by the population with shoulder pathology and what strategies may have led to development of shoulder pathology.

It is possible that both hypermobile and hyperstable adaptive response behaviors may lead to the development of shoulder pathology. For example, a patient may develop shoulder pathology if he or she utilizes a hypermobile behavior such as overusing the shoulder joint when performing an occupation with the affected upper extremity. Ayhan et al. (2015) specifically examined the shoulder after a DRF and found altered scapular kinematics such as increased scapular internal rotation and upward rotation when participants performed shoulder elevation. A patient may also develop shoulder pathology if he or she utilizes a hyperstabilized behavior by not moving the affected upper extremity. After a wrist disorder, Bialocerkowski (2002) found that 31% of participants requested someone else to do the task and 26% used the nonaffected hand to perform the task. By not using the affected upper extremity for daily function, changes can occur to the nonaffected, nontraumatized joints such as the shoulder. Shoulder immobilization can induce adhesion of the joint or capsular contracture (Liu, Ao, Cui, & Zhu, 2011). Immobilization of a nontraumatized joint affects chemical, morphological, and mechanical characteristics of dense connective tissue in and around the articulation (Akeson, Ameil, & Woo, 1987; Ando et al., 2012; Enneking & Horowitz, 1972) and it has been reported

that changes in articular cartilage can occur in approximately two weeks of immobilization (Kunz et al., 2014).

Adaption gestalt. The adaption gestalt is part of the adaptive response generation subprocess along with the adaptive response mechanism. The adaptation gestalt configures the output of the adaptive response mechanism into a plan for the sensorimotor, cognitive, and psychosocial involvement of the person (Schkade & Schultz, 1992). The psychosocial component of the person subsystems is involved in all cognitive activity and must be incorporated into the gestalt at a level that facilitates cognitive processing rather than interferes with it (Schkade & Schultz, 1992). After cast removal post DRF, middle-aged adults demonstrated more emotional problems, such as depression and anxiety, that interfered with occupational performance when compared to the older aged adults (Morris, 2000). Further, middle age adults spend less time on activities, accomplish less, and work less carefully after a DRF (Morris, 2000). The imbalance of the person systems, as evidenced in middle age adults after a DRF, required further examination to understand if psychosocial issues impacted individuals who experienced shoulder pathology concurrent with a DRF.

Adaptive response evaluation subprocess. The adaptive response evaluation subprocess is activated by the person through comparison of the adaptation gestalt to the effect on the occupational response, and it is within this subprocess where the person assesses the experience of relative mastery (Schkade & Schultz, 1992). Relative mastery is defined as the extent to which the person experiences the occupational response as efficient, effective, and satisfying to self and society (Schkade & Schultz, 1992). Relative mastery includes occupational performance that is not only pleasing to self but also to relevant agents within the occupational environment (Schkade & Schultz, 1992). Women, who experience DRFs more frequently than

do men (Singer, McLauchlan, Robinson, & Christie, 1998), identify productivity and self-care as the most impacted performance problems after DRF (Dekkers & Nielsen, 2011; Dekkers & Søballe, 2004). The inability of women to achieve relative mastery in productivity areas such as household chores could impact role expectations and not satisfy the home environment. Achieving relative mastery when performing an occupation is an important component in satisfying both role and environmental expectations (Schkade & Schultz, 1992). The concept of relative mastery, its relationship to role fulfillment, and environmental expectations was examined in the population who experienced shoulder pathology concurrent with a DRF.

During the adaptive response evaluation subprocess, a person must choose between performing the occupation with dysadaptation, adaptation, or neither (Schkade & Schultz, 1992). Dysadaptation is an important concept to define within the population who experiences shoulder pathology concurrent with a DRF. Dysadaptation could be defined as either an inability to adapt in order to perform an occupation or adapting and causing injury to the shoulder. Use of adaptive strategies can result in relative mastery in occupational performance; however, compensatory mechanisms may predispose individuals to other injuries (Bialocerkowski, 2002). For this study, it is important to understand how participants who develop shoulder pathology after a DRF adapted and if the compensatory techniques used may have contributed to the development of shoulder pathology. Further, did the participant use compensatory techniques for ADLs out of fear of injuring the wrist fracture, due to pain, or because he or she wanted to be more independent?

Adaptive response integrative subprocess. "At this point in the occupational adaptation process flow, the person has generated the adaptive response, executed it in the occupational response, and evaluated the occupational event in terms of relative mastery and

placement on the occupational adaptation continuum" (Schkade & Schultz, 1992, p. 835). In the OA model, the adaptive response integrative subprocess is the final step in the OA process (Schkade & Schultz, 1992). During this subprocess, the person integrates all the steps of the adaptive response into the person systems and modifications can occur (Schkade & Schultz, 1992). It is in this final step where learning occurs (Schkade & Schultz, 1992). After a DRF, the use of compensatory mechanisms is reduced over time, however, literature indicates that activities such as inside domestic activities, lifting and carrying activities, and hygiene and dressing still require use of compensatory mechanisms 24 weeks post-DRF (Bialocerkowski & Grimmer, 2004). For example, an individual may avoid the activity at 8 weeks post-DRF then take a longer time to perform that same activity at 24 weeks (Bialocerkowski & Grimmer, 2004). Therefore as person systems change, compensatory mechanisms used also change. For example, improvements in the sensorimotor system may allow an individual to have more use of the hand and wrist or improvements in the psychosocial system may show increased motivation to use the affected upper extremity for occupation. Changes in compensatory mechanisms over time could impact the shoulder. Initial immobilization of the shoulder, due to use of a sling, followed by excessive loading when activity is resumed can individually or collectively have a negative impact on the shoulder joint. Understanding how compensatory mechanisms change over time with patients who develop shoulder pathology after a DRF was examined in this study.

General Systems Theory

The OA model is a client-centered model and is influenced by general systems theory. General systems theory is opposed to reductionism in that the whole can only be understood by focusing on the relationship between the parts that connect into a whole (von Bertalanffy, 1968). The influence of general systems theory in the OA model is seen through the interaction between

the person and the occupational environment as they come together in occupation. When examining patients after DRF, both physicians and therapists may focus only on the DRF and neglect to understand if the wrist injury has impacted the proximal shoulder joint or if the shoulder was injured at the same time the DRF occurred. In addition, patients who develop impairments in two joints of the upper extremity could have different occupational performance deficits than having only one joint impaired. Although reductionism should be utilized for some medical conditions, the phenomenon of experiencing shoulder pathology concurrent with a DRF requires a more holistic viewpoint. The OA model provides a theoretical framework to guide this study and explore this complicated phenomenon.

Relevant Concepts and Research Literature on Topic

DRF and Complication of Shoulder Pathology

Shoulder pathology concurrent with a DRF has not been identified as a complication in the literature and some physicians consider shoulder stiffness after a DRF a minor complication (Cooney et al., 1980). Yet shoulder pathology concurrent with a DRF can easily fit into the definition of a complication post DRF as defined by McKay et al. (2001). They define a complication post DRF as diagnoses that are concomitant with the DRF and that resulted from the DRF or its treatment (McKay et al., 2001). It is possible for a person to injure the shoulder at the time of the fall concomitant with the DRF. When falling forward on an outstretched hand at a height of less than two feet, there is a significant risk for wrist fracture since the height, peak forces surpass the average fracture force of the distal radius (Chiu & Robinovitch, 1998). However, while the shoulder experiences lower peak force than the wrist, it absorbs greater deflection and displacement and therefore absorbs the majority of impact energy during a fall

(Chiu & Robinovitch, 1998). Further, with a fall onto an outstretched hand there is potential for medio-lateral shear force on the shoulder joint (Hsu et al., 2011).

Treatment of DRF and impact on shoulder complex. Shoulder pathology can result from treatment of the DRF. For example, many orthopedic protocols require use of a sugar tong splint for 1-3 weeks after a closed reduction of the DRF followed by 2-3 weeks in a short arm cast (Wolfe, Pederson, Hotchkiss, Kozin, & Cohen, 2010). Surgical intervention to repair a DRF requires 1-3 weeks in a sugar tong splint, followed by a possible short arm cast (Wolfe et al., 2010). Each protocol may also require use of a wrist orthosis (Michlovitz & Festa, 2011). While in a sugar tong splint, short arm cast, or wrist orthosis, patients frequently position the injured upper extremity in shoulder internal rotation and adduction with the elbow in flexion for protection (Michlovitz & Festa, 2011). Patients may also utilize a sling (Laseter & Carter, 1996; Michlovitz & Festa, 2011). Although literature does not support the use of a sling after a DRF (Laseter & Carter, 1996; Michlovitz & Festa, 2011), slings are frequently issued by physicians and hospitals to protect the arm after a DRF (Laseter & Carter, 1996; Michlovitz & Festa, 2011). Misuse of a standard sling can result in improper positioning of the forearm in a dependent position and can lead to hand edema, shoulder capsular tightness, elbow stiffness (Laseter & Carter, 1996; Weinstock, 1999), and decreased functional use of the upper extremity (Laseter & Carter, 1996). It is of interest to this study to understand if individuals who had shoulder pathology concurrent with a DRF used a sling more often and for a longer duration than did individuals with a DRF only.

In studies that investigated complications after DRFs, only one study reported shoulder pathology (Atkins et al., 1990). In 60 patients post DRF, seven patients with no history of shoulder pathology had impaired shoulder mobility on the side of the fracture and five had

shoulder problems due to shoulder injury sustained at the time as the DRF (Atkins et al., 1990). Shoulder pathology was recorded between two and six weeks after cast removal (Atkins et al., 1990). Although this is only one study, it supports the idea that shoulder pathology can occur concurrent with the DRF or after.

Glenohumeral joint changes after wrist immobilization. Although only one study reported shoulder pathology after a DRF (Atkins et al., 1990), there is significant evidence showing changes in the shoulder complex after a wrist is immobilized or after wrist injury. Some studies have looked specifically at changes in joint motion at the shoulder with wrist immobilization (Adams, Grosland, Murphy, & McCullough, 2003; Chan & Chapparo, 1999; King et al., 2003; May-Lisowski & King, 2008; Mell, Childress, & Hughes, 2005), and others have examined changes in muscle activity at the shoulder after a wrist injury or DRF (Ayhan et al., 2015; Ayhan et al., 2014; Murgia et al., 2010). Changes can occur in both the scapulothoracic articulation (Ayhan et al., 2015) and glenohumeral joint (Ayhan et al., 2014; Chan & Chapparo, 1999; King et al., 2003; May-Lisowski & King, 2008; Mell et al., 2005; Murgia et al., 2010). Multiple studies explored shoulder motion while participants performed ADLs (Adams et al., 2003; Ayhan et al., 2014; Chan & Chapparo, 1999; King et al., 2003; May-Lisowski & King, 2008; Mell et al., 2005; Murgia et al., 2010) including writing (Chan & Chapparo, 1999), reaching into a box (Mell et al., 2005), manipulating cans (Chan & Chapparo, 1999; King et al., 2003), and feeding (Ayhan et al., 2014; May-Lisowski & King, 2008). There was increased shoulder flexion and abduction when the wrist was immobilized while pouring from a can (King et al., 2003) and feeding (May-Lisowski & King, 2008). In all studies that examined shoulder compensation for functional tasks, there was an increase in the total shoulder motion used at the glenohumeral joint (Adams et al., 2003; Ayhan et al., 2014; Chan &

Chapparo, 1999; King et al., 2003; May-Lisowski & King, 2008; Mell et al., 2005; Murgia et al., 2010). Murgia et al. (2010) specifically examined shoulder compensation after a DRF. They found that during reaching there is greater than normal shoulder elevation and external rotation aimed at avoiding ulnar deviation of the wrist (Murgia et al., 2010). Further, while turning a page in a book, the shoulder's external rotation and elevation was increased to avoid supination (Murgia et al., 2010). Changes in the mechanics of the glenohumeral joint could potentially lead to the development of shoulder pathology (Chopp, Fischer, & Dickerson, 2011; Punnett, Fine, Keyserling, Herrin, & Chaffin, 2000).

Changes in the scapulothoracic articulation after DRF. The only study that has examined the scapulothoracic articulation after DRF found altered scapular kinematics in the subjects when performing elevation in the frontal, scapular, and sagittal planes (Ayhan et al., 2015). Specifically, scapular internal rotation and upward rotation was increased during elevation in the frontal plane and upward rotation and anterior tilt were increased during lowering of the arm in both the scapular and sagittal planes (Ayhan et al., 2015). Changes in the mechanics of the scapulothoracic joint could potentially lead to the development of shoulder pathology (Endo, Ikata, Katoh, & Takeda, 2001; Ludewig & Cook, 2000; Ludewig & Reynolds, 2009; McClure, Michener, & Karduna, 2006).

Muscular changes in the shoulder complex after wrist immobilization. Along with changes at the glenohumeral and scapulothoracic joint, changes can also occur muscularly in the shoulder when the wrist is immobilized. Some studies have looked specifically at changes in muscle use after the wrist has been immobilized (Bulthaup et al., 1999; Burtner et al., 2003; Mell et al., 2006; Yoo et al., 2010). One electromyography study showed that while moving nuts between bins, wrist immobilization significantly increases muscle activity of the anterior deltoid,

middle deltoid, posterior deltoid, upper trapezius, infraspinatus, and supraspinatus (Mell et al., 2006). Another study found that the muscle activity of the pectoralis major, trapezius, biceps brachii, and medial head of the triceps was significantly increased while simulating picking up a can, emptying it, and setting it down when the wrist is immobilized (Bulthaup et al., 1999). A third study found that during repetitive assembling operations that required shoulder motion, wrist immobilization showed increased activity of the upper trapezius and the serratus anterior (Yoo et al., 2010). Further, during repetitive assembling operation that required shoulder stability, increased activity was found in the upper trapezius, lower trapezius, serratus anterior, and the anterior deltoid (Yoo et al., 2010). A fourth study found that in patients with rheumatoid arthritis, there was more muscle activity in the upper trapezius, deltoid, and pectoralis major during grip activities when using an orthosis (Burtner et al., 2003). Changes in muscle activity could lead to subacromial impingement syndrome (Chester et al., 2010; Cools, Declercq, Cambier, Mahieu, & Witvrouw, 2007; Lopes, Timmons, Grover, Ciconelli, & Michener, 2015; Ludewig & Cook, 2000) due to decreased serratus anterior activity (Ludewig & Cook, 2000), increased upper trapezius muscle activity (Chester et al., 2010; Cools et al., 2007; Lopes, Timmons, Grover, Ciconelli, & Michener, 2015; Ludewig & Cook, 2000), decreased middle trapezius muscle activity (Cools et al., 2007), and increased lower trapezius muscle activity (Ludewig & Cook, 2000). It has been generally accepted that the three trapezius parts along with the serratus anterior play a primary part in stabilization of the shoulder (Cools et al., 2007). Small changes in the actions of the muscles of the scapulothoracic joint can affect the alignment and forces involved in movement around the glenohumeral joint (Cools et al., 2007) and may lead to tensile overload of the rotator cuff and impingement syndrome (Karduna, Kerner, & Lazarus, 2005).

Literature suggests that increased muscle activity may promote muscle fatigue, and individuals with no history of shoulder pathology may be affected by the cumulative strain created by using a wrist orthosis (Bulthaup et al., 1999). In a study that examined the effect of wrist immobilization on the Jebson hand function test, participants complained of fatigue in the shoulders and upper trunk after completing the Jebson hand function test with the wrist immobilized (Carlson & Trombly, 1983). These symptoms of muscle fatigue when using a wrist orthosis could result from increased postural deviations at the shoulder and/or increased muscle activity of upper back (Perez-Balke, & Buchholz, 1994). Leijnse and Rietveld (2013) found that chronic shoulder pain in a violinist was most likely caused by decreased active wrist and digit extension due to surgery to remove a dorsal ganglion cyst. While playing the violin the shoulder was slightly abducted forcing an unnatural compensatory left arm playing position resulting in what the authors hypothesized as a combo of subacromial impingement or general muscle strain (Leijnse & Rietveld, 2013). Although compensation is needed in order to function after a wrist injury, it could result in injury to or dysfunction of proximal joints.

Shoulder pathology, as a complication after DRF, requires further study. Only two studies in this section examined biomechanical changes in the shoulder after a DRF (Ayhan et al., 2015; Murgia et al., 2010). Most of the studies used a wrist orthosis to immobilize the wrist in healthy subjects (Adams et al., 2003; Bulthaup et al., 1999; Chan & Chapparo, 1999; King et al., 2003; May-Lisowski & King, 2008; Mell et al., 2005; Mell et al., 2006; Yoo et al., 2010). The other studies included diagnosis such as wrist disorders (Ayhan et al., 2014) and rheumatoid arthritis (Burtner et al., 2003). Due to most studies not including patients' DRFs, the elements of pain, edema, stiffness, and deconditioning were not factors in how the affected upper extremity was used in functional tasks. These elements are characteristic of patients post DRF. Adding

these elements may potentially show a greater impact on the shoulder than what the current literature says. Although excessive loading of shoulder occurs after the wrist is immobilized or injured, no literature has shown that shoulder pathology can occur. This study was needed to explore the development of shoulder pathology after DRF due to excessive loading of the shoulder complex.

DRF and Functional Outcomes

Demographics and functional outcomes. A functional outcome is defined as a measurement of a patient's physical limitations in performing the usual human tasks of living and includes both functional and behavioral symptoms (American Medical Association, 2014). Different patient characteristics can impact functional outcomes after a DRF. For example, older age negatively impacts functional outcomes post DRF (Abramo, Kopylov, & Tägil, 2008; Chung et al., 2007; Cowie et al., 2015; Nielsen & Dekkers, 2013; Roh, Lee, Noh, Oh, et al., 2014b). This could be because elderly people have a higher incidence of DRFs (Singer et al., 1998), and older patients with osteoporotic bone have more severe fractures (Chung et al., 2007). Along with age, elderly females have worse outcomes than do elderly men (Amorosa, Vitale, Brown, & Kaufman, 2011). This could suggest that males have better healing potential, more ability to compensate, and that they may perceive outcome and disability differently than do women (Amorosa et al., 2011). Lower socioeconomic status is also a predictor of poorer functional outcomes in multiple studies (Chung et al., 2007; Grewal, MacDermid, Pope, & Chesworth, 2007; MacDermid et al., 2002; Paksima et al., 2014) and both Blacks and Latinos have poorer functional outcomes than do Whites (Walsh, Davidovich, & Egol, 2010). Some authors have hypothesized that patients with lower socioeconomic status may have more manual labor jobs (MacDermid et al., 2002) and other authors suggest that these patients may also be less

compliant with hand therapy programs (Chung et al., 2007). Patients who are receiving workers' compensation also have poorer functional outcomes (Grewal et al., 2007; MacDermid et al., 2002; MacDermid et al., 2001). This study explored patient characteristics such as age, gender, race, and work status to describe the population that had shoulder pathology concurrent with a DRF. No study has examined what patient characteristics are associated with developing shoulder pathology after a DRF.

Comorbidities and functional outcomes. Comorbidities can have an impact on functional outcomes after a DRF (FitzPatrick et al., 2012; Grewal et al., 2007; Hollevoet & Verdonk, 2003; Roh, Lee, Noh, Oh, et al., 2014b; Wilson et al., 2014). A comorbidity that is frequently associated with DRFs is osteoporosis. Multiple studies have found that osteoporosis has a negative impact on functional outcomes after a DRF (FitzPatrick et al., 2012; Hollevoet & Verdonk, 2003; Roh, Lee, Noh, Oh, et al., 2014b). Similarly to osteoporosis, the comorbidity of osteoarthritis also negatively impacts functional outcomes after a DRF (Grewal et al., 2007). Other comorbidities related to worse functional outcomes after a DRF include diabetes (Wilson et al., 2014), hypertension (Wilson et al., 2014), and smoking (Grewal et al., 2007; Wilson et al., 2014). Due to the large amount of evidence reporting worse functional outcomes in patients post DRF with osteoporosis, it is of interest to this study to further examine if patients with osteoporosis have shoulder pathology concurrent with a DRF.

Treatment of DRFs and functional outcomes. There are many treatment options for a DRF including both surgical and nonsurgical treatment. Multiple studies have examined differences in functional outcomes between surgical and nonsurgical treatment. Although some studies have found no differences in functional outcomes between the treatments (Azzopardi, Ehrendorfer, Coulton, & Abela, 2005; Venkatesh, Maranna, & Narayanappa, 2016; Wong et al.,

2010), other studies have found surgery to have better functional outcomes (Hung, Leung, Ip, & Lee, 2015; Sharma et al., 2014). Further, one study found cast immobilization to provide a better functional outcome when compared to open reduction and internal fixation including patients with dorsal plating (Lalone, Rajgopal, Roth, Grewal, & MacDermid, 2014). It is of interest in this study to understand what population develops shoulder pathology after a DRF. Surgical and nonsurgical treatment for a DRF follow different protocols, therefore it is of interest to understand whether or not specific treatment protocols are more common in individuals with shoulder pathology concurrent with a DRF.

DRF and Compensatory Mechanisms

After an upper extremity injury, individuals must adjust to life in order to work around the disorder and adapt to living with the disorder (Beaton, Tarasuk, Katz, Wright, & Bombardier, 2001). American Occupational Therapy Association (AOTA) states that compensation, modification, or adaptation are processes selected to direct Occupational Therapy intervention in order to enhance performance, or to prevent injuries, disorders, or other conditions (2011). Although adaptation and compensation have similar meanings, adaptation is the term primarily used in the occupational therapy literature. Schkade and Schulz (1992) define adaptation as the change in the functional state of a person as a result of desire for mastery over occupational challenges. This could include any changes an individual makes in order to perform an activity such as using an adaptive device, or using the nonaffected side. However, when examining the literature, the term compensation or compensatory mechanisms was primarily found when describing the DRF population. Compensatory mechanisms are defined as mechanisms that are used when activity limitations are present in order to decrease the difficulty of performing a task (Bialocerkowski, 2008).

Compensatory mechanisms used after wrist injuries including DRFs. In studies examining compensatory mechanisms used after wrist injury, all participants reported using compensatory mechanisms for hygiene, dressing, inside domestic activities, and lifting/carrying activities (Bialocerkowski, 2002, 2008; Bialocerkowski & Grimmer, 2004). The compensation strategies used were activity dependent and included using two hands, using the nonaffected contralateral hand, altering the type of grip used, avoiding the activity, getting assistance from another person, and taking longer time to complete the task (Bialocerkowski, 2002, 2008; Bialocerkowski & Grimmer, 2004). After a DRF, getting assistance from another person was not required after 9 weeks for hygiene and dressing ADLs, lifting or carrying activities, or inside domestic activities; however, some individuals were still avoiding performing those activities (Bialocerkowski & Grimmer, 2004). Taking a longer time to complete ADLs is one compensatory mechanism reported in studies that examined patients with wrist disorders (Bialocerkowski, 2002), DRFs (Bialocerkowski & Grimmer, 2004), 4-corner wrist fusion (Bialocerkowski, 2008), and wrist immobilization (Adams et al., 2003). Altering the grip used was another compensatory mechanism used when performing activities with a wrist disorder such as work activities (Bialocerkowski, 2002, 2008) and hygiene activities (Bialocerkowski, 2008; Bialocerkowski & Grimmer, 2004).

In patients 8 weeks post DRF, the proportion of hygiene and dressing ADLs performed with the use of compensatory mechanisms was 100% and the proportion that used compensatory mechanisms for inside domestic activities such as preparing food and cleaning was also 100% (Bialocerkowski & Grimmer, 2004). At 24 weeks post DRF, the proportion of individuals who continued to use compensatory mechanisms for hygiene and dressing ADLs remained high at 89% and for inside domestic activities the proportion was 94% (Bialocerkowski & Grimmer,

2004). When performing inside domestic activities, individuals 8 weeks post DRF used multiple compensatory mechanisms such as requiring more time, changing the grip, and getting assistance (Bialocerkowski & Grimmer, 2004). At 24 weeks post DRF, compensatory mechanisms were still being used, but individuals are more likely to use only one compensatory mechanism (Bialocerkowski & Grimmer, 2004). Although the type of compensatory mechanisms that are used may change, individuals need to compensate over a long period of time in order to perform their occupations. This is an important component when studying the population who develops shoulder pathology after a DRF. If an individual is compensating over a long period of time, abnormal movement patterns and excessive loading of the shoulder complex may be occurring. Such loading of the shoulder complex could potentially result in the development of shoulder pathology.

Compensatory mechanisms and shoulder pathology. Although there have been no studies examining what types of compensatory mechanism can lead to shoulder pathology, nonuse (Pomeroy et al., 2011; Raghavan, 2015) or overuse (Bulthaup et al., 1999) could potentially lead to shoulder pathologies. Bialocerkowski (2002) found that 26% of patients use the other hand and 8% of patients use other parts of the body to compensate after a wrist disorder. After a 4-corner wrist fusion, the primarily compensatory joints are the shoulder and elbow when performing outside tasks (Bialocerkowski, 2008). Neither of these studies reported any shoulder pathology in the patients that compensated with another body part or neglected to use their affected upper extremity for functional tasks. Further investigation was needed to understand what compensatory mechanisms put patients at risk for developing shoulder pathologies and what specific activities require the use of those compensatory mechanisms.

Although multiple studies examined compensatory mechanisms used after wrist disorders (Bialocerkowski, 2002, 2008; Bialocerkowski & Grimmer, 2004), only one study specifically examined compensatory mechanisms used after a DRF (Bialocerkowski & Grimmer, 2004). The study by Bialocerkowski and Grimmer (2004) collected quantitative data on ADL performance, magnitude of difficulty performing ADLs, compensatory mechanisms used, and perceived importance of ADLs performed. This study demonstrated that patients who experience a DRF must use compensation in order to perform ADLs. Because compensatory mechanisms are used to perform ADLs, it is of interest to understand what types of compensatory mechanisms are used by individuals who develop shoulder pathology after a DRF. For example, a patient may perform dressing with the injured upper extremity and compensate by overusing the muscles of the shoulder joint. Over time, he or she may develop shoulder pain. In another example, a patient may compensate by having a significant other initially assist with bathing, then after 4 weeks start performing his or her own bathing and at some point realize shoulder stiffness has developed.

DRF and Pain

Pain and functional outcomes. DRFs cause pain and disability (MacDermid et al., 2001; MacDermid et al., 2003), however both pain and disability scores vary in the DRF literature. One study found that 33% report pain at rest and 42% have pain with activity one year after a DRF (Ydreborg et al., 2015). Other studies reported more similar results with 62% (Nielsen & Dekkers, 2013), 63% (Moore & Leonardi-Bee, 2008), and 67% (MacDermid et al., 2003) of their samples reporting pain at one year post DRF. Predictors of higher pain scores at one year post DRF include being a woman aged 65 or older and higher pain intensity scores at baseline (Mehta et al., 2015a). High pain has been found to be a predictor of disability or

decreased occupational performance in multiple studies (Cowie et al., 2015; Mehta et al., 2015a; Nielsen & Dekkers, 2013; Souer et al., 2008; Swart et al., 2012). Further, patients who report moderate to very severe pain are more likely to require medication to manage their pain (Moore & Leonardi-Bee, 2008).

Studies report differences between disability and pain scores at one year. MacDermid et al. (2003) found that pain was reported at one year post DRF in 67% of their sample while 46% reported disability suggesting that most individuals resume functional activities despite pain. In contrast, Moore and Leonardi-Bee (2008) found that 63% of their sample had some degree of pain but 95% of their sample had some degree of disability, suggesting that disability is a greater problem than pain. Nielsen and Dekkers (2013) also found that at one year, a larger proportion of elderly women had more disability than pain. These studies suggest that pain can impact function, but individuals may also have disability that is not due to pain. MacDermid et al. (2002) found that high pain and disability is associated with having workers' compensation, a low education, and radial shortening.

Pain after DRF and shoulder pathology. The relationship between pain and development of shoulder pathology after a DRF has never been examined. In theory, if an individual has pain moving a limb he or she may avoid using that limb functionally (Vlaeyen, Kole-Snijders, Boeren, & Van Eek, 1995; Vlaeyen, Kole-Snijders, Rotteveel, Ruesink, & Heuts, 1995; Vlaeyen & Linton, 2000). Nonuse of the shoulder joint, as seen in diagnoses such as stroke, can result shoulder pathology (Pomeroy et al., 2011; Raghavan, 2015).

DRF and Kinesiophobia

Kinesiophobia is defined as irrational, weakening, and devastating fear of movement and activity stemming from the belief of fragility and susceptibility to injury (Kori, Miller, & Todd,

1990). Caution about painful movement is a normal human illness behavior; however, kinesiophobia is a maladaptive response to pain (Das De et al., 2013). If a patient fears movement of an injured limb, the ability to use that limb for daily function may be impaired (Vlaeyen & Linton, 2000). Many studies have shown that kinesiophobia is a predictor of disability in patients with low back pain (Crombez Vlaeyen, Heuts, & Lysens, 1999; Thomas et al., 2010; Verbunt et al., 2005), musculoskeletal injury (Lundberg, Larsson, Ostlund, & Styf, 2006; Parr et al., 2012; Söderlund & Åsenlöf, 2010), acute upper extremity injury (Das De et al., 2013; Lövgren & Hellström, 2012; Parr et al., 2012; Söderlund & Åsenlöf, 2010), and DRF (Das De et al., 2013; Lövgren & Hellström, 2012; Söderlund & Åsenlöf, 2010). Disability can be a consequence of prolonged avoidance of activity or hypervigilance (Leeuw et al., 2007).

No study has examined the population who experience shoulder pathology concurrent with a DRF nor has a study examined the role of kinesiophobia or fear avoidance within this population. Das De et al. (2013) studied patients with a variety of upper extremity conditions including 31 patients with DRFs. In patients with upper extremity conditions, both kinesiophobia and catastrophic thinking were predictors of upper extremity specific disability (Das De et al., 2013). Lövgren and Hellström (2012) studied 2 groups of patients with a DRF who were treated conservatively with a plaster cast, with each group having 16 subjects. There was a strong relationship between fear of movement or reinjury and arm-specific disability in the second group of subjects (Lövgren & Hellström, 2012). In the third study, Söderlund and Åsenlöf (2010) studied 74 subjects with musculoskeletal injuries including 11 wrist fractures and 13 wrist sprains. Fear of movement was a strong predictor of pain intensity and fear of movement explained the relationship between pain intensity and pain-related disability (Söderlund & Åsenlöf, 2010).

Kinesiophobia and shoulder pathology. Fear of pain significantly influences disability in patients who experience shoulder pain (George et al., 2007). Additionally, fear of pain significantly influences kinesiophobia or one's belief as to whether physical activities should be continued while experiencing pain (George et al., 2007). Higher pain-related fear is predictive of higher levels of disability (George et al., 2007) and has been correlated to shoulder disability in several studies (Feleus et al., 2007; George & Hirsh, 2009; Huis 't Veld, Vollenbroek-Hutten, Groothuis-Oudshoorn, & Hermens, 2007; Lentz, Barabas, Day, Bishop, & George, 2009; Voerman et al., 2007).

Fear avoidance model of pain. Fear avoidance is a construct very closely related to kinesiophobia. Fear avoidance is defined as avoidance of movements and activities based on fear of pain (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Vlaeyen, Kole-Snijders, Rotteveel, et al., 1995; Vlaeyen & Linton, 2000); kinesiophobia is a fear of movement due to a feeling of susceptibility to injury. In the fear avoidance model of pain, pain can be interpreted two different ways (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Vlaeyen, Kole-Snijders, Rotteveel, et al., 1995; Vlaeyen & Linton, 2000). In the first scenario, acute pain is perceived as nonthreatening and patients are more likely to continue performing all daily activities (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Vlaeyen, Kole-Snijders, Rotteveel, et al., 1995; Vlaeyen & Linton, 2000). The participation in daily activity promotes functional recovery for the patient (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Vlaeyen, Kole-Snijders, Rotteveel, et al., 1995; Vlaeyen & Linton, 2000). In contrast, when pain is misinterpreted as dangerous it can promote pain-related fear and associated safety-seeking behaviors such as avoidance and hypervigilance (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Vlaeyen, Kole-Snijders, Rotteveel, et al., 1995; Vlaeyen & Linton, 2000). For example, if an individual post DRF has pain when gripping a

saucepan, he or she may not want to cook a meal with the affected upper extremity. Classical conditioning occurs when a person develops a fear of performing an activity due to his or her experiences (Vlaeyen & Linton, 2000). The same person may feel other activities would elicit the same pain experienced while cooking therefore he or she may avoid activities that require gripping such as mopping the floor. Operant conditioning occurs when a neutral stimulus begins to predict pain and this is when avoidance learning begins (Vlaeyen & Linton, 2000). Although patients can use adaptation by not using the injured limb in the acute pain stage to perform daily activities, a long-term consequence of not using the injured limb is disability and disuse (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Vlaeyen, Kole-Snijders, Rotteveel, et al., 1995; Vlaeyen & Linton, 2000). In summary, evidence supports that pain-related fear is associated with avoidance of activity which leads to poor ADL performance and decreased overall function (Vlaeyen & Linton, 2000). Fear avoidance behaviors may also develop in the acute pain stage of an injury (Turk & Monarch; 2002). Further, pain-related fear could be responsible for worsened physical condition and the occurrence of guarded movement patterns (Vlaeyen & Linton, 2000).

Catastrophic thinking. Catastrophic thinking differs from kinesiophobia in that it is defined as an excessive and negative orientation toward pain (Osman et al., 2000). Although catastrophic thinking and kinesiophobia differ, both psychological factors have been found to be predictors of upper extremity disability (Das De et al., 2013; Parr et al., 2012) and pain intensity (Parr et al., 2012) in patients with acute upper extremity injury. Catastrophic thinking has been specifically examined in the population that has experienced a DRF (Golkari, Teunis, Ring, & Vranceanu, 2015; Roh, Lee, Noh, Oh, et al., 2014a; Teunis, Bot, Thornton, & Ring, 2015) and has been shown to be a predictor of finger stiffness (Teunis et al., 2015), and poorer functional outcomes (Roh, Lee, Noh, Oh, et al., 2014a). Further, two studies found that symptoms of

catastrophic thinking improve over the course of recovery after a DRF (Golkari et al., 2015; Roh, Lee, Noh, Oh, et al., 2014a).

The constructs of kinesiophobia, fear avoidance, and catastrophic thinking have been described in detail in this section. Each of these psychological factors can influence functional outcomes after acute injury. However, the construct of fear avoidance has not been studied in the population who experiences a DRF and catastrophic thinking does not measure pain related to movement, therefore these constructs were not the best fit for this study. In patients who experience shoulder pathology concurrent with a DRF, fear of moving or using the shoulder could impact functional outcomes. Therefore, the construct of kinesiophobia is crucial to understand. The TSK-11) is a tool that captures both fear of pain and fear of movement and was used to measure the construct of kinesiophobia in this study.

DRF and CRPS

CRPS type 1 is a complex clinical syndrome that can be characterized by symptoms of pain, allodynia, hyperalgesia, edema, changes in skin, changes in blood flow, and abnormal sudomotor activity (Dijkstra, Groothoff, Duis, & Geertzen, 2003). CRPS type 1 is a pain condition usually occurring after an injury or trauma to a limb and is believed to be caused by damage to, or malfunction of, the peripheral and central nervous systems (NIH, 2013). The incidence of CRPS type 1 after a DRF has been reported from 1% to 37% (Atkins et al., 1990; Cooney et al., 1980; Dijkstra et al., 2003; Jellad, Salah, & Frih, 2014; Roh, Lee, Noh, Baek, et al., 2014). Characteristics that have been found to be predictors for the development of CRPS type 1 after DRF include being a female and experiencing a more severe trauma (Jellad et al., 2014; Roh, Lee, Noh, Baek, et al., 2014). Development of CRPS type 1 frequently occurs in patients during the third to fourth week after cast removal (Jellad et al., 2014). Other

terminology used to describe CRPS type 1 includes shoulder-hand syndrome (Cooney et al., 1980); reflex sympathetic dystrophy (Veldman, Reynen, Arntz, & Goris, 1993), and algodystrophy (Atkins et al., 1990).

CRPS type 1 and shoulder pathology. Frequently, patients with CRPS type 1 of the upper limb present with shoulder pain (Savaş, Baloğlu, Ay, & Çerçi, 2009; Veldman et al., 1993; Zyluk, 2003). Early research described CRPS type 1, what was then called shoulder-hand-finger syndrome, as a syndrome that occurs in stages starting with pain in the shoulder region and ending with a frozen shoulder (Frykman, 1967). Currently, studies vary reporting anywhere from 12-50% of patients complaining of shoulder pain after developing CRPS type 1 in the upper limb (Savaş et al., 2009; Veldman et al., 1993; Zyluk, 2003). Specifically one study found when examining 829 patients with reflex sympathetic dystrophy that 103 patients who had symptoms in the hand also had complaints in the shoulder including 6 with frozen shoulder and 97 with biceps tendonitis (Veldman et al., 1993). Further, shoulder pain was reported to persist for over a year in one study (Savaş et al., 2009). Overall, there is strong evidence to show that patients with CRPS type 1 in the upper limb experience some type of shoulder pathology. With a reported incidence of 1-37% of patients with DRF having CRPS type 1, there is a lack of evidence examining incidence of shoulder pathology in this specific population. It is of interest in this study to understand if shoulder pathology occurs more often after DRF in patients with CRPS type 1.

DRF and Occupational Therapy

Occupational performance. Performance of occupation is a central concept used when describing occupational therapy. Occupational performance after a DRF has been explored in multiple studies (Beaulé et al., 2000; Bialocerkowski & Grimmer, 2004; Dekkers & Nielsen,

2011; Dekkers & Søballe, 2004; Nielsen & Dekkers, 2013; Ydreborg et al., 2015). In studies that examined occupational performance in women, those who reported 20 or more performance problems at the time of cast removal are more likely to have at least 10 or more performance problems at one year (Nielsen & Dekkers, 2013). Women post DRF report that most problems occur in the area of self-care after cast removal (Dekkers & Søballe, 2004).

In examining what performance problems exist for people post DRF, multiple studies reported high levels of difficulty with feeding (Bialocerkowski, 2002; Dekker & Søballe, 2004). In women over 50, the most difficult problems reported included cutting meat, vegetables, and bread (Dekkers & Søballe, 2004). Similarly, in patients with wrist disorders, 65% reported difficulty using eating utensils (Bialocerkowski, 2002), 74% of patients post DRF found cutting food difficult when the dominant wrist suffers a DRF, and 46% found it difficult when the nondominant wrist suffers a DRF (Beaulé et al., 2000). Very few studies have examined what specific occupations are difficult to perform following a DRF and no studies have been done examining occupational performance problems in patients who developed complications post DRF. Specifically, no studies have examined what occupations are difficult when experiencing shoulder pathology concurrent with a DRF. ADLs that may be impaired if a patient experiences shoulder pathology include placing items overhead, tucking in the back of a shirt, unhooking a bra, washing the back, and combing the hair (Leggin & Iannotti, 1999; Lippitt et al., 1993; Neviaser & Neviaser, 2011; Richards et al., 1994). It is of interest to understand what ADLs are difficult to perform for individuals who have shoulder pathology concurrent with a DRF.

Quality of life. Some studies report that experiencing a DRF can have an impact on a person's quality of life (Gruber et al., 2010, Wilson et al., 2014) although other studies differ, saying that quality of life is not necessarily impacted after a DRF (Dekkers & Nielsen, 2011; Ju,

Jin, Li, Hu, & Hou, 2015; Rohde, Haugeberg, Mengshoel, Moum, & Wahl, 2009; Ruckenstuhl et al., 2014). Results can vary based on when the quality of life data were collected during the recovery from the DRF. Further some studies looked at quality of life only in individuals who had surgery (Gruber et al., 2010; Ruckenstuhl et al., 2014), and the Gruber et al. (2010) study specifically reported quality of life issues in individuals who developed radiocarpal arthritis after the DRF. Quality of life is correlated with a number of performance problems (Dekkers & Nielsen, 2011) and Wilson et al. (2014) reported that quality of life is negatively affected after a DRF because of inability to perform ADLs. Frequently, patients in the hand clinic report that their quality of life has changed since their DRF. It is known that DRF can cause disability in the performance of activities of daily living, occupation, or leisure (MacDermid et al., 2001). Although quality of life will not be quantified in this study, it was explored through interviews. There are no studies examining a patient's quality of life when he or she experiences shoulder pathology concurrent with a DRF.

Hand therapy after a DRF. "Occupational therapy addresses the physical, cognitive, psychosocial, sensory-perceptual, and other aspects of performance in a variety of contexts and environments to support engagement in occupations that affect physical and mental health, well-being, and quality of life" (American Occupational Therapy Association, 2011, p. 1). Occupational therapy is frequently prescribed after a DRF and patients report that they find it helpful (MacDermid, 2004). However, recently multiple studies have been published reporting that there is no difference in functional outcomes between groups of patients who receive a home exercise program and those who attend therapy (Christensen et al., 2001; Krischak et al., 2009; Souer et al., 2011; Wakefield & McQueen, 2000). Handoll and Elliot (2015) and Valdes et al. (2014) found that these studies do not include patients with complexities that require skilled

intervention by a therapist. Only two of the studies that found the same functional outcomes with a home exercise program versus therapy included shoulder exercises in the home exercise program (Christensen et al., 2001; Krischak et al., 2009). Although many therapists report that shoulder exercises are prescribed immediately after a patient is referred for rehabilitation post DRF (Hurov, 1997; Laseter, & Carter, 1996; Michlovitz & Festa, 2011; Michlovitz, LaStayo, Alzner, & Watson, 2001), it is not necessarily considered a standard of care by all physicians and therapists. There is a lack of evidence establishing the most effective interventions to use for the treatment of DRF (Handoll & Elliot, 2015; Michlovitz et al., 2001; Valdes et al., 2014).

Less than 10% of patients post DRF are referred to therapy during the immobilization period (Michlovitz et al., 2001). Of the patients referred to therapy during the immobilization period, 39% only attend for a home exercise program (Michlovitz et al., 2001). The average number of days from time of diagnosis to therapy consultation is 30.9 days for Medicare patients who underwent a open reduction internal fixation, 48.7 days for Medicare patients who were treated by external fixator, and 47.5 days for Medicare patients who were treated with percutaneous pinning (Waljee, Zhong, Shauver, & Chung, 2014). Proximal joints should be cleared for any problems at initial evaluation because the initial pain of the wrist fracture can mask problems in proximal joints (MacDermid, 2004). However, assessment of the shoulder at initial evaluation is not necessarily considered a standard of care after a DRF. Inattention to the shoulder could result in missing early signs of shoulder pathology. Further, a potential relationship has been found between waiting longer to see an occupational or physical therapist after a DRF and less change in perceived pain and disability over time (Wilson et al., 2014).

Instruments

Functional Outcomes

The studies in the literature reviewed used multiple instruments to quantify functional outcomes. These include both patient-reported outcome measures and physician-based scoring systems. The patient-reported outcome measures will be discussed first, followed by physician-scored outcome measures.

Disabilities of the Arm Shoulder and Hand. The Disabilities of the Arm, Shoulder, and Hand (DASH, Kennedy, Beaton, Solway, McConnell, & Bombardier, 2011) was used to quantify functional outcomes and/or upper extremity disability in multiple studies in the literature review (Amorosa et al., 2011; FitzPatrick et al., 2012; Hung et al., 2015; MacDermid et al., 2001; Nielsen & Dekkers, 2013; Paksima et al., 2014; Sharma et al., 2014; Swart et al., 2012; Walsh et al., 2010; Wilson et al., 2014; Ydreborg et al., 2015). "The DASH is a 30-item, self-report questionnaire designed to measure physical function and symptoms in patients with any or several musculoskeletal disorders of the upper limb" (Institute of Work and Health, 2013a, para. 1). The DASH describes the disability that is experienced by individuals with upper limb disorders and can monitor change in function and symptoms over time (Institute of Work and Health, 2013a). The QuickDASH is a shortened version of the DASH that has 11 items instead of 30 items to measure physical function and symptoms in patients with any or several musculoskeletal disorders of the upper limb (Institute of Work and Health, 2013b). Multiple studies have shown that the DASH is a reliable and valid tool to use with patients post DRF (Kleinlugtenbelt et al., 2016; Lövgren & Hellström, 2012; Westphal, Piatek, Schubert, Schuschke, & Winckler, 2002). The QuickDASH can be used to instead of the DASH with

similar precision in upper extremity disorders (Beaton, Wright, & Katz, 2005; Gummesson, Ward, & Atroshi, 2006) and DRFs (Abramo et al., 2008).

The DASH is the best instrument for evaluating functional outcomes in patients with multiple disorders of the upper extremity (Changulani, Okonkwo, Keswani, & Kalairajah, 2008) and is valid and reliable when used with patients who have multiple upper extremity disorders (Beaton, Katz, et al., 2001; Hunsaker, Cioffi, Amadio, Wright, & Caughlin, 2002). Validity for the DASH was established by correlating the DASH with other outcome measures including the Brigham Questionnaire and Shoulder Pain and Disability Index (Beaton, Katz, et al., 2001), Short Form-36, and Short Musculoskeletal Function Assessment (Hunsaker et al., 2002). However, the correlation of the DASH with severity of the pain in the wrist joint is weak (Changulani et al., 2008), and pain severity should be assessed separately from the DASH (Waljee et al., 2016). Further, the DASH is not joint specific or side specific and the score from the DASH could be reflective of other diseases that are affecting the joints of either or both upper extremities. Therefore, the disability score could be reflective of the impact of a disease rather than the DRF. This is an especially important point when looking at the studies that look at functional outcomes following specific surgical interventions. For example, Hung et al. (2015) found better functional outcomes with locking plate fixation rather than casting in elderly patients. However, the researchers did not control for medical conditions that could affect joint movement or pain. The QuickDASH was the tool used to measure functional outcomes in this study. The QuickDASH was chosen because it is quicker to administer than the DASH, and it is a valid and reliable tool for assessing functional outcomes in individuals with upper extremity disorders (Beaton et al., 2005; Gummesson et al., 2006) and DRFs (Abramo et al., 2008).

Validity for the QuickDASH was established by correlating QuickDASH measurement properties with the DASH (Beaton et al., 2005; Gummesson et al., 2006).

Patient Rated Wrist Evaluation. The Patient Rated Wrist Evaluation (PRWE) (MacDermid, 1996; MacDermid, Turgeon, Richards, Beadle, & Roth, 1998) was used to quantify functional outcomes and the degree of wrist-related musculoskeletal disability in multiple studies in the literature review (Grewal et al., 2007; Lalone et al., 2014; MacDermid et al., 2002; MacDermid et al., 2001; MacDermid et al., 2003). The PRWE is a 15-item patient-reported questionnaire designed to assess pain in the wrist and functional difficulties with ADLs post wrist injury (MacDermid et al., 1998). Multiple studies have shown that the PRWE is a reliable and valid tool to use with patients post DRF (Kleinlugtenbelt et al., 2016; Lövgren & Hellström, 2012; MacDermid, Richards, Donner, Bellamy, & Roth, 2000; Mehta, MacDermid, Richardson, MacIntyre, & Grewal, 2015b) and with musculoskeletal upper extremity problems (Schmitt & Di Fabio, 2004). Construct validity was established for the PRWE by correlating scores on PRWE to the SF-36 (MacDermid et al., 1998.) The PRWE is more responsive to change than the DASH in patients post DRF (Changulani et al., 2008; MacDermid et al., 1998). Although the joint-specific PRWE is the most responsive to change in patients post DRF (Changulani et al., 2008), there is less evidence supporting its use with patients who have multiple upper extremity disorders. Further, the clinimetric studies that evaluated measurement properties of the PRWE had low methodological quality, meaning that the results could be biased (Kleinlugtenbelt et al., 2016). This same conclusion was also found for the DASH (Kleinlugtenbelt et al., 2016).

The Michigan Hand Outcome Questionnaire. The Michigan Hand Outcome Questionnaire (MHQ, Chung, Hamill, Walters, & Hayward, 1999; Chung, Pillsbury, Walters,

Hayward, 1998) was used to quantify wrist and hand functional outcomes in two studies in the literature review (Chung et al., 2007; Roh, Lee, Noh, Oh, et al., 2014b). The MHQ is a 37-item patient-reported questionnaire designed to assess overall hand function, ADLs, pain, work performance, aesthetics, and patient satisfaction with hand function (University of Michigan, 2014). This instrument measures outcomes in patients with condition of, or injury to, the hand or wrist (University of Michigan, 2014). The MHQ also includes a section that collects demographic information from the patient (University of Michigan, 2014). One study found that the MHQ is responsive to change in functional outcomes in patients post DRF (Kotsis, Lau, & Chung, 2007), and the MHQ is a reliable and valid instrument for measuring hand outcomes (Chung et al., 1998; Dias, Rajan, & Thompson, 2008). Construct validity was established for the MHQ by correlating scores on the MHQ to the Short Form-12 (Chung et al., 1998). No evidence supports the use of the MHQ for conditions or injuries other than the hand or wrist. Further, there have been very few clinimetric studies that have evaluated measurement properties of the MHQ especially in the DRF population. In a study evaluating functional outcome measures post DRF, the MHQ was not even included because it did not meet the research requirements of the consensus-based standards for the selection of health measurement instruments (Kleinlugtenbelt et al., 2016).

Canadian Occupational Performance Measure. The Canadian Occupational Performance Measure (COPM, Law et al., 2005) was used to quantify functional outcomes, occupational performance, and satisfaction with occupational performance in multiple studies in the literature review (Dekkers & Nielsen, 2011; Dekkers & Søballe, 2004; Nielsen & Dekkers, 2013; Ydreborg et al., 2015). The COPM is a client-centered outcome measure used to detect change in an individual's self-perception of occupational performance over time (Law et al.,

2005). Through a semi-structured interview, the client identifies occupational performance problems, rates the importance of each of the identified occupations in his or her life, selects the top five occupational performance problems to address in therapy, and rates their performance and satisfaction with performance in the five chosen occupations (Law et al., 2005). The COPM is a valid and reliable instrument that can be used with multiple patient populations (Carswell et al., 2004). The COPM has been validated in the rheumatoid arthritis population (Ripat, Etcheverry, Cooper, & Tate, 2001), hand osteoarthritis population (Kjeken, Slatkowsky-Christensen, Kvien, & Uhlig, 2004), and the upper limb disabilities population (Veehof, Sleegers, van Veldhoven, Schuurman, & van Meeteren, 2002). More recently the COPM was been validated in the hand injury population (van de Ven-Stevens, Graff, Peters, van der Linde, & Geurts, 2015). Construct validity was established for the COPM by correlating scores on the COPM to the DASH-Dutch Language Version (Veehof et al., 2002). However, another study found that the COPM has only a moderate correlation with the DASH and MHQ and takes twice as long to administer (van de Ven-Stevens et al., 2015). Further, of the four studies that used the COPM to measure functional outcomes post DRF, three of the studies examined only women, making it difficult to extrapolate the results to men. Due to the extended length of time the COPM takes to administer and the lack of validation in the DRF population, the COPM is not the best fit to measure functional outcomes in this study.

The Adelaide questionnaire. The Adelaide questionnaire (Bialocerkowski, Grimmer, & Bain 2003a, 2003b) was used in one study in the literature review (Bialocerkowski & Grimmer, 2004) to quantify functional outcome and assess an individual's ability to perform ADLs following a DRF. The Adelaide questionnaire is the only instrument that assesses compensatory mechanisms used to perform activities. The Adelaide questionnaire consists of two components:

a standard component which assesses an individual's ability to perform 25 ADLs and a component which assesses the magnitude of performing, compensatory mechanisms used, and perceived importance of up to five important ADLs nominated by the injured individual (Bialocerkowski & Grimmer, 2004). The Adelaide questionnaire is a valid and reliable instrument to use with individuals with wrist disorders (Bialocerkowski et al., 2003a, 2003b). Construct, content, and face validity was established by proving that outcome scores on the Adelaide questionnaire reflect how ADLs improve over time, by proving that there is a relationship between outcome scores and impairment measures and proving that the Adelaide Questionnaire covers the full scope of activity limitations for wrist diagnosis (Bialocerkowski et al., 2003b). Construct, content, and face validity was established by proving that outcome scores on the Adelaide questionnaire reflect how ADLs improve over time, by proving that there is a relationship between outcome scores and impairment measures and proving that the Adelaide Questionnaire covers the full scope of activity limitations for wrist diagnosis (Bialocerkowski et al., 2003b). Section 3 stage 4 of the Adelaide questionnaire asks the individual if he or she has changed the way the activity is performed and lists specific compensatory mechanisms that have been reported by other wrist-injured patients (Bialocerkowski et al., 2003a, 2003b). Although there are only two studies that have reported the measurement properties of the Adelaide questionnaire, it is the only measurement tool that examines compensatory mechanisms. This section was utilized to describe compensation strategies used by individuals post DRF.

Modified Mayo Wrist Score. Two physician-based scoring systems were used to quantify functional outcomes in studies in the literature review. Physician-based scoring systems are different from patient-reported scoring systems because the physician completes these outcome measures. First, the Modified Mayo Wrist Score (MMWS) includes objective

assessment of range of motion and grip strength and subjective assessment of pain and return to activity and/or employment (Cooney, Bussey, Dobyns, Linscheid, 1987). The MMWS was used to quantify functional outcomes in only one study in the literature review (Wong et al., 2010). No literature was found reporting validity or reliability of the MMWS. Further, the one study that used the MMWS also used a quality of life measure to gain a better understanding of outcomes post DRF (Wong et al., 2010). This shows that the authors may have felt that the MMWS did not provide enough information about a patient's function post DRF.

Gartland and Werley Scoring System. The Gartland and Werley scoring system is the second physician-based scoring system used to quantify functional outcomes in studies in the literature review. The Gartland and Werley scoring system includes an objective assessment of residual deformity; range of motion; and complications and subjective assessment of pain, disability, range of motion, strength, and activity restrictions (Gartland & Werley, 1951). The Gartland and Werley scoring system was used in two studies in the literature review to quantify functional outcomes (Sharma et al, 2014; Venkatesh et al., 2016). No literature was found reporting validity or reliability of The Gartland and Werley score (Changulani et al., 2008). Further, when compared with scores on the DASH, there was only a moderate correlation (.44) between Gartland and Werley scores and DASH scores (Kwok, Leung, & Yuen, 2011). The Gartland and Werley scoring system does not take into account the patient's perspective on outcome; therefore, the two studies that used this tool cannot justify that outcomes improved from the viewpoint of the patient.

Kinesiophobia

The studies in the literature review used one instrument to quantify kinesiophobia. Kinesiophobia was quantified using the Tampa Scale of Kinesiophobia (TSK, Miller, Kori, &

Todd, 1991). The TSK is a 17-item questionnaire used to quantify fear of movement/(re)injury and was used in multiple studies in the literature review (Crombez et al., 1999; Das De et al., 2013; Feleus et al., 2007; George et al., 2007; Huis ‘t Veld et al., 2007; Keijsers, Feleus, Miedema, Koes, & Bierma-Zeinstra, 2010; Lentz et al., 2009; Lundberg et al., 2006; Parr et al., 2012; Söderlund & Åsenlöf, 2010; Thomas et al., 2010; Verbunt et al., 2005). Studies have shown that the TSK is a valid and reliable tool to use with patients post DRF (Lövgren & Hellström, 2012) and with shoulder pain (Mintken, Cleland, Whitman, & George, 2010). A shortened version of the TSK, called the TSK-11, is both reliable and valid (Hapidou et al., 2012; Tkachuk & Harris, 2012; Woby, Roach, Urmston, & Watson, 2005). Validity for the TSK-11 was established by correlating scores of the TSK-11 to the Pain Catastrophizing Scale (Hapidou et al., 2012) and the TSK (Tkachuk & Harris, 2012; Woby et al., 2005). Further, the TSK is a valid and reliable instrument for measuring pain-related fear in patients with acute back pain (Swinkels-Meewisse, Swinkels, Verbeek, Vlaeyen, & Oostendorp, 2003).

Three studies examined kinesiophobia in the DRF population (Das De et al., 2013; Lövgren & Hellström, 2012; Söderlund & Åsenlöf, 2010). Lövgren and Hellström (2012) reported a strong relationship between kinesiophobia as measured by the TSK and arm specific disability as measured by the PRWE. Spearman Correlation coefficient of 0.78 was reported. However, this relationship only occurred in the second group of the two groups examined in this study. One explanation given by the authors for this finding is that group two had three to four weeks pass since the injury to the time of testing, meaning that subjects may have improved their self-efficacy within that time frame (Lövgren & Hellström, 2012). Lövgren and Hellström (2012) state that this finding supports the finding of Söderlund and Åsenlöf (2010) who report that fear of movement explains the relationship between pain intensity and disability in patients

with acute pain. However, by having just one of the two homogenous samples show a strong relationship between kinesiophobia and arm-specific disability is concerning, especially because of the large difference in Spearman Correlation Coefficients between the two groups. The Spearman Correlation Coefficient was 0.20 for the first group and 0.78 for the second group. Further, each group had only 16 participants and no power analysis was mentioned in the article. Although the groups were homogenous in background variables such as gender, age, and hand dominance, group one participated in data collection 10 days after fracture whereas group two participated in data collection at 28 days after the fracture. In order to conclude there is a relationship between kinesiophobia and arm-specific disability, a larger sample is needed and all data for all participants should be collected at 28 days post fracture.

Pain

The studies in the literature review used multiple instruments to quantify pain. The VAS is an instrument used to quantify pain intensity (McCormack, Horne, & Sheather, 1988) and was used in multiple studies in the literature review (Cowie et al., 2015; Moore & Leonardi-Bee, 2008; Swart et al., 2012; Ydreborg et al., 2015). The VAS of pain intensity is a horizontal line with two descriptors representing extremes of pain intensity at either end such as no pain and extreme pain (Jensen, Chen, & Brugger, 2003). The VAS is the most used measure of pain intensity in research (Jensen et al., 2003). Reliability of the VAS is high when assessing acute pain (Bijur, Silver, & Gallagher, 2001) and is a valid measure to use for patients postoperatively (DeLoach, Higgins, Caplan, & Stiff, 1998) and in the adult rheumatology population (Hawker, Mian, Kendzerska, & French, 2011). The validity of the VAS was established by comparing scores on the VAS to the 11-point numeric pain scale (DeLoach et al., 1998), the 5-point verbal descriptive scale, and the numeric rating scale (Hawker et al., 2011. The pain subscale of the

PRWE (MacDermid, 1996; MacDermid et al., 1998) is an instrument used to quantify frequency and intensity of pain in the wrist while the person is at rest as well as during repeated movements and while lifting a heavy object. The PRWE was used to quantify pain in multiple studies (MacDermid et al., 2001; MacDermid et al., 2003; Mehta et al., 2015b). The PRWE is a valid and reliable tool to assess both pain and functional difficulties with ADLs post DRF (Kleinlugtenbelt et al., 2016; Lövgren & Hellström, 2012; MacDermid et al., 2000; Mehta et al., 2015b). The DASH (Kennedy et al., 2011) is an instrument used to quantify the severity of pain and activity-related pain in the upper limb, and this instrument was used in one study in the literature review (Nielsen & Dekkers, 2013). The DASH is a valid and reliable tool to assess pain symptoms and physical function in patients post DRF (Kleinlugtenbelt et al., 2016; Lövgren & Hellström, 2012; Westphal et al., 2002). Finally, the CR-12 was used in one study in the literature review (Wilson et al., 2014) and was adapted from the Borg CR12 scale by the authors of the study. Therefore there is no reliability or validity information available for this instrument. Pain should be captured separately from any functional outcome measures (Waljee et al., 2016). Pain is better captured through visual analog scales, which are more straightforward and easier to interpret (Waljee et al., 2016).

Methodological Underpinnings

Phenomenology

Qualitative research seeks to describe the complex nature of humans and how individuals perceive their own experiences within a specific social context (Portney & Watkins, 2009). Phenomenological inquiry is a qualitative research methodology offering a systematic way of studying and learning about phenomena (Wilding & Whiteford, 2005). The lived experience is

critical to phenomenology (Richards & Morse, 2007), and this study looked in depth into the lived experiences of patients who have shoulder pathology concurrent with a DRF.

Phenomenology is derived from the interpretivism paradigm which is based on constructivism, the opposite of objectivism (Crotty, 1998). In the constructionist view, there is no objective truth and reality is a conceptual construction (Crotty, 1998; Trochim & Donnelly, 2008). The interpretivism paradigm integrates human interest into research by looking at culturally-derived and historically-situated interpretations of the social life-world (Crotty, 1998) lending itself to the phenomenological research methodology where research is focused on experiences in human context (Crotty, 1998; Smith, Flowers, & Larkin, 2009). Both the constructivism epistemology and the interpretivism paradigm guided this study in allowing the researcher to interpret meanings from the data collected. This can be difficult because different people construct meanings in different ways (Crotty, 1998). However, it is the role of the researcher to submerge himself or herself into the data in order to explain each individual's human and social reality.

Hermeneutic phenomenology. In using a constructivism epistemology and interpretivism paradigm, the specific methodology that has been chosen for use in the qualitative portion of this mixed methods study is hermeneutic phenomenology. This form of phenomenology is based on hermeneutics or the theory of interpretation (Guignon, 2012) and was originated by Martin Heidegger. Hermeneutic phenomenology is concerned with human experience as it is lived (Dowling, 2007) and has an ontological focus. Heidegger believed that the concept of Being, which he referred to as Dasein, forms the background to all of life (Blackham, 1961) and Being-in-the-world describes how human beings exist, act, or are involved in the world (Guignon, 2012; van Manen, 1990). The concepts of Being and Being-in-

the-world reflect OTs' philosophical beliefs about the importance of everyday life and everyday doing in the context to which one lives (Wilding & Whiteford, 2005). Therefore, the hermeneutic phenomenology methodology complements OT research in that it uncovers meanings in people's everyday lives.

Hermeneutic phenomenology offers a descriptive, reflective, interpretive, and engaging methodology from which the essence of an experience can be obtained (Richards & Morse, 2007). In acknowledging that people are in their own worlds and are only understandable within their own contexts, this study explored each participant's lived experience within their own world. In doing this, this study explored relationships that participants had in regard to things, people, events, and situations. Those areas of exploration could include ADLs and IADLs performance and participation within their home, support of family members and friends, and ability to perform work duties. Further, it is important that when the researcher attempts to grasp the essence of each participant's lived experience, he or she understands that each participant's description is a perception, a form of interpretation (Boyd, 1993; van Manen, 1990). This gives the opportunity to look at a phenomenon from various viewpoints or lenses. Human experience makes sense to only those who live it (Creswell, 1998), and the interpretation of people's meaning-making activities is central to the phenomenological inquiry (Smith et al., 2009).

Summary

A theoretical framework has been provided, an extensive literature review has been performed, a review of the instruments and measures used in the literature has been completed, and a thorough explanation of the phenomenological approach has been presented. The OA model provides a framework consistent to what the literature also provides. In the OA model, the OA process is the adaptive response to an occupational challenge. This adaptive response

may be required after an injury to be able to perform occupations. The literature shows that individuals with wrist injuries use compensatory strategies to perform ADLs. The literature also supports the use of adaptation after wrist injury or immobilization as seen by excessive loading of the shoulder during ADLs. Further, compensation or adaptation can be seen by nonuse of the affected extremity or use of the nonaffected side because of kinesiophobia. Further, patients with high pain may avoid using the injured upper extremity. Specific patient populations such as patients with CRPS type 1 may be more prone to developing shoulder pathology after a DRF because symptoms of CRPS type 1 often involve the shoulder. Individuals may also develop shoulder pathology due to injury to the shoulder concomitant with the DRF or due to poor positioning. The current literature supported further inquiry into the population that has shoulder pathology concurrent with a DRF. There is no current research specifically examining this population nor has there been any research that has described their lived experiences.

Chapter 3: Methodology

The convergent parallel mixed methods design was selected for this research study. This design was chosen because it was the best fit for addressing the research problem and purpose of the study. More information was needed on the phenomenon of experiencing shoulder pathology concurrent with a DRF, and the purpose of this mixed methods study was to expand the understanding by using both quantitative and qualitative methods. The convergent parallel mixed methods design will be reviewed and the rationale for choosing the design will be discussed. The threats to the validity of both the quantitative and qualitative strands will be explained and how those threats were addressed will be reviewed. Strengths and weaknesses of the convergent parallel mixed methods design will be discussed and the number of participants that will be required for the study will be explained. All inclusion and exclusion criteria used to choose participants will be reviewed as well as all participant recruiting procedures. Reliability and validity of the instruments used in the study will be explained as well as rationale as to why those particular instruments were chosen. The timeline for this study will be reviewed and all ethical considerations are described. Finally, funding, study setting, data collection procedures, and data analysis are explained.

Research Design

This study utilized a convergent parallel mixed methods design. This is a type of design in which qualitative and quantitative data are collected at the same time, analyzed separately, and then merged (Creswell, 2014; Creswell & Plano Clark, 2011; Tashakkori & Teddlie, 1998; Teddlie & Tashakkori, 2009). The convergent parallel mixed methods design treats both the qualitative and quantitative data with equal priority so that both can play an equally important role in addressing the research questions (Creswell, 2014; Creswell & Plano Clark, 2011;

Tashakkori & Teddlie, 1998; Teddlie & Tashakkori, 2009). To best address the research questions, the convergent parallel mixed methods design obtains different but complementary data on the same topic (Teddlie & Tashakkori, 2009). "The key idea with this design is to collect both forms of data using the same or parallel variables, constructs, or concepts" (Creswell, 2014, p. 222). Comparing and contrasting quantitative statistical results with qualitative findings allows the researcher to triangulate the data for corroboration and validation purposes and results in a more complete understanding of the phenomenon (Creswell, 2014; Creswell & Plano Clark, 2011).

This study investigated shoulder pathology in a group of patients with DRFs by using both quantitative and qualitative methods. A convergent parallel mixed methods design collects both quantitative and qualitative data using parallel constructs (Creswell, 2014; Creswell & Plano Clark, 2011; Teddlie & Tashakkori, 2009). Based on an extensive literature review, clinical experience, and the research questions in this study, four constructs were developed. Although other constructs or themes can emerge through the qualitative strand, the four constructs that were used for this study were function, kinesiophobia, pain, and compensation. Data were collected for each of these constructs in both strands, however, the qualitative strand for each participant differed based on individual lived experience of having shoulder pathology concurrent with a DRF. Differences in participants' lived experiences maximized the depth of the data collected and offered the opportunity to look at a phenomenon from different viewpoints.

The quantitative strand of this study used an observational cross-sectional design. Data were collected prospectively, and shoulder pathology was observed as it naturally occurs. An observational design is used for descriptive research. Descriptive research documents the factors

that describe characteristics of individuals or groups (Portney & Watkins, 2009). The quantitative strand of this study consisted of collecting demographics, patient characteristics, and health status factors in the population who experiences a DRF.

The qualitative strand used an emergent cross-sectional design. An emergent design means that the initial research plan cannot be concrete, and phases of the research process can change after the researcher starts to collect the data (Creswell, 2013). The qualitative strand of this study consisted of semi-structured interviews with participants who have shoulder pathology concurrent with a DRF at 5-9 weeks post DRF. However, by utilizing an emergent design, the questions were modified based on the responses of the individuals being studied (Creswell, 2013).

This is a cross-sectional study in that the researcher studied participants at one point in time (Portney & Watkins, 2009). In the quantitative strand, participants were studied between 5-7 weeks by completing all outcome measure questionnaires. In the qualitative strand only one semistructured interview was performed with each participant at 5-9 weeks post DRF. After all data were collected from both strands, they were analyzed separately then merged to provide a comprehensive understanding of the phenomenon of experiencing shoulder pathology concurrent with a DRF.

Rationale

The rationale of choosing the convergent parallel mixed method design was to obtain different but complementary data on the same topic to best understand the research problem. There are multiple ways to look at everyday life; however, by using a mixed methods design, the researcher was able to look at the research problem from two separate viewpoints and bring those viewpoints together to give a more comprehensive story. There have been no studies that

have specifically examined the population who experience shoulder pathology concurrent with a DRF. Quantitative instruments alone cannot fully explain the lived experience of this population. However, qualitative methods can illuminate results of the quantitative results by allowing the individual to describe impact of shoulder pathology on everyday life.

Procedures

Participants in this study were followed for a maximum of 9 weeks with the assumption that most participants would have shoulder pathology by 7 weeks post DRF. The time span of 9 weeks was chosen because the hand surgeon and occupational therapist followed participants for at least 9 weeks and within that time frame it is possible to develop shoulder pathology. It was unreasonable to ask participants to come in more often than what is required by the hand surgeon, and it is not reasonable for the hand surgeon to see the participant free of charge more frequently. Therefore each individual was evaluated for shoulder pathology by the hand surgeon at each follow-up visit, and no additional visits were required. To determine the time when data were collected for the quantitative strand, both a literature review and interview with two hand surgeons was performed. The two hand surgeons reported that most patients complain of shoulder pathology 4-8 weeks post DRF. Only one study reported shoulder pathology after a conservatively treated DRF (Atkins et al., 1990). Atkins et al. (1990) collected data 2-6 weeks after cast removal. Using the research article by Atkins et al. (1990) and clinical experience, it was decided by the primary investigator (PI) that participants would be followed for a maximum time of 9 weeks with quantitative data collection occurring at 5-7 weeks. If a participant was diagnosed with shoulder pathology within the first 9 weeks post DRF, that participant was placed in the shoulder pathology group. All data were collected from the participants at a follow-up that took place between 5-7 weeks post DRF. Data collected were used to describe the population

who had shoulder pathology and were used to compare differences in outcome measures between patients who had shoulder pathology concurrent with a DRF and patients who had a DRF only. After a participant presented with shoulder pathology, he or she was asked if he or she would like to participate in the qualitative strand. If the participant agreed to participate in the qualitative strand, an audio-taped interview was performed at 5-9 weeks post DRF. An interview guide (See Appendix E) was used for the interview.

Threats

Quantitative strand. A threat to internal validity was maturation. A maturation threat consists of events that naturally occur in life which could cause an outcome (Trochim & Donnelly, 2008). For example, a patient may develop shoulder pain for a few days and it naturally improves before being evaluated by the hand surgeon or the injury does not present itself until after the individual is finished participating in the study. In this study, a few participants complained of shoulder pain to the treating therapist but had no symptoms when evaluated by their hand surgeon.

Another threat to internal validity was attrition. Although attrition is extremely important, if a participant did not complete data collection at 5-7 weeks, that participant was dropped from the study. Two participants were dropped from this study because they did not complete data collection. Additionally, no data collectors used coercion to recruit subjects or sustain subjects. Other internal validity threats included a patient having shoulder pathology prior to the fall and not reporting it and any additional confounding variables that may exist.

A threat to external validity explains how you might be wrong in making a generalization (Portney & Watkins, 2009; Trochim & Donnelly, 2008). Nonprobability convenience sampling was the sampling strategy used in this study. Generalizing about the population of individuals

who experience DRFs is difficult when using this type of sampling strategy. For example, the local orthopedic practice collected data for this study. The local orthopedic practice only took Medicare and Workers' Compensation. All other insurances were out of network. Due to this, the sample may not have been representative of the population who fracture the distal radius frequently, such as young men. Young men may financially be unable to see a physician at this orthopedic practice unless they have Workers' Compensation. In this study, only one young man was in the sample. Further, patients who can afford to use out of network benefits generally have a higher income, and this could reflect a higher education level. Washington DC specifically has a high proportion of people with higher levels of education (Berube, 2010).

Further, some patients may not want to participate in the study and this could be another threat to external validity. Patients with Workers' Compensation may be reluctant to participate, especially if they have an attorney. Patients that have demanding jobs may not want to participate due to time constraints. It is possible that patients who are unwilling to participate in the study could represent specific groups resulting in the sample not being representative of the population. Further, because patients who do not speak English will not be included in the sample, this could also result in a sample that is not representative of the population.

Addressing these threats is difficult based on the sampling method that was used in this study; however, some strategies can be used to improve external validity. Participants were recruited from all three of the orthopedic practice locations. Although all three locations are located in the Washington DC metro area, participants from different geographical areas could represent a more diverse population. The data collectors tried to ensure that once participants were selected, they fully participated in the study. This assisted in obtaining a larger sample representative of the population who experiences a DRF.

Qualitative strand. Internal validity in qualitative research is frequently referred to as credibility (Lincoln & Guba, 1985). Credibility involves establishing that the results of qualitative research are credible from the participant's perspective (Creswell, 2013; Trochim & Donnelly, 2008). A threat to credibility would be not validating the findings of the semistructured interviews with the participant. In order to address this, the PI performed member checking. In member checking, the investigator took summaries of the findings back to participants and asks them whether the findings were an accurate reflection of the experiences (Creswell, 2013; Creswell & Plano Clark, 2011; Teddlie & Tashakkori, 2009). In this study, each participant was given the findings and interpretations of his or her interview after data analysis had been completed. At that time the participants either affirmed that the data reflected their views, feelings, and experiences or it did not. Affirmation showed credibility of the study.

A potential threat to credibility was the bias of the PI. The PI has worked with the population of interest for over 17 years and could have some preconceptions of the experiences of this population. Preconceptions of the experiences of this population and the literature review impacted what constructs were addressed in the subquestions of the qualitative strand and additionally could have impacted the interview process. To address this threat, bracketing was performed. Hermeneutic phenomenology acknowledges that bracketing can be used to identify preunderstandings of the research topic; however, it is understood that these ideas are never fully transcended or out of our conscious (Wilding & Whiteford, 2005). It is also suggested that those preunderstandings enable rather than constrain the researcher in that research is a personal endeavor, shaped by our own culture and our own needs (Hasselkus, 1997). In this study, all preunderstandings of the phenomenon were bracketed prior to the start of the study. Preunderstanding of the phenomenon came from 17 years of working with patients who have

experienced DRFs, some whom have experienced shoulder pathology. Those preunderstandings were revisited during both data collection and data analysis. Revisiting the preunderstandings during data collection gave the researcher the ability to formulate additional subquestions that engaged the participant. Revisiting the preunderstandings during data analysis gave the researcher the potential of viewing the new data in the light of prior experience. However, during interpretation of the data, priority was given to the new data rather than the preunderstandings.

External validity in qualitative research is frequently referred to as transferability (Lincoln & Guba, 1985). Transferability is the degree to which results of qualitative research can be generalized to other settings (Smith et al., 2009; Trochim & Donnelly, 2008). A threat to transferability would be neglecting to sufficiently describe the research context and assumptions central to the research topic. In order to address this, the PI provided rich, thick descriptions of the participants under study by making notes about the context in which their experiences occured. In giving a rich, thick description, the PI enables readers to transfer information to other settings (Creswell, 2013; Lincoln & Guba, 1985; Teddlie & Tashakkori, 2009).

Strengths and Weaknesses of Design

Strengths. A convergent parallel mixed methods design provides the strengths to offset the weaknesses of using a qualitative or quantitative method alone (Creswell & Plano Clark, 2011). For example, understanding the specific functional deficits that a patient post DRF experiences is extremely important. Utilizing the QuickDASH, which asks only nine questions related to function, does not give a comprehensive picture of a patient's function post DRF. Utilizing qualitative methods obtains additional information about the impact on daily activities after a DRF and how the additional impairment of shoulder pathology impacts those daily

activities. Another strength of the convergent parallel mixed methods is that it utilizes both deductive and inductive reasoning to address the research problem (Creswell & Plano Clark, 2011). For example, a thorough literature review was performed to understand the constructs most related to experiencing shoulder pathology concurrent with a DRF. Although the literature review uncovered important constructs, the qualitative interview provides themes that were not discussed in the literature. This ability to bring two different types of reasoning together allows new information about the research topic to emerge. Lastly, the ability to triangulate and seek convergence of results is a strength of using a mixed method design (Creswell & Plano Clark, 2011; Greene, 2007). For example, qualitative findings can corroborate quantitative results to develop a more complete understanding of the phenomenon (Creswell & Plano Clark, 2011; Greene & Caracelli, 1997). Qualitative findings may also refute the quantitative findings. Differences in results of the qualitative and quantitative data analysis provide additional insight into this phenomenon. Because there are two separate strands, results of individual strands can either support or refute findings in the literature. This has the potential to add more research to the existing literature.

Weaknesses. Having an unequal sample size of both quantitative and qualitative data is a weakness of using a convergent parallel mixed methods design because inequality of the data collection in each strand can limit the amount of data collected from one individual (Creswell, 2014; Creswell & Plano Clark, 2011). For example, 16 participants developed shoulder pathology and only seven were interviewed; information that could have been obtained from the other nine participants will never be collected. That information could have been potentially more useful to the study. Finally, another weakness of the study design is that it is also possible that the results from each strand could be discrepant, making it difficult for the researcher to

integrate the results (Creswell & Plano Clark, 2011; Teddlie & Tashakkori, 2009). However, differences in qualitative and quantitative strand results can provide additional information that addresses gaps in the literature

Participants

Participants for this study were patients who experienced a DRF and who were being treated at a local orthopedic practice with three offices. Nonprobability convenience sampling was used to obtain this sample. Nonprobability convenience sampling is a method of sampling where participants are chosen based on their availability to participate in the study (Portney & Watkins, 2009; Trochim & Donnelly, 2008). Further, participants were chosen based on whether or not they met both inclusion and exclusion criteria. The PI is an employee of a local orthopedic practice, therefore it was convenient to recruit participants from this organization for the study. All data collectors were trained not to coerce any patients to participate in the study. Those data collectors included the PI, two hand surgeons, and one occupational therapist.

Power and Sample Size

Quantitative strand. In determining the number of participants needed for the quantitative strand a power analysis was performed using G*power 3.1 software. In reviewing the literature, three articles were used to determine number of participants (Amorosa et al., 2011; Egol, Karia, Zingman, Lee, & Paksima, 2014; FitzPatrick et al., 2012). Each article studied the DRF population and looked at functional outcomes using the DASH. The articles examined functional outcomes in individuals with either comorbidities or complications post DRF. The Amorosa et al. study (2011) looked at two different variables including ulnar styloid fracture and open or closed injury. G*power 3.1 software determined an effect size for each article utilizing standard deviation and mean scores reported in the article. Analysis was done to determine

sample size for the shoulder pathology group and the DRF only group with each group having at least an equal numbers of participants. Results of the power analysis for each article were compared, and the most reasonable sample size was determined.

After running a power analysis, two articles had a medium effect size of .66 (Amorosa et al., 2011; Egol et al., 2014) and two articles had a large effect size .88 (Amorosa et al., 2011) and .89 (FitzPatrick et al., 2012). Egol et al. (2014) compared patients with hand stiffness post DRF with patients who did not develop hand stiffness post DRF, and Amorosa et al. (2011) compared patients with ulna styloid fracture post DRF with patients who did not have an ulnar styloid fracture post DRF. Both studies compared DASH scores between the groups using *t* tests for data analysis (Amorosa et al., 2011; Egol et al., 2014). Egol et al. (2014) found the mean score for the hand stiffness group at 6 months was 30 and the non hand stiffness group was 15. Standard deviation score for the hand stiffness group was 25 and the non hand stiffness group was 20 (Egol et al., 2014). Amorosa et al. (2011) found a mean score for the ulnar styloid fracture group was 30 and the non styloid fracture group was 15. The standard deviation score for the ulnar styloid fracture group was 25 and the non styloid fracture group was 20 (Amorosa et al., 2011).

Amorosa et al. (2011) compared patients with open fractures post DRF with patients with closed fractures post DRF, and FitzPatrick et al. (2012) compared patients with osteoporosis post DRF with patients with osteopenia post DRF. Both studies compared DASH scores between the groups using *t* test for data analysis (Amorosa et al., 2011; FitzPatrick et al., 2012). Amorosa et al. (2011) found a mean score for the open fracture group was 40 and the closed fracture group was 20. The standard deviation score for the open fracture group was 25 and the closed fracture group was 20 (Amorosa et al., 2011). FitzPatrick et al. (2012) found a mean score for the

osteoporosis group was 30 and the osteopenia group was 10. The standard deviation score for the osteoporosis group was 30 and the osteopenia group was 10 (FitzPatrick et al., 2012).

To determine the number of participants needed to find a significant difference in QuickDASH scores between patients who have shoulder pathology concurrent with a DRF and patients who do not, power analysis was performed using G*power 3.1 software. In using a *t* test for data analysis, the sample size is determined by choosing to conduct a two-tailed test with an alpha level of .05. In choosing a power, a power level of 0.80 is considered reasonable to use for a behavioral scientist (Cohen, 1988). In choosing .80 as the power level, there is 80% probability that there is a statistical difference between the two groups being studied (Portney & Watkins, 2009). There is also a 20% chance that a Type II error will be made in that the null hypothesis will not be rejected when it is really false (Portney & Watkins, 2009). As mentioned before, effect sizes were determined using the DASH mean scores and standard deviation scores from three articles. Effect sizes ranged from medium (.66) to large (.88-.89). Sample size was determined by looking at the available research and determining what change in mean score was reasonable. With an effect size of .89, a total sample size of 42 and a change in mean score of 20 seemed reasonable for this study. Further, both studies that had large effect sizes used designs reflective of the design of the quantitative strand of this study. Therefore, a sample of 21 was required for the shoulder pathology group and a sample of 21 is required for the nonshoulder pathology group.

Qualitative strand. The sampling method that was used for the qualitative strand was purposive sampling. Purposive sampling occurs when a researcher handpicks participants based on specific criteria (Portney & Watkins, 2009; Richards & Morse, 2007, Teddlie & Tashakkori, 2009). All participants were chosen by the PI and had a primary diagnosis of a DRF and a

secondary diagnosis of shoulder pathology. In determining sample size in qualitative research there are no universally accepted rules (Teddlie & Tashakkori, 2009). Sample size can partly depend on organizational constraints, richness of the data collected, and the degree of commitment to the level of analysis (Smith et al., 2009). Creswell and Plano Clark (2011) recommend a sample size of four to 10 participants for the qualitative strand of a mixed methods study. When using a phenomenological approach, 3 to 10 participants (Dukes, 1984) and 5 to 25 participants are recommended (Polkinghorne, 1989). A sample size of 4 to 6 participants was the goal for the qualitative strand of this study (Creswell & Plano Clark, 2011; Dukes, 1984; Polkinghorne, 1989). However, seven participants were interviewed for the qualitative strand of this study.

Inclusion Criteria

Inclusion criteria includes having a diagnosis of a DRF, being over the age of 18, being proficient in the English language including being able to speak and understand English and reading and writing English, and having normal shoulder function prior to the DRF. Each hand surgeon interviewed the patient to confirm that there was no shoulder injury prior to the fall. The shoulder pathology can occur at the same time the DRF occurred, due to compensation at the shoulder joint, or due to disuse.

Exclusion Criteria

Each hand surgeon was given all exclusion criteria. Chart review and interview confirmed if a patient should be excluded from the study. Patients were excluded if they had cognitive deficits or physical disabilities that would limit their ability to participate in the study or make decisions regarding their participation in the study. A patient was also excluded if he or she had a history of shoulder injury prior to the DRF, either orthopedic or neurologic. A patient

was also excluded if he or she had sustained another injury to the elbow, wrist, or hand concurrent with the DRF. In addition, if injury to the shoulder, occurring at the same time as the DRF, is severe such as a fracture, rotator cuff tear that requires surgery, labral tear, or nerve injury, the patient was excluded. Further, if a participant had a trauma or any other medical condition affecting the shoulder during the time enrolled in the study, the participant was not included in the study. Finally, any individual post DRF who is longer than two weeks from date of injury was not included in the study.

Recruiting Procedures

After approval by the IRB, the recruitment process was initiated. The hand surgeons at a local orthopedic practice participated in recruitment of participants for the study using the oral recruitment script that was written by the PI and is located in Appendix K of this document. The recruitment of all participants occurred at all three of the orthopedic practice locations. Both hand surgeons met with the PI before recruitment started and were educated on the population that would be recruited and the process of obtaining informed consent. Any patients post DRF who met both inclusion and exclusion criteria were asked to participate in the study by the hand surgeons. If the hand surgeons identified a potential participant, and the PI was in the building at that time, the PI also participated in both recruitment and obtaining consent. The informed consent form with information regarding the purpose of the study was given to patients by the hand surgeons or PI and any questions about the study were answered. If the patient agreed to participate in the study, informed consent was obtained. If the patient had questions regarding participation in the study he or she contacted the PI or the PI contacted the patient.

Timeline

Complete draft proposal submission: August 5, 2016

Proposal defense: November, 2016

IRB protocol approval: February 24, 2017

Study implementation date: March 1, 2017

Data Analysis: March-September, 2018

Completion of dissertation report: Spring 2019

Dissertation Defense: Spring 2019

Graduation: Summer 2019

Ethical Considerations and Review (IRB)

Prior to beginning this study, the PI completed institutional review board (IRB) documents for this study. At no time was the routine treatment of the participants disrupted. There was no intervention provided to participants and no intervention was withheld from the participants.

Informed Consent

Patients who came to a local orthopedic practice with a DRF were asked if they would like to participate in this study by either the PI or the two hand surgeons. Information regarding the purpose of the study and requirements to participate in the study was given to the potential participant by the two hand surgeons or the PI during their first or second visit with the physician. The informed consent form (Appendix J) was reviewed with each potential participant and any questions regarding consent were answered at that time by either the two hand surgeons or the PI. The PI's contact information was located on all consent forms and all potential participants were encouraged to contact the PI with any questions regarding participation in the study. If the potential participant agreed to be in the study, informed consent was obtained by either the two hand surgeons or the PI. Each consent form had a signature from

the participant or a mark from the participant if he or she could not write due to injury to his or her dominant upper extremity. In order to participate in the study, informed consent was obtained within two weeks of the date of injury or occurrence of the DRF. If a potential participant wanted to think about participating in the study, he or she was given two weeks from the first visit with the hand surgeon to decide. Each participant was given a copy of the informed consent form. In addition to the informed consent form, each participant was required to sign the Protected Health in Research Authorization Form (Appendix M) which was required by Nova Southeastern University's IRB and the Health Insurance Portability and Accountability Act (HIPAA) of 1996. Each participant was given a copy of the Protected Health in Research Authorization Form.

Confidentiality

The consent forms were identified using the participants' names. These paper documents were stored in a secure location by each data collector. All three orthopedic practice locations and all three outpatient rehabilitation clinic locations had a locked file cabinet where all consent forms and questionnaires were placed. Keys to the locked cabinets were in the possession of the data collectors. Raw data will be kept for a minimum of three years, then destroyed. All quantitative data forms had an identification number that was assigned to each participant. All interviews were recorded with a digital recorder and later transcribed. All transcriptions had the same identification number that was assigned to the participant for the quantitative data collection forms. The digital recorder was kept by the PI in a locked cabinet at the outpatient rehabilitation clinic location. After transcription was complete, the digital recording of the interview was erased from the device. All transcriptions were stored on a password-secured computer and backed up on an external hard drive.

Funding

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Study Setting

The study setting was the orthopedic practice offices or the outpatient rehabilitation offices. All data collection and assessments completed by the hand surgeon for the quantitative strand occurred in a private treatment room. All data collection and assessments completed by the occupational therapist for the quantitative strand occurred in a private room at one of the outpatient rehabilitation clinics. The PI conducted qualitative strand audiotaped interviews in a private room at one of the outpatient rehabilitation clinic locations listed above. The location was chosen by the participant based on the convenience of that location to the participant. If a participant was not familiar with the location chosen, the PI gave directions on how to get to that location.

Instruments and Measures

Quantitative Strand

All four constructs described at the beginning of this chapter were collected in the quantitative strand using instruments at 5-7 weeks post DRF. The construct function was measured by using the QuickDASH, the construct kinesiophobia was measured by using the TSK-11, the construct pain was measured by using the VAS, and the construct compensation was measured by using the compensation section of the Adelaide questionnaire.

Function. The QuickDASH questionnaire (Appendix A) was used to quantify function in this study. The QuickDASH is a shortened version of the DASH questionnaire that has 11

items instead of 30 items to measure physical function and symptoms in patients with any or several musculoskeletal disorders of the upper limb (Institute of Work and Health, 2013b). A higher score on the QuickDASH meant that the individual had worse function while a lower score meant that the individual had higher function. The QuickDASH was chosen to use in the study for multiple reasons. First, both the QuickDASH and the DASH are the only instruments used in the DRF literature that can measure physical function and symptoms in patients with several musculoskeletal disorders of the upper limb (Changulani et al., 2008). This study was interested in measuring function in both the DRF population and the population that experiences shoulder pathology concurrent with a DRF; therefore, a tool capable of measuring function in patients with several musculoskeletal disorder was needed. Second, it takes less time to complete the QuickDASH than the DASH. This enabled improved participation and less chance of questions left unanswered. Third, the QuickDASH was chosen because it can be used instead of the DASH with similar precision in upper extremity disorders (Beaton et al., 2005; Gummesson et al., 2006; Whalley & Adams, 2009), and DRFs (Abramo et al., 2008). The QuickDASH has been found to be both a reliable and valid instrument to measure physical function and symptoms in patients with upper-limb musculoskeletal conditions (Beaton et al., 2005; Gabel, Yelland, Melloh, & Burkett, 2009; Kennedy et al., 2013). Validity for the QuickDASH was established by correlating QuickDASH measurement properties with the DASH (Beaton et al., 2005; Gummesson et al., 2006). Validity for the DASH was established by correlating the DASH with other outcome measures including the Brigham Questionnaire and Shoulder Pain and Disability Index (Beaton, Katz, et al., 2001), Short Form-36 and Short Musculoskeletal Function Assessment (Hunsaker et al., 2002). Lastly, scores from the

QuickDASH are a ratio level of data and each questionnaire gave a score as long as there was no more than one question left unanswered.

Kinesiophobia. The TSK-11 (Appendix B) was used to quantify kinesiophobia in this study. The TSK-11 is a shortened version of the TSK questionnaire and has 11 items instead of 17 items (Tkachuk & Harris, 2012; Woby et al., 2005). The TSK-11 gives an overall score, an avoidance score, and a harm score. A higher score on the TSK-11 means that the individual has more kinesiophobia, and a lower score means that the individual has less kinesiophobia. A higher score on the avoidance subscale means that the individual avoids movement in the affected extremity more, and a lower score means the individual avoids movement in the affected extremity less. A higher score on the harm subscale meant that the individual felt that movement of the affected extremity caused more harm to the body, and a lower score meant that the individual felt that movement of the affected extremity caused less harm to the body. The TSK-11 was chosen because it is both reliable and valid in measuring fear of movement/(re)injury (Tkachuk & Harris, 2012; Woby et al., 2005), and it takes less time to complete than does the TSK. This enabled improved participation and less chance of questions left unanswered. Studies have shown that the TSK is a reliable tool to use with patients post DRF (Lövgren & Hellström, 2012) and with shoulder pain (Mintken et al., 2010). Validity for the TSK-11 was established by correlating scores of the TSK-11 to the Pain Catastrophizing Scale (Hapidou et al., 2012) and the TSK (Tkachuk & Harris, 2012; Woby et al., 2005). Lastly, scores from the TSK-11 are a ratio level of data, and each questionnaire gave a score as long as all questions were answered.

Pain. The VAS (Appendix C) was used to quantify pain intensity in this study. The VAS of pain intensity is a line with two descriptors representing extremes of pain intensity such

as no pain and extreme pain (Jensen et al., 2003). A higher score on the VAS meant that the individual had higher pain intensity, and a lower score on the VAS meant that the individual had lower pain intensity. The VAS was chosen to use in this study because it is the most used measure of pain intensity in research (Jensen et al., 2003), has high reliability when assessing acute pain (Bijur et al., 2001), and is a valid measure to use for patients postoperatively (DeLoach et al., 1998) and in the adult rheumatology population (Hawker et al., 2011). The validity of the VAS was established by comparing scores on the VAS to the 11-point numeric pain scale (DeLoach et al., 1998), the 5-point verbal descriptive scale, and the numeric rating scale (Hawker et al., 2011). Lastly, VAS scores are ordinal level of data because pain was documented in the number of centimeters from the left side of the scale the participants mark their pain at. The scale is 10 centimeters in length. Therefore, if a participant has a minimal amount of pain, pain may be marked at 2.5 centimeters from the left side of the scale.

Compensation. The compensatory section of the Adelaide Questionnaire (Appendix D) was used to quantify compensatory strategies in this study. The Adelaide questionnaire was chosen because it is the only instrument that assesses compensatory mechanisms used to perform activities after a wrist injury. The Adelaide questionnaire consists of two components. A standard component which assesses an individual's ability to perform 25 ADLs and an individualized component which assesses the magnitude of performing, compensatory mechanisms used, and perceived importance of up to five important ADLs nominated by the injured individual (Bialocerkowski & Grimmer, 2004). The Adelaide questionnaire is a valid and reliable instrument to use with individuals with wrist disorders (Bialocerkowski et al., 2003a, 2003b). Construct, content, and face validity were established by proving that outcome scores on the Adelaide questionnaire reflect how ADLs improve over time, by proving that there is a

relationship between outcome scores and impairment measures and proving that the Adelaide Questionnaire covers the full scope of activity limitations for wrist diagnosis (Bialocerkowski et al., 2003b). The Adelaide Questionnaire asks the individuals if they have changed the way they perform activities and lists specific compensatory strategies that have been reported by other wrist-injured patients (Bialocerkowski et al., 2003a, 2003b). This section was utilized to describe compensation strategies used by individuals post DRF. The compensatory strategies the participant had to choose from were avoiding the activity, performing the activity with two hands, holding a jar between the legs, taking rest breaks when performing the activity, using a wrist brace when performing the activity, doing the activity with one hand, changing the way the item is lifted or gripped, and taking longer to perform the activity. The compensatory section of the Adelaide questionnaire generated ratio data and compensatory strategies used were assessed for the first five questions on the QuickDASH questionnaire. These included opening a jar, doing heavy household chores, carrying a shopping bag or briefcase, washing your back, and using a knife to cut food. Each compensatory strategy counted as 1 and a total was generated for each participant. A higher score meant that the individual used more compensatory mechanisms to perform the ADL/IADLs on the QuickDASH and a lower score meant that the individual used less compensatory mechanisms to perform the ADL/IADLs on the QuickDASH. Individual compensatory strategies such as avoid activity, do activity with one hand, and take longer to perform the activity were individually counted for each subject. A higher score means that an individual used that specific compensatory mechanism more and a lower score means that an individual uses that specific compensatory mechanism less. Scores from this tool were a ratio level of data.

Qualitative Strand

Semi structured interview. When utilizing a phenomenological approach, the instrument most often used is an interview (Creswell, 2013). For this study, a semistructured interview was performed with participants who had shoulder pathology concurrent with a DRF. The semistructured interview included using an interview guide (Creswell, 2013). An interview guide included the main research question asking each participant what the lived experience of having shoulder pathology concurrent with a DRF is like and also included five to seven open-ended subquestions (Creswell, 2013, 2014). Although the interview guide contained subquestions, all participants were encouraged to discuss the issues most relevant to them. In order to meet the needs of each participant, subquestions were altered or new questions were developed during the interview (Richards & Morse, 2007; Smith et al., 2009).

Reliability in qualitative research is the extent to which the inquiry is dependable (Lincoln & Guba, 1985; Teddlie & Tashakkori, 2009). Dependability for a semistructured interview is the ability of the human instrument to yield consistent results (Lincoln & Guba, 1985). This depends in part on the experience of the researcher (Richards & Morse, 2007). The PI for this study has performed one interview for a qualitative strand of a mixed methods study. This limited experience could inhibit the amount of information obtained from a participant. Because it is difficult to replicate an interview entirely, use of an interview guide improved the reliability of the interview. Good quality memoing, tape recording, and transcription of the interview also improved reliability (Creswell, 2013). Further, coding of the interview data was the most important part in establishing reliability of an interview (Creswell, 2013).

Validity or credibility of the semistructured interview involved establishing that the results are credible from the perspective of the participant (Lincoln & Guba, 1985). Member

checking is a strategy that was used to improve credibility of the semistructured interview. Each participant was given the findings and interpretations of his or her interview after data analysis had been completed. At that time the participants either affirmed that the data reflected their views, feelings, and experiences or that it did not. Affirmation shows credibility. Lastly, giving a rich, thick description of the participants under study by making notes about the context in which their experiences occurred improved the validity or transferability of the semistructured interview.

Data Collection Procedures

Quantitative Strand

Prior to the start of the study, all data collectors including Dr. David Moss, Dr. Richard Barth, and Madeline Fetsko OTR/L were educated on how to collect data by the PI. Each data collector learned how to obtain informed consent, administer questionnaires, and answer questions regarding all of the questions on the questionnaires. Each data collector learned how to check the questionnaires for completeness and how to store all questionnaires for confidentiality. At this meeting with all the data collectors, the PI answered any questions they had. Further, prior to the study all data collectors completed the collaborative institutional training initiative through the Nova Southeastern University IRB website.

In order to participate in the study, informed consent had to be obtained within two weeks of the date of injury or occurrence of the DRF. After informed consent was obtained, the participant completed a questionnaire (See Appendix F). The questionnaire had an identification number at the top which was the identification number assigned to that specific participant. This questionnaire collected demographic information including age, gender, and race. Some fracture status information was also collected including date of injury, what side the fracture was located

on, and if the dominant extremity was fractured. The data collector reviewed each questionnaire with the participant and answered any questions.

After the initial questionnaire was given, each participant completed follow-up appointments with the hand surgeon. At each visit with the hand surgeon, the shoulder was assessed. Shoulder assessment included an interview with the participant to ask if he or she had any pain or stiffness in the shoulder joint. The hand surgeon assessed each participant's shoulder range of motion and performed a Neer impingement test and a Hawkins Kennedy impingement test. The hand surgeon also clarified with the participants that the shoulder injury was not pre-existing. There was no specific assessment of scapular mobility performed by the hand surgeon. The hand surgeon saw the participant an average of five times between the date of injury and 9 weeks. If the shoulder was positive for shoulder pathology, the hand surgeon recorded the date the shoulder pathology started and the shoulder diagnosis. The hand surgeon interviewed the participant to learn if he or she had pain at the shoulder at the time of the fall or if the shoulder pathology occurred over time due to either excessive loading of the shoulder muscles or disuse of the shoulder joint. The hand surgeon recorded that the shoulder pathology was the result of the fall or that the shoulder pathology was due to compensation/disuse. See Appendix H for the physician shoulder pathology form which was completed at each visit with the hand surgeon. If the participant was being followed by an occupational therapist at an outpatient rehabilitation clinic, then the treating occupational therapist evaluated the shoulder weekly for shoulder pathology. If the participant presented with shoulder pain or limited active range of motion, the participant was sent to the hand surgeon for a formal evaluation and diagnosis. If a participant was diagnosed with shoulder pathology by the hand surgeon, then that participant was placed in the shoulder pathology group.

At 5-7 weeks, either a hand surgeon or occupational therapist at a local orthopedic practice collected the remainder of the quantitative data and again assessed the shoulder for shoulder pathology. At that time, a participant may have already been diagnosed with shoulder pathology and placed in the shoulder pathology group or might have been diagnosed with shoulder pathology at that time. All participants that did not present with shoulder pathology between date of injury and 9 weeks were placed in the DRF group. Data collection at 5-7 weeks included collecting demographics, employment and work status, fracture status, and health status using a questionnaire (See Appendix G). Further health status was collected including function using the QuickDASH (Appendix A), kinesiophobia using the TSK-11 (Appendix B), pain intensity on the VAS (Appendix C), and compensation strategies used by each participant was collected by counting the number of strategies used by each participant for the first five functional tasks on the QuickDASH (Appendix D). Before giving the participant the questionnaires, instructions on how to complete the questionnaires was read aloud to the patient. Each questionnaire had an identification number at the top, the same as the one used for the first questionnaire. The participant was able to ask questions to the data collector at any time while filling out the questionnaires. Demographics included collecting information on whether or not the participant currently had an able and willing caregiver, and if that caregiver provided care at that time. Employment and work status included assessing each participant's productive role. Productive role options included paid employment, homemaker, volunteer, and student. The level that each participant was able to perform that productive role was also assessed. Employment and work status also included assessing if the participant was receiving workers' compensation. Fracture status included if surgical intervention was performed, as well as date of surgery, if a sling was used, and how many days the sling was used. Health status included

whether or not the participant had been diagnosed with CRPS and osteoporosis. A treating physician could only give the diagnosis of CRPS or osteoporosis to a participant. After the questionnaires were completed, the data collector checked each form to make sure all questions had been answered. These paper documents were stored in a secure location by each data collector.

If a participant developed shoulder pathology between 7-9 weeks, the occupational therapist or hand surgeon notified the PI. At that time, the hand surgeon performed an evaluation and a formal diagnosis was given. If the hand surgeon determined shoulder pathology was present, then that participant was placed in the shoulder pathology group. Any participant who developed shoulder pathology after 9 weeks was not included in the study.

Qualitative Strand

Data collection for the qualitative strand included in-depth, open-ended interviews. The purpose of the phenomenological interview was to draw from participants a vivid picture of their lived experience including the context which shaped their experience (Sorrell & Redmond, 1995). The goal of the phenomenological interview was to obtain a narrative or story from the participant (Sorrell & Redmond, 1995). In order to do this the researcher established a rapport with the participant. Participation by both the researcher and participant facilitated a collaborative awareness of new meanings in the lived experience (Sorrell & Redmond, 1995) and provided more in-depth data (Smith et al., 2009). All preunderstandings of the phenomenon were bracketed prior to the start of the study and included the PI identifying any personal experiences and assumptions of the population who had shoulder pathology concurrent with a DRF. Preunderstanding of the phenomenon came from 17 years of working with patients who have suffered DRFs, some whom have experienced shoulder pathology. This technique was

used to deter the PI from having any bias while performing the study. Preunderstandings were revisited prior to performing each interview. During the interview, the preunderstandings gave the PI information that helped formulate additional questions to engage the participant.

All interviews were individual and conversational. Conversations encouraged participants to describe their experiences. Each interview was audiotaped, with written permission of interviewees, and later transcribed. Written permission of interviewees was obtained during the consent process. Interviews occurred in one of the private treatment rooms at one of the three outpatient rehabilitation clinics locations. A broadly structured script guided the interview process with the participant. First, the participant was asked a general question: What is the lived experience of having shoulder pathology at the same time as a DRF? What is it like living with your injury? Based on preunderstandings of this phenomenon and the constructs being used for data collection in the quantitative strand, the researcher used the subquestions numbered below.

1. Has your injury affected your ability to perform the activities that you do every day? If so, how?
2. Has your injury affected your ability to fulfill your roles with family, community, or other groups? If so, how?
3. Has your injury affected your ability to perform your job? If so, how?
4. Can you describe how you feel when you try moving or using your injured arm?
5. Do you have pain? If so, can you describe your pain? How does pain effect your day? How does pain effect your ability to do what you need or want to do?
6. Have you had to change the way you do things since your injury? If so, can you describe what has been different or how you have had to change how you do things?

Utilization of a script provided a basis for comparing responses between participants; however, it had to be pliable enough to allow the interviewer to probe and ask follow-up questions (Portney & Watkins, 2009). During the interview, observational memoing was used to document what was being observed (Groenewald, 2004). This included body postures, facial expressions, or emotions. After each interview, theoretical memoing was used to document what the PI is experiencing after each interview (Groenewald, 2004). This included statements made by the participant that resonated with the PI or insights. Each interview was recorded on a digital voice recorder. The interview was transcribed and deleted from the digital voice recorder. All transcription was kept on the password secured computer and backed up with an external hard drive. Microsoft Word® was used to manage data transcripts and any observational memoing.

Data Analysis

Quantitative Strand

Quantitative data were collected for two groups: participants post DRF with shoulder pathology and participants post DRF without shoulder pathology. Outcome measures for the quantitative strand occurred between 5-7 weeks post DRF. If the hand surgeon diagnosed a participant with shoulder pathology, that participant was in the shoulder pathology group. If the hand surgeon did not diagnose the participant with shoulder pathology, that participant was in the DRF only group. SPSS® was used to analyze all quantitative data.

Descriptive statistics were used to describe the population that experienced shoulder pathology concurrent with a DRF. This analysis of data answered the first research question by describing demographics, patient characteristics, and clinical factors that described the population who experience shoulder pathology concurrent with a DRF. This analysis also provided the number of participants in the sample with shoulder pathology and what type of

shoulder pathology occurred (i.e., rotator cuff tendonitis/subacromial impingement, adhesive capsulitis, shoulder stiffness, shoulder pain). Descriptive statistics were reported for each group including the mean scores and percentages of the dependent variables.

The Spearman rank correlation test (r_S) and Kendall tau b (r_τ) were used to state mathematically if a relationship existed between two variables. It was of interest to determine if there was one characteristic that was more closely related to a particular outcome. For example, did participants with dominant DRFs indicate more compensatory strategies or did participants who had surgery indicate less pain or kinesiophobia. These correlations were added to the nonparametric statistics that were reported.

Data in this study were also analyzed using the independent samples Mann-Whitney U test statistical method. This method was chosen because the VAS, used to measure pain, is ordinal data. The Mann-Whitney U test is a nonparametric test and can be used when the data violates assumptions underlying the independent samples *t* test. The Mann-Whitney U test was used to determine if participants with shoulder pathology concurrent with a DRF have significantly worse function, higher kinesiophobia and pain, and more use of compensatory strategies than do patients with no shoulder pathology. This analysis of data answered research questions two through five. All data obtained from the QuickDASH, TSK-11, and compensatory strategy section of the Adelaide questionnaire were ratio data. Data obtained from the VAS were ordinal data. In comparing the shoulder pathology group with the no shoulder pathology group, a Mann-Whitney U test of $p < .05$ indicated if there was a significant difference between the two group means. A significance level of .05 was chosen because it defines the maximal acceptable risk of making a Type I error (Portney & Watkins, 2009), which is rejecting a true null hypothesis (Portney & Watkins, 2009), or stating there is a relationship or effect when there

really is not. Based on the results of the study, the null hypothesis will either be accepted or rejected. In reporting results of the Mann-Whitney U test, statistics were reported including the correlation coefficients or r_S and r_τ, U values, p values, and median values. Additionally, a Shapiro-Wilk test was reported. The Shapiro-Wilk test reported the normality of the outcome measure test scores for the shoulder pathology group and the DRF only group.

Qualitative Strand

The theoretical influences of hermeneutic phenomenology are embedded in the perspectives that are brought to the process of gathering, interpreting, and understanding one's data (Wilding & Whiteford, 2005). Specifically, the concept of the hermeneutic circle influenced the process of data analysis. The hermeneutic circle represents the idea of looking at a human in a circular pattern and refers to the premise that in order to understand any given part, you look to the whole; to understand the whole, you look to the parts (Kincheloe & McLaren, 2003; Smith et al., 2009). For example, during data analysis, the meaning of a word became clearer when seen in the context of the entire sentence and the meaning of the entire sentence depended on the cumulative meanings of the individual words (Smith et al., 2009). Utilization of this concept was important in understanding specific dimensions of experiencing shoulder pathology concurrent with a DRF and also understanding the phenomenon as a whole. The use of the hermeneutic circle concept is complementary to Occupational Therapy research in that viewing a person holistically and understanding how the parts of a person contribute to the person as a whole are central concepts in many Occupational Therapy theories.

Hermeneutic phenomenological data analysis procedures that were used in this study included reading and rereading of the interview transcripts, memoing, phenomenological reflection, and theme development. To start the data analysis process, repeated reading of the

interview transcripts occurred along with listening to the audiotapes of the interviews. Repeated readings of the interview transcripts allows the researcher to understand how certain narratives bind sections of the interview together and allows a model for the overall interview structure to develop (Smith et al., 2009). By reading the entire text the researcher was able to build a sense of the data as a whole without getting caught up in the details of coding (Creswell & Poth, 2018).

Memoing were used throughout the research process. Memoing is a technique used to record what the researcher is learning from the data by taking notes (Groenewald, 2010). Observational memos were taken to document what was observed in the interview, theoretical memos were used to document what the researcher was experiencing after each interview, and analytical memos were used to review the researcher's progress in theme development (Groenewald, 2004). No rules pertain to memoing; however, each memo should contain one idea, be dated and referenced, and evolve as the research moves forward (Groenewald, 2010).

Horizonalization of the data occurs when the researcher finds significant statements in the interview about how the participant is experiencing the phenomenon (Creswell, 2013; Moustakas, 1994). These statements were grouped into meaning units or codes. Each meaning unit or code was a statement that illuminated the researched phenomenon (Creswell, 1998; Holloway, 1997; Hycner, 1999). A meaning unit or code can be composed of any number of words; however, it must be coherent and contain a complex idea which is distinctive from all other ideas (Ratner, 2002). Next, the PI went back to reflect on the interview transcripts and the meaning units. Interpretation involves making sense of the data to find the larger meaning of the data (Creswell & Poth, 2018). All meaning units for each interview were scrutinized, and any redundant units were eliminated (Moustakas, 1994). For this phenomenological study, the researcher interpreted the data with the goal being to describe the personal experiences of the

population through epoche and to describe the essence of the phenomenon (Creswell & Poth, 2018). After phenomenological reflection and interpretation of the meaning units was completed, meaning units were clustered and themes were formed (Groenewald, 2004).

Data Integration

To integrate the data using a convergent parallel mixed methods design, a merging analysis approach was used to compare results of the quantitative and qualitative strands (Creswell & Plano Clark, 2011). This approach included collecting both strands concurrently, independently analyzing each strand, specifying the dimensions by which to compare the results from the two databases, specifying the information that would be compared across the dimensions, representing the comparisons with tables, and interpreting how the combined results illuminate the mixed methods research question (Creswell & Plano Clark, 2011). The constructs of function, kinesiophobia, pain, and compensation had been identified as important factors to explore in relation to shoulder pathology concurrent with a DRF. These are also the dimensions investigated in the study. In addition, when a new dimension emerged, that information from the new dimension was also compared from both strands.

The strategy that was used for comparing results is a side-by-side comparison for merged data analysis (Creswell, 2014; Creswell & Plano Clark, 2011). Tables were used to display the comparisons. The information obtained from the side-by-side comparison answered all the mixed methods research questions. Interpretation included comparing, contrasting, and synthesizing the results of the qualitative and quantitative strands (Creswell & Plano Clark, 2011). Teddlie & Tashakkori (2009) refer to the integration or synthesizing of both strands as forming meta-inferences. Meta-inferences are conclusions generated through an integration of the inferences obtained from each strand of the study (Teddlie & Tashakkori, 2009). For a

summary of the procedures and data analysis, see Appendix I.

Summary

A convergent parallel mixed methods design was used for this study. Both the quantitative and qualitative strands were collected in parallel, analyzed separately, and then merged. Participants were recruited from a local orthopedic practice and had a primary diagnosis of DRF. Informed consent was obtained from all participants and all study documents were safely stored to ensure confidentiality. Participants were followed for 9 weeks and at each follow-up visit, with either the hand surgeon or the occupational therapist, the shoulder was assessed. If any participant presented with shoulder pathology and was diagnosed with shoulder pathology by a hand surgeon, he or she was placed in the shoulder pathology group. Quantitative data were collected at the initial 1-2 visits and at 5-7 weeks. Quantitative data were collected through questionnaires and information collected included demographics, employment and work status, fracture status, and health status. This included collecting data on function with the QuickDASH, kinesiophobia with the TSK-11, pain with the VAS, and compensation with the compensatory mechanisms checklist. Interviews were performed concurrently with the quantitative data collection with participants who had shoulder pathology. All interviews were recorded with a digital recorder and later transcribed. At the end of the study, data analysis of the quantitative and qualitative strands was performed. Descriptive statistics were used to describe the demographics, patient characteristics, and clinical factors of the population who had shoulder pathology concurrent with a DRF. An independent samples Mann Whitney U test was used to determine if participants with shoulder pathology concurrent with a DRF had significantly worse function, higher kinesiophobia and pain, and more use of compensatory strategies than did patients with no shoulder pathology. Data analysis of the qualitative strand

included phenomenological reflection and interpretation of the codes followed by clustering codes and forming themes. Finally, a merged analysis was performed using a side by side comparison to compare and contrast results of the quantitative and qualitative strands.

Chapter 4: Results

The purpose of this convergent parallel mixed methods study was to expand the understanding of the impact of shoulder pathology on individuals with DRF including the effect the injury has had on occupational performance. In order to improve the protocols used in the rehabilitation of individuals post DRF, more information about the phenomenon of shoulder pathology on individuals with DRF was needed, and the present study was designed to address this gap in the literature. The results section includes the quantitative strand data analysis, the qualitative strand data analysis, and the mixed method data analysis. The quantitative data analysis describes the population who had shoulder pathology concurrent with a DRF and reports differences in outcome measures between the shoulder pathology group and the DRF only group. Additionally, the quantitative strand analysis reports correlations for each group. The qualitative strand describes themes that emerged when asking the qualitative research question: *What is the lived experience of having shoulder pathology at the same time as a DRF? What is it like living with your injury?* Finally, the mixed methods analysis coincides, compares, and contrasts results of the quantitative and qualitative strands to expand on the understanding of the phenomenon of having shoulder pathology concurrent with a DRF.

Quantitative Strand Data Analysis

The purpose of this convergent parallel mixed methods study was to expand the understanding of the impact of shoulder pathology in individuals with DRF. This study explored the possible differences in the functional outcome scores, kinesiophobia scores, pain levels, and number of compensatory mechanisms used between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only. Descriptive statistics analysis and an independent samples Mann-Whitney U statistical test were conducted. The following

research questions guided the quantitative analysis:

1. What demographics, patient characteristics, and clinical factors describe the population who had shoulder pathology concurrent with a DRF?
2. Are there differences in functional outcome scores (as measured by the Quick Disabilities of the Arm, Shoulder, and Hand) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only?

   Hypothesis: Participants who had shoulder pathology concurrent with a DRF had significantly worse functional outcome scores than did participants who have a DRF only.
3. Are there differences in kinesiophobia scores (as measured by the TSK-11) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only?

   Hypothesis: Participants who had shoulder pathology concurrent with a DRF had significantly worse kinesiophobia scores than did participants who had a DRF only.
4. Are there differences in pain levels (as measured by a visual analog scale) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only?

   Hypothesis: Participants who had shoulder pathology concurrent with a DRF had significantly worse pain scores than did participants who had a DRF only.
5. Are there differences in the number and types of compensatory mechanisms (as measured by the compensatory mechanisms checklist of the Adelaide questionnaire) used between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only?

Hypothesis: Participants who had shoulder pathology concurrent with a DRF used a higher number of compensatory mechanisms than did participants who had a DRF only.

Research Question One

What demographics, patient characteristics, and clinical factors describe the population who had shoulder pathology concurrent with a DRF?

The first research question aimed to determine the demographics, patient characteristics, and clinical factors that describe a population who had shoulder pathology concurrent with a DRF and those participants who had a DRF only. The sample of the study consisted of 45 participants who had experienced a DRF and who were being treated at a local orthopedic practice. Among these 45 participants who had experienced a DRF, 16 (35.6%) experienced a DRF concurrent with shoulder pathology. Tables 1 and 2 summarize the demographics, participant characteristics, and clinical factors of participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only. The tools used to gather demographic information on participants were researcher-developed questionnaires. The researcher-developed questionnaire given at 1-2 weeks post DRF can be found in Appendix F and the researcher-developed questionnaire given at 5-7 weeks can be found in Appendix G.

Shoulder pathology concurrent with a DRF group. For the 16 participants who had shoulder pathology concurrent with a DRF, there were 15 (93.8%) females and 1 (6.2%) male. In regard to race, 13 (81.3%) participants were Caucasians, 1 (6.3%) was African American, and 2 (12.5%) identified as "other." Of the 16 participants, 12 (75%) fractured their left distal radius and 2 (12.5%) of the participants had an ulna fracture which required ORIF in addition to the radius fracture. Among the 16 participants who had shoulder pathology concurrent with a DRF,

4 (25%) participants responded that the fracture side was their dominant side. For the type of shoulder pathology, 6 (37.5%) had shoulder pain, 4 (25%) had shoulder stiffness, 3 (18.8%) had both shoulder impingement and shoulder pain, 2 (12.5%) had shoulder impingement, and 1 (6.3%) had shoulder impingement and shoulder stiffness. In 10 (62.5%) of the participants who had shoulder pathology concurrent with a DRF, the shoulder pathology was caused by compensation or disuse as determined by the treating hand surgeon. In 6 (37.5%) of the participants the shoulder pathology was caused by the initial fall as determined by the treating hand surgeon.

The 6 participants in whom the shoulder pathology was caused by the fall had 0 days prior to the onset of symptoms and therefore were not captured in this statistic. There were 12 (75%) out of 16 participants who had an able and willing caregiver. Surgery was performed on 12 (75%) of the 16 participants and 13 (81.3%) used a sling after their DRF. The mean number of days in sling was 10.31 days (*SD* = 8.47). The shortest number of days using a sling was 2 days and the longest was 27 days. There were 5 (31.3%) out of 16 participants who had a diagnosis of osteoporosis. In terms of productive roles of the 16 participants, 11 (68.8%) were paid employees, 9 (56.3%) were homemakers, 2 (12.5%) were volunteers, and 1 (6.3%) was a student. Refer to Table 1 for this demographic, patient characteristic, and clinical factor data.

For the participants who had shoulder pathology concurrent with a DRF, the mean age was 64.56 years old (*SD* = 9.00). The oldest participant was 82 years old and the youngest was 49 years old. Among the 10 participants in whom the shoulder pathology was caused by compensation or disuse, the mean number of days before the shoulder symptoms started was 42.6 days (*SD* = 25.83). This statistic describes the average number of days between the date of injury and the date shoulder pathology started. The shortest number of days between the date of

injury and when the shoulder pathology started was 3 days, and the longest number of days was 67 days. Refer to Table 2 for this demographic and patient characteristic data.

DRF only group. Among the 29 participants who had a DRF only, the mean age was 67.76 years old (*SD* = 16.21). The oldest participant was 96 years old and the youngest was 20 years old. There were 23 (79.3%) females and 6 (20.7%) males. There were 28 (96.6%) Caucasians and 1 (3.4%) participant who identified as "other." Of the 29 participants with a DRF only, 20 (69%) fractured their left distal radius and 1 (3.4%) of the participants had an ulna fracture which required ORIF in addition to the radius fracture. Among the 29 participants who had a DRF only, 11 (37.9%) responded that they had a fracture of their dominant side. There were 15 (51.7%) participants who had an able and willing caregiver. Surgery was performed on 14 (48.3%) participants who had a DRF only and 14 (48.3%) used a sling after their DRF. The mean number of days in sling was 7.50 days (*SD* = 8.86). The shortest number of days in a sling was 1 day and the longest number was 35 days. There were 5 (17.20%) participants who had a DRF only who also had a diagnosis of osteoporosis. In terms of productive roles, 15 (51.7%) were paid employees, 18 (62.1%) were homemakers, 10 (34.5%) were volunteers, and 2 (6.90%) were students. Refer to Table 1 and Table 2 for this demographic, patient characteristic, and clinical factor data.

Table 1

Frequency and Percentage Summaries, Represented as n(%), of Demographic, Patient Characteristics, and Clinical Factors of Participants Who Had a Shoulder Pathology Concurrent With a DRF and Those With a DRF Only

	Shoulder Pathology concurrent with DRF		
	No (n = 29)	Yes (n = 16)	Total (N = 45)

		Shoulder Pathology concurrent with DRF		
		No (n = 29)	Yes (n = 16)	Total (N = 45)
Fracture side	Right	9(31)	4(25)	13(28.9)
	Left	20(69)	12(75)	32(71)
Subsequent ulna fracture	DU	1(3.4)	0(0)	1(2.2)
	DU-ORIF	1(3.4)	2(12.5)	3(6.7)
Hand dominance	Right	26(89.7)	16(100)	42(93.3)
	Left	2(6.9)	0(0)	2(4.4)
	Ambidextrous	1(3.4)	0(0)	1(2.2)
Is dominant side fracture side	No	18(62.1)	12(75)	30(66.7)
	Yes	11(37.9)	4(25)	15(33.3)
Gender	Male	6(20.7)	1(6.2)	7(15.6)
	Female	23(79.3)	15(93.8)	38(84.4)
Race	Afr. Amer.	0(0)	1(6.3)	1(2.2)
	Caucasian	28(96.6)	13(81.3)	41(91.1)
	Other	1(3.4)	2(12.5)	3(6.7)
Type of Shoulder Pathology	SI	0(0)	2(12.5)	2(4.4)
	SI, SP	0(0)	3(8.8)	3(6.7)
	SI, SS	0(0)	1(6.3)	1(2.2)
	SP	0(0)	6(37.5)	6(13.3)
	SS	0(0)	4(25)	4(8.9)
Causation of Shoulder Pathology	C/D	0(0)	10(62.5)	10(22.2)
	Fall	0(0)	6(37.5)	6(13.3)
Had a willing and able caregiver	No	14(48.3)	4(25)	18(40)
	Yes	15(51.7)	12(75)	27(60)
Productive Role- Paid Employment	Yes	15(51.7)	11(68.8)	26(57.8)
Ability to perform paid employment role	Full	10(34.5)	7(43.8)	17(37.8)
	Modified	4(13.7)	3(18.8)	7(15.5)
	Unable	1(3.4)	1(6.3)	2(4.4)
Productive Role- Homemaker	Yes	18(62.1)	9(56.3)	27(60)
Ability to perform homemaker role	Full	5(17.2)	1(6.3)	6(13.3)
	Modified	13(44.8)	8(50.1)	21(46.6)
Productive Role- Volunteer	Yes	10(34.5)	2(12.5)	12(26.7)
Ability to perform volunteer role	Full	4(13.8)	0(0)	4(8.9)
	Modified	5(17.2)	2(12.5)	7(15.6)
	Unable	1(3.4)	0(0)	1(2.2)
Productive Role- Student	Yes	2(6.9)	1(6.3)	3(6.7)

		Shoulder Pathology concurrent with DRF		
		No (n = 29)	Yes (n = 16)	Total (N = 45)
Ability to Perform Student Role	Full	2(6.9)	1(6.3)	3(6.7)
Surgery	No	15(51.7)	4(25)	19(42.2)
	Yes	14(48.3)	12(75)	26(57.8)
Sling use	No	14(48.3)	3(18.8)	17(38.6)
	Yes	14(48.3)	13(81.3)	27(61.4)
	No Answer	1(3.4)		1(3.4)
Osteoporosis	No	24(82.8)	11(68.8)	35(77.8)
	Yes	5(17.2)	5(31.3)	10(22.2)

*DU = distal ulna, DU-ORIF = distal ulna ORIF, SI = Shoulder Impingement, SP = Shoulder Pain, SS = Shoulder Stiffness, C/D = Compensation/Disuse

Table 2

Descriptive Statistics Summaries of Age, When Shoulder Symptoms Started, and Time in Sling of Participants Who Had Shoulder Pathology Concurrent With a DRF and Participants with a DRF Only

Shoulder Pathology		Age	Shoulder Symptoms Started (days after injury)- Compensation and Disuse Group Only	Time in Sling (days)
No	Mean	67.76		7.50
	N	29		14
	Minimum	20.00		1.0
	Maximum	96.00		35.0
Yes	Mean	64.56	42.6	10.31
	N	16	10	13
	Minimum	49.00	3.00	2.00
	Maximum	82.00	67.00	27.00
Total	Mean	66.62	42.6	8.85
	N	45	10	27
	Minimum	20.00	3.00	1.00

Maximum	96.00	67.00	35.00

Nonparametric Statistics

A Mann-Whitney U test was used for research questions two through five. Statistics reported for this test include the *Mann-Whitney U* score, mean rank score, and sum of ranks score. A Mann-Whitney test relies on scores being ranked from lowest to highest for the entire sample. Ranks for this study start at 1 and go up to 45 because there were 45 participants. If two participants had the same score then they can also receive the same rank. The Mann-Whitney U test scored all participants together from lowest to highest for each variable that was tested. The mean rank score was then computed for the shoulder pathology concurrent with a DRF group and the DRF only group. The group with the lowest mean rank has the lowest scores in it and the group with the highest mean rank has the highest scores in it. Differences in mean rank scores between groups was then tested using a significance level of 0.05. Sum of ranks is the total of all the rank scores for each group. Finally, the *Mann-Whitney U* score summarizes the differences in mean rank numbers in a single number. The measurement tools that were used for the nonparametric testing included the QuickDASH, TSK-11, VAS, and the compensatory mechanism checklist from the Adelaide questionnaire. All of these measurement tools were thoroughly described in Chapter 3. A level of significance of 0.05 or less was used in the Mann-Whitney U tests.

Prior to data analysis using a Mann-Whitney U test, a Shapiro-Wilk test was performed. A Shapiro-Wilk test was performed to understand whether or not the shoulder pathology concurrent with a DRF and the DRF only groups were normally distributed. This test was performed for both groups and all outcome measures. The only outcome measures that were normally distributed for the shoulder pathology concurrent with a DRF group and for the DRF

only group were the QuickDASH scores and kinesiophobia avoidance scores.

Research Question Two

Are there differences in functional outcome scores (as measured by the Quick Disabilities of the Arm, Shoulder, and Hand) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only?

Hypothesis: Participants who had shoulder pathology concurrent with a DRF had significantly worse functional outcome scores than did participants who have a DRF only.

A Mann-Whitney U test was conducted to determine the difference in functional outcome score (as measured by the QuickDASH) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only. Results of the Mann-Whitney U test show that there is no significant difference in the functional outcome scores between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only (*Mann-Whitney U* = 162.50, $p = 0.10$). Given this result, the hypothesis that "participants who had shoulder pathology concurrent with a DRF had significantly worse functional outcome scores than did participants who had a DRF only" was not supported.

Research Question Three

Are there differences in kinesiophobia scores (as measured by the TSK-11) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only?

Hypothesis: Participants who had shoulder pathology concurrent with a DRF had significantly worse kinesiophobia scores than did participants who had a DRF only.

A Mann-Whitney U test was conducted to determine the significance of the differences in kinesiophobia scores (as measured by the TSK-11) between participants who had shoulder

pathology concurrent with a DRF and participants who had a DRF only. Results of the Mann-Whitney U test showed that there are no significant differences in the *kinesiophobia avoidance* scores (*Mann-Whitney U* = 180.50, $p = 0.22$), *kinesiophobia harm* scores (*Mann-Whitney U* = 156, $p = 0.07$), and kinesiophobia total scores (*Mann-Whitney U* = 177.50, $p = 0.20$) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only. Given this result, the hypothesis that "participants who had shoulder pathology concurrent with a DRF had significantly worse kinesiophobia scores than did participants who had a DRF only" was not supported.

Research Question Four

Are there differences in pain levels (as measured by a visual analog scale) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only?

Hypothesis: Participants who had shoulder pathology concurrent with a DRF had significantly worse pain scores than did participants who had a DRF only.

A Mann-Whitney U test was conducted to determine differences in pain levels (as measured by the VAS) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only. Results of the Mann-Whitney U test show that there is a significant difference in the pain levels between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only (*Mann-Whitney U* = 136.50, $p = 0.02$). Mean rank comparison in Table 3 shows that participants who had shoulder pathology concurrent with a DRF had greater pain levels (28.97) than did those participants who had a DRF only (19.71). The participants who had shoulder pathology concurrent with a DRF had a higher mean rank score than did participants who had a DRF only. Given this result, the hypothesis that

"participants who had shoulder pathology concurrent with a DRF have significantly worse pain scores than did participants who had a DRF only" was supported.

Table 3

Mean Ranks of Pain Levels of Participants Who Had Shoulder Pathology Concurrent With a DRF and Participants With a DRF Only

	Shoulder Pathology	N	Mean Rank	Sum of Ranks	*p* value
Pain (out of 10)	No	29	19.71	571.50	
	Yes	16	28.97	463.50	$p = 0.02$*
	Total	45			

***** Significant at $p < .05$

Research Question Five

Are there differences in the number of compensatory mechanisms (as measured by the compensatory mechanisms checklist of the Adelaide questionnaire) used between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only?

Hypothesis: Participants who had shoulder pathology concurrent with a DRF used a higher number of compensatory mechanisms than did participants who had a DRF only.

A Mann-Whitney U test was conducted to determine whether or not there was a significant difference in the number of compensatory mechanisms (as measured by the compensatory mechanisms checklist of the Adelaide questionnaire) used between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only. Results of the Mann-Whitney U test show that there is significant difference in the number of *compensatory mechanism avoid activity* used for 5 ADL/IADL tasks on the QuickDASH (*Mann-Whitney U* = 143.50, $p = 0.03$) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only. This

was the only *p*-value less than the level of significance value. Mean rank comparison in Table 4 shows that participants who had shoulder pathology concurrent with a DRF had a greater number of the compensatory mechanism avoid activity used for 5 ADL/IADL tasks on the QuickDASH (28.53) than those participants who had a DRF only (19.95). The participants who had shoulder pathology concurrent with a DRF had a higher mean rank score than did participants who had a DRF only. Given this result, the hypothesis that "participants who had shoulder pathology concurrent with a DRF used a higher number of the compensatory mechanism than did participants who had a DRF only" was only partially supported. Results of the Mann-Whitney U test show that there are no significant differences in the total number of compensatory mechanisms used (*Mann-Whitney U* = 214.00, $p = 0.67$), number of *compensatory mechanism use one hand only* (*Mann-Whitney U* = 203.5, $p = 0.49$), and number of *compensatory mechanism take longer to perform the activity* (*Mann-Whitney U* = 226.50, $p = 0.89$) between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only.

Table 4

Mean Ranks of Number of Compensatory Mechanisms Used for 5 ADL/IADL Tasks by Participants Who Had Shoulder Pathology Concurrent With a DRF and Participants With a DRF Only

Compensatory Mechanism	Shoulder Pathology	N	Mean Rank	Sum of Ranks	*p* value
Total # Used	No	29	22.38	649.00	
	Yes	16	24.13	386.00	$p = 0.67$
	Total	45			
Avoid Activity	No	29	19.95	578.50	$p = 0.03$*

	Yes	16	28.53	456.50	
	Total	45			
Use One Hand Only	No	29	22.02	638.50	$p = 0.49$
	Yes	16	24.78	396.50	
	Total	45			
Take Longer to Perform the Activity	No	29	22.81	661.50	$p = 0.89$
	Yes	16	23.34	373.50	
	Total	45			

***** Significant at $p < .05$

Correlations

Correlation statistics were performed to state mathematically whether a relationship existed between two variables. The variables of interest for this analysis were two nominal variables: surgery (yes/no), fracture side is dominant side (yes/no) and the ordinal variable of pain intensity. Correlations were also calculated between each of the outcome measures. The correlation tests that were used were nonparametric statistical tests and were chosen based on whether the variables were nominal, ordinal, or continuous. All correlation testing that was not significant can be found in Appendix N.

DRF only group. The first relationship that was examined was the relationship between having surgery and all outcome measures. A Kendall tau b correlation test was performed between the nominal variable surgery (yes/no) and all outcome measures except pain intensity. Results of the Kendal tau b correlation show that there was a positive relationship between not having surgery and the kinesiophobia avoidance score $r\ (27) = -.329$, $p < .05$ and between not having surgery and the kinesiophobia total score $r\ (27) = -.341$, $p < .05$. These results mean that participants that did not undergo surgery had higher kinesiophobia avoidance scores and higher kinesiophobia total scores. These results can also be found in Table 5. There was no correlation

between surgical status and scores on the QuickDASH, kinesiophobia harm, compensatory mechanisms used total, compensatory mechanism avoid activity, compensatory mechanism use one hand only, and compensatory mechanism take longer to perform activity. Due to pain intensity being an ordinal variable, a Spearman rank correlation was used to analyze the relationship between pain intensity and surgical status. There was no relationship between pain intensity and surgery status in the DRF only group.

The second relationship that was examined was the relationship between fracturing the dominant side and all outcome measures. The Kendall tau b correlation test was performed for the nominal variable 'fracture side is the dominant side' (yes/no) and all the outcome measures except pain intensity. Pain intensity was examined using the Spearman rank correlation test because pain intensity is ordinal data. There was no correlation between 'fracture side is the dominant side' and scores on QuickDASH, kinesiophobia avoidance score, kinesiophobia harm, kinesiophobia total, compensatory mechanisms used total, compensatory mechanism-avoid activity, compensatory mechanism use one hand only and compensatory mechanism-take longer to perform activity. The Spearman rank correlation test was used to explore whether or not there was a relationship between pain intensity and 'fracture side is dominant side.' Results of Spearman rank correlation test found there was no relationship between pain intensity and fracturing your dominant side in the DRF only group.

The third relationship that was examined was the relationship between pain intensity and all other outcome measures. A Spearman rank correlation test found that there was a positive relationship between kinesiophobia avoidance score and pain intensity $r_s(27) = .431$, $p < .05$. There was no correlation between pain intensity and the rest of the outcome measures. Finally, the last relationship that was examined was the relationship between all outcome measures

except pain intensity in the DRF only group. There was a positive relationship between the QuickDASH and the compensatory mechanism avoid activity score $r_s(27) = .830$, $p < .01$ meaning that participants who had higher QuickDASH scores also had higher compensatory mechanism avoid activity scores. There was a negative correlation between kinesiophobia harm score and compensatory mechanism used total score $r_s(27) = -482$, $p < .01$ meaning that participants who had lower kinesiophobia harm scores had higher total compensatory mechanism scores. There was no correlation between any of the other outcome measures. Results of relationships between outcome measures for the DRF only group are in Table 5

Table 5

Statistically Significant Correlations in DRF Only Group

Variables compared		Coefficient	*p* value
No surgery	TSK-11 avoidance score	*r (27) = -.329	$p < .05$
No surgery	TSK-11 total score	*r (27) = -.341	$p < .05$
VAS score	TSK-11 avoidance score	r_s (27) = .431	$p < .05$
QuickDASH score	Compensatory mechanism-avoid activity (# used for 5 ADL/IADL tasks)	r_s (27) = .830	$p < .01$
TSK-11 harm score	Compensatory mechanism (total # used for 5 ADL/IADL tasks)	r_s (27) = -.482	$p < .01$

*r = Kendall tau b; r_s = Spearman rank

Shoulder pathology group. The first relationship that was examined was the relationship between having surgery and all outcome measures. A Kendall tau b test was run to test if there was a relationship between having surgery and scores on all outcome measures except pain intensity. There was no correlation between having surgery and scores on the QuickDASH, kinesiophobia avoidance, kinesiophobia harm, and kinesiophobia total, compensatory mechanisms used total, compensatory mechanism avoid activity, compensatory mechanism use one hand only, and compensatory mechanism take longer to perform activity. Due to pain intensity being an ordinal variable, a Spearman rank correlation was used to determine if there was a relationship between pain intensity and having surgery. There was no relationship between pain intensity and having surgery in the shoulder pathology group $r_s(14) = -.344$.

The second relationship that was examined was the relationship between if 'fracture side is dominant side' and all outcome measures for the shoulder pathology group. The Kendall tau b correlation test was performed for the nominal variable 'fracture side is the dominant side' (yes/no) and all the outcome measures except pain intensity. There was no correlation between having the dominant side be the fracture side and scores on QuickDASH, kinesiophobia avoidance, kinesiophobia harm, kinesiophobia total, compensatory mechanisms used total, compensatory mechanism avoid activity, compensatory mechanism use one hand only, and compensatory mechanism take longer to perform activity. The Spearman rank correlation test was used to understand if there is a relationship between pain intensity and if 'fracture side is dominant side.' There was no relationship between pain intensity and fracturing your dominant side in the shoulder pathology group $r_s(14) = -.094$.

The third relationship that was examined was the relationship between pain intensity and all other outcome measures for the shoulder pathology group. A Spearman rank correlation test found that there was a positive relationship between QuickDASH score and pain intensity $r_s(14) = .585$, $p < .05$. A higher score on the QuickDASH means that an individual has less functions. There was also a positive relationships between kinesiophobia harm score and pain intensity $r_s(14) = .611$, $p < .05$, kinesiophobia total score and pain intensity $r_s(14) = .621$, $p < .05$, compensatory mechanism total score and pain intensity $r_s(14) = .519$, $p < .05$, and compensatory mechanism avoid activity and pain intensity $r_s(14) = .766$, $p < .01$. There was no correlation between pain intensity and the rest of the outcome measures. Finally, the last relationship that was examined was the relationship between outcome measures in the shoulder pathology group. There was a positive relationship between the QuickDASH and the compensatory mechanism avoid activity score $r_s(14) = .623$, $p < .05$ and there was a positive relationship between kinesiophobia-total score and QuickDASH score $r_s(14) = .536$, $p < .05$. Results of relationships between outcome measures for the shoulder pathology concurrent with the DRF group are in Table 6.

Table 6

Statistically Significant Spearman Rank Correlation Tests Between Outcome Measures—Shoulder Pathology Group

Variables compared		Coefficient	*p* value
VAS score	TSK-11 harm score	$r_s(14) = .611$	$p < .05$
VAS score	TSK-11 total score	$r_s(14) = .621$	$p < .05$

VAS score	QuickDASH score	$r_s(14) = .585$	$p < .05$
VAS score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	$r_s(14) = .519$	$p < .05$
VAS score	Compensatory mechanism-avoid activity (# used for 5 ADL/IADL tasks)	$r_s(14) = .766$	$p < .01$
QuickDASH Score	TSK-11 total score	$r_s(14) = .536$	$p < .05$
QuickDASH Score	Compensatory mechanism-avoid activity (# used for 5 ADL/IADL tasks)	$r_s(14) = -.623$	$p < .05$

r_s = Spearman rank

Table 7 is a synopsis of the significant tests that were found in the nonparametric testing. Specific wording used in Table 7 represents specific measurement tools used in this study. For example, activity avoidance is a specific compensatory mechanism from the Adelaide questionnaire. Avoidance behavior represents the avoidance subscale from the TSK-11. Fear of harm to the body represents the harm subscale from the TSK-11. Fear of movement represents the TSK-11 total score and function represents the QuickDASH score.

Table 7

Synopsis of Mann Whitney U and Correlation Testing

Comparison between DRF only group and DRF/shoulder pathology group	
Finding	Result
Increased pain in shoulder pathology	

group	*Mann-Whitney U* = 136.50, $p = 0.02$
Increase in activity avoidance in shoulder pathology group	*Mann-Whitney U* = 143.50, $p = 0.03$

Correlations in DRF only group

Variables compared		Finding	Result
No surgery	TSK-11 avoidance score and TSK-11 total score	Less avoidance behaviors and fear of movement when patients did not have surgery	Kendall tau b = r (27) = -.329, $p <$ .05 & r (27) = -.341, $p <$ .05.
VAS score	TSK-11 avoidance score	More avoidance behavior when pain was increased	Spearman rank correlation $r_s(27) =$ .431, $p <$ .05
QuickDASH score	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	Less function with increased activity avoidance	Spearman rank correlation $r_s(27) =$ .830, $p <$ .01*
TSK-11 harm score	Compensatory mechanism (total # used for 5 ADL/IADL tasks)	Less fear of harm to body with increased compensatory mechanisms	Spearman rank correlation $r_s(27) = -482$, $p <$ .01

Correlations in DRF/shoulder pathology group

Variables compared		Finding	Result
VAS score	QuickDASH score	Less function with increased pain	Spearman rank correlation $r_s(14) = .585$, $p <$ .05

VAS score	TSK-11 harm score	Increased fear of harm to body when pain was increased	Spearman rank correlation $r_s(14) = .611$, $p < .05$
VAS score	TSK-11 total Score	More fear of movement when pain was increased	Spearman rank correlation $r_s(14) = .621$, $p < .05$
VAS score	Compensatory mechanism (total # used for 5 ADL/IADL tasks)	Increased compensatory mechanisms when pain was increased	Spearman rank correlation $r_s(14) = .519$, $p < .05$
VAS score	Compensatory mechanism-avoid activity (# used for 5 ADL/IADL tasks)	Increased activity avoidance when pain was increased	Spearman rank correlation $r_s(14) = .766$, $p < .01$
QuickDASH score	Compensatory mechanism-avoid activity (# used for 5 ADL/IADL tasks)	Less function with increased activity avoidance	Spearman rank correlation $r_s(14) = .623$, $p < .05$*
QuickDASH score	TSK-11 total Score	Less function when fear of movement was increased	Spearman rank correlation $r_s(14) = .536$, $p < .05$

*Spearman rank correlation that was significant in both groups

Summary

The purpose of this quantitative methodology was to expand the understanding of the impact of shoulder pathology on individuals with DRF. For research question one, demographics, patient characteristics, and clinical factors describing the population who has

shoulder pathology concurrent with a DRF was presented. Comparison of descriptive statistics for the shoulder pathology concurrent with a DRF and DRF only group was presented in Tables 1 and 2. These tables give a summary of how these two groups were similar and different. For research questions two through five, results of the Mann-Whitney U test showed that there was a significant difference only in the pain intensity levels and compensatory mechanism avoid activity between participants who had shoulder pathology concurrent with a DRF and participants who had a DRF only. Participants who had shoulder pathology concurrent with a DRF had greater pain levels and more use of the compensatory mechanism of avoid activity for the five ADL/IADL tasks on the QuickDASH than did those participants who had a DRF only. Correlation testing using the Kendall tau b test found that there was a negative relationship between surgery status and kinesiophobia avoidance score and kinesiophobia total score for the DRF only group. This means that participants who had a DRF only and did not have surgery had higher kinesiophobia. Additionally, the Spearman rank correlation test found that the DRF only group had correlations between outcome measures including pain intensity and kinesiophobia avoidance score, the QuickDASH and the compensatory mechanism avoid activity score, and the QuickDASH and the kinesiophobia total score for the DRF only group. Pain intensity was correlated to five variables in the shoulder pathology concurrent with a DRF group. Those variables include kinesiophobia harm score, kinesiophobia total score, QuickDASH, compensatory mechanisms total used, and compensatory mechanism avoid activity. Additionally, the QuickDASH was correlated with the kinesiophobia total score and the compensatory mechanism avoid activity meaning that individuals who had a DRF concurrent with shoulder pathology and had worse function also had worse kinesiophobia and avoided activity more than did individuals who had a DRF only.

Qualitative Strand Data Analysis

In order to improve the rehabilitation of individuals post DRF, more information about the phenomenon of shoulder pathology in individuals with DRF was needed. The qualitative portion of this mixed methods study describes the lived experience of what it was like living with shoulder pathology concurrent with a DRF. The qualitative strand was guided by one primary research question and six sub-questions. The research question and sub-questions were as follows:

1. What is the lived experience of having shoulder pathology at the same time as a DRF? What is it like living with your injury?

    a. Has your injury affected your ability to perform the activities that you do every day? If so, how?

    b. Has your injury affected your ability to fulfill your roles with family, community, or other groups? If so, how?

    c. Has your injury affected your ability to perform your job? If so, how?

    d. Can you describe how you feel when you try moving or using your injured arm?

    e. Do you have pain? If so, can you describe your pain? How does pain affect your day? How does pain affect your ability to do what you need or want to do?

    f. Have you had to change the way you do things since your injury? If so, can you describe what has been different or how you have had to change how you do things?

Data Collection and Analysis

A single one-on-one, semistructured interview was conducted with seven participants who had been diagnosed with shoulder pathology within nine weeks of their DRF. The PI conducted qualitative-strand audiotaped interviews in a private room at one of the outpatient rehabilitation clinic locations listed in Chapter 3. The location was chosen by the participant based on the convenience of that location to the participant. Interview data were collected using the interview guide (see Appendix E). All participants were female. All participants were at least 18 years of age and had normal shoulder function prior to the DRF. No participants had a history of shoulder injury or another concurrent injury to the elbow, wrist, or hand. There were no deviations from the data collection procedure described in Chapter 3, and no unusual circumstances were encountered.

Recorded interviews were transcribed verbatim, yielding approximately 90 pages of transcriptions. To start the data analysis process, repeated reading of the interview transcripts occurred along with listening to the audiotapes of the interviews. Repeated readings of the interview transcripts allowed the researcher to understand how certain narratives bound sections of the interview together and allowed a model for the overall interview structure to develop (Smith et al., 2009). By reading the entire text the researcher was able to build a sense of the data as a whole without getting caught up in the details of coding (Creswell & Poth, 2018). The researcher then performed horizontalization of the interview data. Horizontalization of the data occurs when the researcher finds significant statements in the interview about how the participant is experiencing the phenomenon (Creswell, 2013; Moustakas, 1994). These statements were then grouped into meaning units or codes. Each code or meaning unit was a statement that illuminated the researched phenomenon (Creswell, 1998; Holloway, 1997; Hycner, 1999). All meaning units for each interview were scrutinized and any redundant units

were eliminated (Moustakas, 1994). Next, the PI went back to reflect on the interview transcripts and the meaning units. Interpretation involves making sense of the data to find the larger meaning of the data (Creswell & Poth, 2018). For this phenomenological study, the researcher interpreted the data with the goal to describe the personal experiences of the population through epoch and to describe the essence of the phenomenon (Creswell & Poth, 2018). After phenomenological reflection and interpretation of the meaning units was completed, meaning units were clustered and themes were formed (Groenewald, 2004). In this chapter, each theme will be discussed with supporting excerpts from the interview transcripts.

Theme One: It's Difficult to Perform Occupations and Changes Had to be Made

Theme one had a total of 30 codes that contributed to it. Codes described difficulties performing a variety of occupations including dressing, grooming, bathing, feeding, toileting, cooking, housekeeping, shopping, exercising, writing, using the computer, driving, performing work tasks and childcare tasks, and participating in leisure activities. Codes also described how participants adapted or compensated to perform the occupations that were difficult. The codes describing the adaptations or compensatory mechanisms included avoiding using the injured side, taking longer to perform activities, requiring help from others, learning to do activities with the nondominant side and relying on the nondominant side more, and using the injured side to assist.

All participants described difficulties performing ADLs. Participant 1 had experienced difficulties in showering, styling her hair, flossing her teeth, and putting on jewelry:

> You don't realize just how much you use your strength to [style] even your hair . . . I like to just wear it up and pin it up, but it was a little bit harder to grasp and pin it . . . Putting

> on my little earrings, that was more difficult . . . I floss regularly, but I could not floss. (Participant 1)

Participant 4 had found that toileting was more difficult because of her injury; she said:

> Okay. I'll be as graphic as you need. I am already a 63-year-old woman, after having children. When I need to use the bathroom; I need to use the bathroom. It took me a while to figure out I couldn't just whip off my trousers like I could before. I had to really think. Okay, this is going to take like a minute and a half, not 30 seconds. So that was an issue for me a couple of times. (Participant 4)

Dressing was difficult for many participants because of the tightness of the clothing or because of fasteners. Participant 2 had to avoid articles of clothing that had zippers:

> I had to find things that fit over the cast, so I could only wear certain things. Yes, zippers. I couldn't do zippers at first. I couldn't wear anything with zippers. I completely couldn't wear things with zippers. That's why everything that you'll see me wear is like knit, pullover, pull up. (Participant 2)

Participant 3 learned that she was unable to wear sports bras when she put one on one day and later found herself unable to take it off: "I almost slept with it on, 'cause I was having a heck of a time getting it off." Participant 5 found her clothing choices briefly confined to the single article that she was able to put on and take off:

> Initially, until I got the cast on, it was really hard to even get dressed, partly that it was physically awkward to get dressed, but also there was so much wrapping on my hand that I couldn't wear a lot of clothes and anything that had a sleeve to it or something I couldn't get my arm through it. So, I ended up wearing a kimono, so it was kind of frustrating. (Participant 5)

Difficulties with IADLs and work-related tasks were reported by many of the participants. Participant 2 found that she could not change the sheets on a bed: "I couldn't make a bed. Maybe I can make a bed, like fold the sheets down, but I couldn't change the sheets on a bed. I couldn't fold laundry." Participant 3 encountered difficulties in doing the laundry: "Like I was trying to do some laundry yesterday, and pulling the stuff out of the washing machine, and putting it in the dryer, and that movement, that back and forth movement was a problem." Participant 4 found herself unable to cook: "I didn't have to cook, but I had to heat things up. I tried to slice some meat at one point, couldn't do it." Participant 6 also had trouble cooking, but she was able to adapt: "I took shortcuts. I cut up a lot of produce, but they were bigger chunks . . . One-handed chopping."

Participants reported that their injury had affected their ability to do their job. Participant 2 described her difficulty with typing: "I figured out how to type with the fingers . . . That was really awkward with my left hand. It slowed me down, probably a little with that on the computer." Participant 4 indicated that the difficulty of typing while she had her injury had made her more error-prone at work: "I'm a journalist and I couldn't type. So I sent a lot of emails with a lot of typos in them." Participant 3 stated, "I can't [work]. I'm a flight attendant . . . on an airplane. I have to be able to lift a 58-pound window."

Participants reported that the injury affected their ability to participate in leisure activities. Participant 5 reported:

> I stopped going to some things, particularly, I was supposed to have my arm elevated, so if it was something a play or something like that I wouldn't go because it was really hard to go to a play that lasts two and a half hours. (Participant 5)

All participants reported using compensatory mechanisms during their recovery. Some participants reported that their injury caused them to seek assistance with IADLs that they had been able to do for themselves before they were injured. Participant 1 needed to ask strangers to help her lift heavy items in stores:

> When I would go shopping at the store and I had to get something heavy, I'd wait for somebody to come along to put my stuff in my cart. Then, when I would go to my car I'd wait for somebody to come along and say, "Oh, could you please put this in my trunk of my car?" (Participant 1)

Participant 5 also encountered challenges in taking out her household garbage and had to ask her husband for help:

> I normally want to take out the garbage and stuff like that. We're in an apartment so you have the garbage chute, so it was really hard to open the garbage chute and put the garbage in. So he had to do that kind of stuff for a while which he normally doesn't do. He also did more shopping and stuff like which I normally do. (Participant 5)

Participant 6 needed to ask strangers to open bottles for her when she was out of her house: "I could use my left hand enough to sort of stabilize a bottle of Perrier. I really couldn't get the cap off, so I constantly had to ask people, 'Can you open this for me?'

Another change that was made by participants was learning to use the nondominant hand to perform ADLs and IADLs. Participant 5 described how she had learned to perform grooming tasks with her nondominant hand while her dominant hand was injured:

> Now I'm finally getting to the point where I can use my right hand a little bit to comb my hair. But other than that I've been doing all the combing my hair with my left hand,

> putting my makeup on with my left hand, brushing my teeth with my left hand. So, I've switched over a lot to my nondominant hand. (Participant 5)

Participant 7 also explained that she had changed to performing everyday tasks with her nondominant, uninjured hand:

> [I] just have been determined to live my life pretty much the way I would by using my left hand, because it's a real concern about if it is good to do a little bit of movement or is pushing it going to add to the problem of the recovery? So, any daily routine, whether it's making a bed, scooping kitty litter, anything with meal preparation as much as I can do myself, I just did with my left hand. (Participant 7)

Participant 4 had injured her nondominant hand, but she had made a change to performing everyday two-handed tasks with only her dominant, uninjured hand or using her injured side for support:

> Definitely I'm doing a lot less with my left hand. Like, when I walk my dog, I hold the leash in my right hand. I'm trying to pick up my granddaughter, but I can only do it with my right hand. And then support it with my upper left arm. (Participant 4)

Participant 3 described some of the compensatory mechanisms she had been using since her injury to drive:

> I'm driving. I can drive with one hand. This [injured] hand is the guide, and then this [uninjured] hand does the work. When I do a U turn. There's a lot of U turns around here, but I really have to get my hand around the wheel, and then hold onto it with this hand. I can't put a lot of pressure on it, but I can just hold the wheel until I can get my hand moved again. (Participant 3)

Several participants indicated that they took longer to perform activity because of their injury. Participant 1 explained why she had been getting up earlier since her injury:

> Definitely everything took longer. Yeah, I had to get up, I'd say I got up maybe 15, 20 minutes earlier than I otherwise would have to make sure I had the time to do everything I needed to do. I also was a little bit more organized than usual just cut back on the time. (Participant 1)

Participant 2 also found that since her injury she had to get up an earlier than usual:

> In the morning, I used to always make spinach with egg whites, right? Maybe top a mushroom in there almost every day. It doesn't really take that long. With the injury, no way. I'm going to have to get up like an hour earlier if I wanted to do that. (Participant 2)

Participant 6 reported "A lot of things can be done with the left hand. Just takes longer."

Theme Two: There is Fear and Uncertainty.

There were six codes that contributed to this theme. Those codes included: emotions related to injury, cautious, fearful, not feeling safe, if it hurts I shouldn't do it, will moving it more cause more harm, I didn't know what to expect, health care professionals forget to tell you what you can and can not do, and nervous that exercise or activity will cause pain. Theme two emerged when participants discussed the emotions that they felt in relationship to their injury. Some participants reported feeling fearful and describe themselves as cautious or tentative. For example, Participant 2 said:

> [I'm] Fearful of hurting it again or twisting it a certain way, that it's going to hurt . . . The doctor says I can exercise, but I'm kind of afraid . . . I've always been kind of clumsy, quite frankly . . . so I'm a little psychologically tentative. (Participant 2)

Excerpts from Participant 4's interview illuminates the idea that individuals feel more fragile after injury when she said "The biggest impact for me was that I am not a person who shies away from activity and danger and risk-taking, and I became very cautious . . . I became like a little old lady."

Other excerpts illustrate recognition by the participant that they are fearful of falling and experiencing a reinjury. This fearfulness comes from the fact that they had a fall which caused their injuries. Participant 3 said:

> I have a fear of falling… Okay, I just have a fear of stumbling, and falling on my . . . and reinjuring or injuring something else. What's the word I want to use? I'm just a little bit afraid of reinjuring. (Participant 3)

Participant 6 also discussed her fear of falling and discussed it within the context of her own life experience where her dad had a fall after he had just gotten off a cast from a prior injury.

> No. I'm pretty good, but I am careful. For sure. So of course the thing I worry about the most, having seen my dad do this, is that I'll fall and hurt my right side. Because you're so busy protecting the one you just injured. I don't think you can do much about that, except be sort of more aware. (Participant 6)

Other participants described being protective of their injured side and were cautious about moving it. Participant 1 said "I'm feeling very protective of it. Actually, when I had the cast on if I'd move it this way I could really feel it." Participant 3 described how a fear of pain made her

actually avoid moving it that direction, she said: “I know when I move in certain ways I know I’m going to feel it so I try to avoid doing it like that.”

Some of the participants reported that part of them being cautious was that they didn’t know what they should or shouldn’t do. This illustrates that participants didn’t feel like they had enough direction from their physician or therapist. Participant 4 describes this in detail when she says:

> I think sometimes when professionals take care of people who aren’t professionals, they forget to tell them basic things like, "Here’s what you can do and here’s what you can’t do.” and, “You won’t be able to rebreak your wrist if you do the following things. But this is why I don’t want you to do them.” or, “Yes, you can jump in a pool with no fear.” or, “Yes, you can pick up your granddaughter who weights 26 pounds or whatever she weighs and it won’t impact your wrist.” (Participant 4)

Participant 2 also commented on this; she said: “You know like, ‘Be careful what you do. Take things slowly.’ That’s all they tell you. They don’t tell you you’re not going to be able to write.” Some participants described being cautious about doing their exercises because they caused pain. Participant 7 said:

> The shoulder gives me pain, but usually the exercises for it don’t. The fingers don’t give me pain, but the exercises do. So, when I have something that I think, “Oh, that didn’t hurt. That didn’t hurt. Why don’t I do it again?” I don’t know if that’s a good idea or not. I was thinking I’ll ask; I think I see him tomorrow. (Participant 7)

Participant 5 added to this by describing that not only does she not know the limits of what she can do with her injury, and that she has fear of pain when doing exercises. She said “I think it’s

more in fear of having pain . . . I'm concerned about not lifting too much . . . I'm nervous about doing some of [my exercises], that it'll cause the pain."

Theme Three: Impact of Pain.

There were seven codes that contributed to this theme. Those codes included: pain with movement or activity, feelings of pain, difficulty sleeping due to pain and adaptations needed to sleep, had to use sling for pain control, pain with weight bearing or pressure, I have been miserable (pain related), and I feel like I need to be honest when explaining my injury to others. Theme three emerged when participants described how they felt, or their experience with their injury. All participants described having pain but at different locations and different severities, and some participants reported that they had pain with movement, with weight bearing or with use of the injured upper extremity.

Participant 1 described her sharp pain as occurring when she moved her injured arm in certain ways:

> I only have pain when I move it in the wrong direction, but I didn't have any pain when I was just moving my fingers. That didn't bother me. It was just if I move too much this way or too much that way, then I'd have pain . . . when I moved it it'd be like, "Ooh!"
>
> And then I'd have to put it back. I could feel it. It's a sharp pain. (Participant 1)

Participant 3's sharp pain occurred when she moved her shoulder, hand, or wrist, and it limited her ability to perform tasks that required lifting the injured hand:

> Most of the time it's a sharp pain on the top of my hand, and when I move my thumb I can feel it down in my wrist because they had to move tendons to put the plate in. I don't have any strength in my thumb to push, or to hold something heavy. If I turn it [the shoulder] a certain way, it's a sharp pain. (Participant 3)

Participant 4's sharp pain occurred with any movement or weight bearing on her injured hand or wrist, and it limited her ability to perform her occupational therapy exercises:

> It's sharp if I put too much pressure on my wrist. My primary pain is well, using my hand in any way that puts any strain on it. And also just I'm very stiff so just going like this hurts. So I haven't been as religious about my exercises as I should be. I'm gonna try to work on that on vacation but even doing my exercises hurts. (Participant 4)

Participant 7 described a constant, dull ache in her shoulder and hand that intensified into a sharp pain, which she compared to that of being struck with an ax, when she used the hand. She stated that her pain affected her ability use the injured hand for daily activities:

> I mean frankly, it was miserable. Degrees of misery every day. No relief from the shoulder . . . I can honestly say I have what I would describe as a chronic ache at best all day, every day. And then in addition to that, certain movements, then I would get that ax feeling. The shoulder has not let up. I can't put my arm behind my back to do simple daily exercises like hook a bra, hair care. (Participant 7)

Multiple participants complained of pain during sleep and described how pain had a negative effect on the occupation of sleep. Participant 7 said:

> I would wake up at 2:00 and then I'd go back to sleep and I'd wake up and think, "Oh, good, I slept," and it would be 2:17. You know, it would just, every night, just spurts and starts, constantly. 'Cause I just, the slightest movement would be a zing that would kind of wake me up. (Participant 7)

Participant 6 also described her pain with sleeping, she said:

> My shoulder and upper chest were really sore. No matter what I did. A couple of times I actually thought I had chest pain. Logically I thought, so it was very hard to sleep and

> get comfortable. I was terrified I'd actually lie on the side I broke, right? Other than that, lying on my back or anything else was very uncomfortable. (Participant 6)

Participants reported that since their injury they had made changes to the way they slept because of pain. Participant 2 said "I took sleeping pills." Participant 7 used pillows to prop up her cast at night: "Sleeping involves a lot of pillows of different sizes and shapes." Participant 5, who normally slept on one side, had been gradually learning to sleep on the other side: "I naturally like to sleep on that side, [so] it's hard to sleep on the other side. I think it's just a habit more than anything else. I can sleep on that side eventually."

Theme Four: Tried to be Normal, but Couldn't

There were 11 themes that contributed to theme four. Those codes included: it was really hard, I tried to resume my life, can't use my injured hand, it was frustrating, it was awkward, difficulty using the nondominant hand, it's challenging, I want to be independent, inconvenience of the injury, didn't like to rely on husband, things were hard you wouldn't think would be hard. Theme four emerged when participants talked about the effect of their injury on their daily life. Additionally, theme four represented a feeling of loss participants had. This loss described both a loss of identity and a loss of function.

Multiple participants talked about their loss of function. Participant 5 talked about the frustration with just trying to use an iPhone, she said:

> One of the things I found most frustrating was to try to use my iPhone. I finally figured out how to set it up so I could dictate into the iPhone, but even then I was always working sort of backwards with my hand to see what I was doing. So, that was really frustrating. (Participant 5)

Participant interview excerpts illuminated the difficulty and frustration of performing occupation. Participant 4 said: "I tried to just be normal, but couldn't. The only thing I could do was eat cereal and go back to bed." Participant 6 also described her frustration when she said: "With one arm, shopping and stuff like that, doing it all one-handed is a drag." Participant 7 tried to perform childcare but questioned her ability to do it when she said:

> The one thing I did that was probably a mistake was trying to get my granddaughter out of her crib and trying to do it with one arm and just kind of pulling her legs across and then I just thought, "This wasn't good. I have no business doing that unless I can really pick her up well, in case she wiggles or something." (Participant 7)

Other participants described the loss of identity that they experienced. Participant 2 said:

> I couldn't really put on makeup. It was so difficult with my left hand that it just wasn't worth it, literally, unless I was going out to a function or something. Daily, I used to wear makeup. Not a lot of makeup, but a little bit. (Participant 2)

Participant 7 also talked about her frustration with makeup, she said "So things like that, as a woman. Doing mascara or anything like that with the left hand, trying not to look like a freak." Participant 3 describes missing the use of her injured side, she said: "I really feel like I've learned to learn how to do things without my left hand, but I still miss it." Participant 4 described how she used to be independent, she said: "And in my family life, it's affected my ability to do all the things I want to do myself. Like, I'm very independent, I want to do everything I normally do, so I can't do all that as well." Participant 7 also described this saying: "But you know as a woman you want to be on your own too."

Some participants described frustration due to the inability to fulfill roles. Participant 3 describes her frustration with not being unable to work as a flight attendant:

> Have you seen a flight attendant on an airplane with a cast on her? I have to be able to lift a 58-pound window. I've got to get this back. It's going to be . . . I've got to be able to do all those things before I can get back. (Participant 3)

Participant 7 became emotional when she talked about her inability to care for her grandchildren. She said: "I can't lift the baby and I used to take him a couple times a week and Friday nights."

Other participants described a frustration with relying on others to do things. Participant 5 said "Not being able to drive was hard just because I don't like being dependent on my husband, who I don't think is a good driver." Participant 7 discussed her difficulties with dressing and not wanting to rely on her husband to help her get dressed, she said: "Not that I am afraid of having my husband seeing me in the nude; I just don't want to be a nuisance."

Summary

Phenomenological analysis produced four themes that described the experience of having shoulder pathology concurrent with a DRF. Theme one: It's difficult to perform occupations and changes had to be made, described the vast difficulties that participants had performing occupations and the compensatory mechanisms that were needed to perform those difficult occupations. Theme two: There is fear and uncertainty, described the emotions that participants felt in relationship to their injury. Theme three: The impact of pain, described how participants felt, or their experiences with their injury. Finally theme four: Tried to be normal but couldn't, described the loss of function and loss of identity that participants experienced. These four themes provided a larger picture of the lived experience of this population by describing their personal experiences and describing the essence of the phenomenon of having shoulder pathology concurrent with a DRF.

Mixed Methods Data Analysis

To integrate the data using a convergent parallel mixed methods design, a merging analysis approach was used to compare results of the quantitative and qualitative strands (Creswell & Plano Clark, 2011). This approach included collecting both strands concurrently, independently analyzing each strand, specifying the dimensions by which to compare the results from the two databases, specifying the information that will be compared across the dimensions, representing the comparisons with tables, and interpreting how the combined results illuminate the mixed methods research question (Creswell & Plano Clark, 2011). The constructs of function, kinesiophobia, pain, and compensation had been identified as important factors to explore in relation to shoulder pathology concurrent with a DRF. These are also the dimensions investigated in the study. Themes one, two, and three further illustrate the quantitative results in these dimensions. Theme one: It's difficult to perform occupations and changes had to be made, described the dimensions of function and compensation. Theme two: There is fear and uncertainty, highlights the dimension of kinesiophobia. Theme three: The impact of pain, described the dimension of pain. All themes specifically represent the four dimensions of this study except for theme four. Theme four: Tried to be normal but couldn't, described the loss of function and loss of identity that participants experienced. However, when converging the result of the quantitative strand correlation testing with the qualitative strand, interview excerpts illuminating theme four were used because it further explained the research question.

The strategy that was used for comparing results is a side-by-side comparison for merged data analysis (Creswell, 2014; Creswell & Plano Clark, 2011). Tables were used to display the comparisons. The information obtained from the side-by-side comparison explained the five mixed methods research questions. Interpretation included comparing, contrasting, and

synthesizing the results of the qualitative and quantitative strands (Creswell & Plano Clark, 2011).

The mixed methods data analysis for this study was guided by these four research questions:

1. How do the qualitative interview results coincide with the results of the visual analog scale; compensatory mechanisms checklist; Quick Disabilities of the Arm, Shoulder, and Hand; and TSK-11?
2. How do the qualitative interview results elaborate on the results of the visual analog scale; compensatory mechanisms checklist; Quick Disabilities of the Arm, Shoulder, and Hand; and TSK-11?
3. To what extent do the results of the visual analog scale; compensatory mechanisms checklist; Quick Disabilities of the Arm, Shoulder, and Hand; and T-11 disagree with the qualitative interview results?
4. When comparing the results of the qualitative interview data with the quantitative instrument data, what information emerges that expands the understanding of the phenomenon of having shoulder pathology concurrent with a DRF?

Mixed Methods Research Question One

Results of the first research question indicate how qualitative interview results coincide with the results of the Mann-Whitney U test. Results of this analysis are presented in the tables below. Significant results of the Mann-Whitney U test were merged with participant narratives from each of the coinciding themes. The VAS was used to measure pain intensity and interview excerpts will be presented that illuminate the pain experienced by the participants. The

Compensatory Checklist from the Adelaide Questionnaire was used to measure the total number and type of compensatory mechanisms used for the 5 ADL/IADL tasks on the QuickDASH. Those tasks included opening a tight or new jar, heavy household chores, carrying a shopping bag or briefcase, washing back, and using a knife to cut food. Interview excerpts will be presented that illuminate how participants avoided these activities. Results for pain intensity are shown in Table 8.

Table 8

Merged Analysis of Quantitative and Qualitative Results—Pain Intensity

Quantitative Results	Qualitative Results
Increased pain in shoulder pathology group compared to DRF only groups as measured via the VAS (Mann-Whitney U = 136.50, $p = 0.02$). Refer to Table 3	Theme 3 (Impact of pain)
Using the Mann-Whitney U test, individuals with a DRF concurrent with shoulder pathology had significantly higher pain intensity than did individuals with a DRF only.	I only have pain when I move it in the wrong direction, but I didn't have any pain when I was just moving my fingers. That didn't bother me. It was just if I move too much this way or too much that way, then I'd have pain . . . when I moved it it'd be like, "Ooh!" And then I'd have to put it back. I could feel it. It's a sharp pain. (Participant 1) I feel it in the shoulder . . . It's an ache in my wrist where I injured it. It's an achy pain, like a dull ache, like I could feel it right now . . . I have it right now, because we were moving it a lot, right? If I put the brace back on, it will probably go away. It's in the same spot in my wrist all the time, which is pretty much the top, below my thumb. (Participant 2) It's more than an ache, but it's less than a

	sharp, stabbing pain. Sometimes I just feel like I want to just drop my arm. I don't have the strength in it. I just want to drop it. (Participant 3)
	My shoulder bothers me mostly at night getting to sleep, especially my right shoulder. I think part of it is because I kept it elevated even when I was in a cast so I had it in a funny position and it seems like it hasn't gotten back to normal, it's still painful at times . . . There are certain things, like when I move my thumb it really is painful. (Participant 5)
	But I can honestly say I have what I would describe as a chronic ache at best all day, every day. Made it impossible to sleep comfortably through a whole night. And then in addition to that, certain movements, then I would get that ax feeling here and back here. But it has been miserable. I mean, frankly, it was miserable. Degrees of misery every day. No relief from the shoulder. And I thought it's funny, I broke my wrist, the wrist is the least of it. The pain has almost all been in the shoulder. (Participant 7)

Interview excerpts in Table 8 coincided with the quantitative strand results by describing each participant's high pain intensity. Additionally, interview excerpts illuminate the high pain intensity that participants experienced when trying to use or move their injured upper extremity. Type of pain, severity of pain, and the overall impact of pain on daily life was described as it coincided with the result of the quantitative strand where participants who had shoulder pathology concurrent with a DRF had significantly more pain intensity than did participants with a DRF only. There was a lack of detail in some interview excerpts. Some participants did not specifically mention both shoulder and wrist pain. The interview excerpts presented were the

descriptions provided by the participants and describe their lived experience. It cannot be concluded that the individuals in the DRF only group would not describe pain similarly.

Results for the merged analysis from the Mann Whitney U test result and excerpts from theme one of the qualitative analysis for the compensatory mechanism of avoiding the first ADL task on the QuickDASH are shown in Table 9.

Table 9

Merged Analysis of Quantitative and Qualitative Results—Avoiding Opening a Tight or New Jar

Quantitative Results	Qualitative Results
Increased activity avoidance in shoulder pathology group compared to DRF only groups as measured via the Compensatory Checklist from the Adelaide Questionnaire (Mann-Whitney U = 143.50, $p = 0.03$). Refer to Table 4	Theme 1 (It's difficult to perform occupations and changes had to be made) Theme 4 (Tried to be normal, but couldn't)
Using the Mann-Whitney U test, individuals with a DRF concurrent with shoulder pathology avoided activities such as opening a tight or new jar significantly more than did individuals with a DRF only.	Oh, as simple as opening a bottle, because turning a bottle cap, I couldn't put pressure with this so I'd oftentimes have to maybe put it up underneath my arm to turn the cap. (Participant 1) You know, can't do a lot of things, like simple tasks, like brush your teeth, can't open a jar, can't cut meat. (Participant 2) One of my neighbors had a open house type thing, and I couldn't open the bottles, but I could pour them. I had one of the guys to open the bottles, and I'd just pour. (Subject 3) I think I'm more quick to go to my husband and say, "Can you open this?" "Can you fix that?" (Participant 5) Until I could use my left hand enough to sort

	of stabilize a bottle of Perrier. I really couldn't get the cap off, so I constantly had to ask people, "Can you open this for me?" (Participant 6)

Interview excerpts in Table 9 coincide with the quantitative strand results by describing each participant's inability to open a jar or bottle. Additionally, interview excerpts highlight how many participants asked others to open items for them.

Results for the merged analysis from the Mann Whitney U test result and excerpts from theme one of the qualitative analysis for the compensatory mechanism of avoiding the second ADL task on the QuickDASH are shown in Table 10.

Table 10

Merged Analysis of Quantitative and Qualitative Results—Avoiding Doing Heavy Household Chores

Quantitative Results	Qualitative Results
Increased activity avoidance in shoulder pathology group compared to DRF only groups as measured via the Compensatory Checklist from the Adelaide Questionnaire (Mann-Whitney U = 143.50, $p = 0.03$). Refer to Table 4	Theme 1 (It's difficult to perform occupations and changes had to be made.)
Using the Mann-Whitney U test, individuals with a DRF concurrent with shoulder pathology avoided activities such as heavy household chores significantly more than did individuals with a DRF only.	I couldn't make a bed. Maybe I can make a bed, like fold the sheets down, but I couldn't change the sheets on a bed. I couldn't fold laundry. (Participant 2) I just tend to do menial things. I'm not cleaning. I was trying to do some laundry yesterday, and pulling the stuff out of the washing machine, and putting it in the dryer, and that movement, that back and forth movement was a problem. (Participant 3)

	Yeah, laundry was really hard. I could wash it in the washer and put it in the dryer, but to fold it was really awkward, especially when it was painful at first. Like I normally want to take out the garbage and stuff like that. We're in an apartment so you have the garbage chute, so it was really hard to open the garbage chute and put the garbage in. So he had to do that kind of stuff for a while which he normally doesn't do. (Participant 5)

Interview excerpts in Table 10 coincide with the quantitative strand results by describing participants' inability to perform heavy household chores. Additionally, interview excerpts further explained how many movements needed to perform these tasks were difficult or awkward and that family members had to help with heavy household chores.

Results for the merged analysis from the Mann Whitney U test result and excerpts from theme one of the qualitative analysis for the compensatory mechanism of avoiding the third ADL task on the QuickDASH are shown in Table 11.

Table 11

Merged Analysis of Quantitative and Qualitative Results—Avoiding Carrying a Shopping Bag or Briefcase

Quantitative Results	Qualitative Results
Increased activity avoidance in shoulder pathology group compared to DRF only groups as measured via the Compensatory Checklist from the Adelaide Questionnaire (Mann-Whitney U = 143.50, $p = 0.03$). Refer to Table 4	Theme 1 (It's difficult to perform occupations and changes had to be made)

Using the Mann-Whitney U test, individuals with a DRF concurrent with a shoulder pathology avoided activities such as carrying a shopping bag or briefcase significantly more than did individuals with a DRF only	Then, when I would go to my car I'd wait for somebody to come along and say, "Oh, could you please put this (shopping bag) in my trunk of my car?" (Participant 1) If I went to Whole Foods, I had to be very careful that I can only buy what I could carry with one hand. I had to make a conscious effort. Like, "Oh I can't get the jar of salsa, because that's going to make the bag too heavy, since I already have milk." It could only be what I could carry with my left (nonaffected) hand. (Participant 2) But today I was at the market and I couldn't carry the bag of groceries with my left hand for sure and even my right hand; it was too heavy for just one hand. (Participant 4) With one arm. Shopping and stuff like that, doing it all one-handed is a drag. I mostly would go and buy a few items. (Participant 6)

Interview excerpts in Table 11 coincide with the quantitative strand results by describing participants' inability to carry a shopping bag. Additionally, interview excerpts illuminate the difficulty participants had carrying heavy items and how this limited what they could buy at the store.

Results for the merged analysis from the Mann Whitney U test result and excerpts from theme one of the qualitative analysis for the compensatory mechanism of avoiding the fourth ADL task on the QuickDASH are shown in Table 12.

Table 12

Merged Analysis of Quantitative and Qualitative Results—Avoiding Washing Back

Quantitative Results	Qualitative Results

Increased activity avoidance in shoulder pathology group compared to DRF only groups as measured via the Compensatory Checklist from the Adelaide Questionnaire (Mann-Whitney U = 143.50, $p = 0.03$). Refer to Table 4	Theme 1 (It's difficult to perform occupations and changes had to be made) Theme 4 (Tried to be normal, but couldn't)
	I also was taking less showers than was the norm. (Participant 5).
Using the Mann-Whitney U test, individuals with a DRF concurrent with a shoulder pathology avoided activities such as washing back significantly more than did individuals with a DRF only	Washing everything. I have been having trouble even just washing my right arm with my left hand. I've had it . . . For a couple of weeks, three weeks I've had my husband wash me 'cause I couldn't do it. Forget my back, but I've tried to get a sponge to pull back and forth but I couldn't pull with my left hand. I could only pull with the right hand. It was an issue. (Participant 3)

Interview excerpts in Table 12 coincide with the quantitative strand results by describing participants' inability to wash their back. Additionally, interview excerpts highlighted how participants avoided bathing themselves for a certain period of time because it was so difficult.

Results for the merged analysis from the Mann Whitney U test result and excerpts from theme one of the qualitative analysis for the compensatory mechanism of avoiding the fifth ADL task on the QuickDASH are shown in Table 13.

Table 13

Merged Analysis of Quantitative and Qualitative Results—Avoiding Using a Knife to Cut Food

Quantitative Results	Qualitative Results
Increased activity avoidance in shoulder pathology group compared to DRF only groups as measured via the Compensatory Checklist from the	Theme 1 (It's difficult to perform occupations and changes had to be made)

Adelaide Questionnaire (Mann-Whitney U = 143.50, p = 0.03). Refer to Table 4	
Using the Mann-Whitney U test, individuals with a DRF concurrent with a shoulder pathology avoided activities such as using a knife to cut food significantly more than did individuals with a DRF only	A couple of times I asked someone else to cut my food. (Participant 1) I was literally on a business trip eating with my hands . . . Because we were at a Brazilian steakhouse and there was nothing but steak, and I couldn't cut it . . . I got so that I would only order food I didn't have to cut, because I couldn't cut anything. (Participant 2) I didn't have to cook, but I had to heat things up. I tried to slice some meat at one point, couldn't do it. The only thing I could do is eat cereal and go back to bed. (Participant 4) I can't really cut. (Participant 7)

Interview excerpts in Table 13 coincide with the quantitative strand results by describing participants' inability to use a knife to cut food. Additionally, interview excerpts illuminate how participants avoided eating foods that required cutting or had to ask other people to cut their food.

Qualitative strand interview excerpts shown in Table 14 illuminate the relationship between pain intensity and kinesiophobia. Participants describe their fear that performing activity will cause pain or make pain worse.

Table 14

Merged Analysis of Quantitative and Qualitative Results—Greater Kinesiophobia in Individuals With High Pain Intensity

Quantitative Results	Qualitative Results

More fear of movement when pain was increased as measured by correlating the TSK-11 to the VAS (Spearman rank correlation $r_s(14) = .621$, $p < .05$). Refer to Table 6	Theme 2 (There is fear and uncertainty) Theme 3 (Impact of Pain)
Using the Spearman Rank Correlation Test individuals with a DRF concurrent with shoulder pathology who had high pain intensity have greater kinesiophobia.	Definitely the wrist is sore. I have to be careful what I do. (Participant 2) I think it's more in fear of having pain . . . I'm concerned about not lifting too much . . . I'm nervous about doing some of [my exercises], that it'll cause the pain. (Participant 5) The shoulder gives me pain, but usually the exercises for it don't. The fingers don't give me pain, but the exercises do. So, when I have something that I think, "Oh, that didn't hurt. That didn't hurt. Why don't I do it again?" I don't know if that's a good idea or not. (Participant 7)

Results in Table 15 indicate how kinesiophobia effects the ability to perform occupation. Interview excerpts highlight how the participants' fear of movement is reflected in their inability or hesitation to perform functional activities.

Table 15

Merged Analysis of Quantitative and Qualitative Results—Participants With Greater Kinesiophobia Have Less Function

Quantitative Results	Qualitative Results
Less function when fear of movement was increased as measured by correlating the TSK-11 to the QuickDASH (Spearman rank correlation $r_s(14) = .536$, $p < .05$) Refer to Table 6	Theme 1 (It's difficult to perform occupations and changes had to be made) Theme 2 (There is fear and uncertainty) Theme 4 (Tried to be normal but couldn't)

Using the Spearman Rank Correlation Test individuals with a DRF concurrent with shoulder pathology who had worse function had greater kinesiophobia.	[The injury] hasn't really completely stopped me from doing anything except exercise. I like to do yoga, so I can't do my yoga. I'm a little nervous about even getting started on that. (Participant 1) I couldn't exercise, which bothered me . . . My knees hurt. It's like if you're not regularly working out your joints and stuff . . . The doctor says I can exercise, but I'm kind of afraid. (Participant 2) So, I think maybe I'm just not ready for that. Or should I keep trying that? I think that's a question I go through daily. (Participant 7)

Mixed Methods Research Question Two

Results of the second research question indicate how qualitative interview results elaborate on the Spearman rank correlation test results. In Table 16, qualitative interview excerpts from theme three highlight how pain intensity had a negative effect on occupational performance. Participants describe how pain made it difficult to drive, open containers, and sleep. Participants also describe how they wanted to perform occupations but couldn't because of the pain.

Table 16

Merged Analysis of Quantitative and Qualitative Results—The Negative Effect of Pain Intensity on Function

Quantitative Results	Qualitative Results
Less function with increased pain as measured by correlating the VAS to the QuickDASH (Spearman rank correlation $r_s(14) = .585$, $p < .05$) Refer to Table 6	Theme 1 (It's difficult to perform occupations and changes had to be made) Theme 3 (Impact of pain) Theme 4 (Tried to be normal but couldn't)
	But anyways, turning the wheel too much could aggravate it because you have to hold on to it. (Participant 1) Towards the end as it was healing it got a bit better right? I could start to do things like even with the cast on, like maybe take the shampoo cap off or something right? I couldn't do that the majority of the time because it hurt. (Participant 2) When I try to move my arm I can feel my shoulder, it's an issue because if I want to pull something. (Participant 3) Still having trouble with my hip, and a little bit of trouble with my shoulder. But I wasn't able to do much anyway. So it wasn't like I was able to run around and do things. I was in a sling and in a lot of pain. (Participant 4)
Using the Spearman rank correlation test, individuals with a DRF concurrent with shoulder pathology who had higher pain intensity also had less function.	So I think it's mostly getting to sleep. Sometimes it wakes me, I'm waking up a little bit more but I don't know if that's due to the shoulder or not. (Participant 5) It was very hard to sleep and get comfortable. (Participant 6) But until recently, I couldn't even hold the toothbrush to twist the top off because any little movement I would feel it right up to the shoulder. (Participant 7)

In Table 17, qualitative interview excerpts from theme three further explain how participants had to use compensatory mechanisms because of pain in their injured upper extremity. Participants described that they could only used their noninjured upper extremity for daily activities because of high pain intensity using their injured upper extremity or avoided performing the activity.

Table 17

Merged Analysis of Quantitative and Qualitative Results—The Use of Compensatory Mechanisms Due to Pain

Quantitative Results	Qualitative Results
Increased compensatory mechanisms when pain was increased as measured by correlating the VAS to the Compensatory Mechanism Checklist from the Adelaide Questionnaire (Spearman rank correlation $r_s(14) = .519$, $p < .05$). Refer to Table 6	Theme 1 (It's difficult to perform occupations and changes had to be made) Theme 3 (Impact of pain)
Using the Spearman rank correlation test, individuals with a DRF concurrent with shoulder pathology who had higher pain intensity also had more use of compensatory mechanisms.	I could feel whenever I put a lot of pressure on this. It's a lot more pressure than I realized, for example, when you're trying to hold the meat down and cut. So sometimes I was like . . . . A couple of times I asked someone else to cut my food. (Participant 1) I can't really stop my life because of pain. And I have a high pain tolerance so I just change the way I do things. (Participant 4) At first it was really painful and it seemed really awkward to do anything with my left hand. (Participant 5) The shoulder has not let up. I can't put my arm behind my back to do simple like do simple exercise like hook a bra, hair care. I

	have become very skilled with my left hand. (Participant 7)

Mixed Methods Research Question Three

Results of the third research question indicate how qualitative interview results disagree or do not correlate with the results of the Mann-Whitney U test for the QuickDASH, TSK-11, and the Compensatory Mechanism Checklist from the Adelaide Questionnaire. The independent samples Mann-Whitney U test found there was no significant difference in TSK scores between individuals who had shoulder pathology concurrent with a DRF and participants who had a DRF only. This quantitative analysis result disagrees with results of theme two of the qualitative analysis. However, participants with shoulder pathology concurrent with a DRF were the only participants interviewed for this study. It cannot be concluded that participants with a DRF only would not have similar or more reported kinesiophobia than would participants with shoulder pathology concurrent with a DRF. This mixed methods analysis shows that although participants who had shoulder pathology concurrent with a DRF did not have significantly greater kinesiophobia than did participants with a DRF only, they did frequently report kinesiophobia. All of the participants in the qualitative strand reported kinesiophobia in relationship to their injury as seen in Table 18.

Table 18

Merged Analysis of Quantitative and Qualitative Results—Differences Between Strands With Kinesiophobia

Quantitative Results	Qualitative Results
No differences in shoulder pathology group compared to DRF only groups	Theme 2 (There is fear and uncertainty)

as measured via the TSK-11 (Mann-Whitney U = 177.50, p = 0.20).	
Using the Mann-Whitney U test, individuals with a DRF concurrent with a shoulder pathology did not have significantly greater kinesiophobia than did individuals with a DRF only.	I'm feeling very protective of it. Actually, when I had the cast on if I'd move it this way I could really feel it. (Participant 1) [I'm] Fearful of hurting it again or twisting it a certain way, that it's going to hurt . . . The doctor says I can exercise, but I'm kind of afraid . . . I've always been kind of clumsy, quite frankly . . . so I'm a little psychologically tentative. (Participant 2) I have a fear of falling . . . Okay, I just have a fear of stumbling, and falling on my . . . and reinjuring or injuring something else. What's the word I want to use? I'm just a little bit afraid of reinjuring. (Participant 3) The biggest impact for me was that I am not a person who shies away from activity and danger and risk-taking, and I became very cautious . . . I became like a little old lady. (Participant 4) I think it's more in fear of having pain . . . I'm concerned about not lifting too much . . . I'm nervous about doing some of [my exercises], that it'll cause the pain. (Participant 5) No. I'm pretty good, but I am careful. For sure. So of course the thing I worry about the most, having seen my dad do this, is that I'll fall and hurt my right side. Because you're so busy protecting the one you just injured. (Participant 6) The shoulder gives me pain, but usually the exercises for it don't. The fingers don't give me pain, but the exercises do. So, when I have something that I think, "Oh, that didn't hurt. That didn't hurt. Why don't I do it again?" I don't know if that's a good idea or

not. (Participant 7)

Results of the Mann-Whitney U test found that there was no significant difference in total number of compensatory mechanisms used, compensatory mechanism of using one hand only, or compensatory mechanism of taking longer to perform activity between individuals who had shoulder pathology concurrent with a DRF and participants who had a DRF only. In the qualitative strand interviews, multiple compensatory mechanisms were described including using two hands, using the nonaffected contralateral hand, altering the type of grip used, avoiding the activity, getting assistance from another person, and taking a longer time to complete the task. However, participants with shoulder pathology concurrent with a DRF were the only participants interviewed for this study. It cannot be concluded that participants with a DRF only would not have similar or more reported compensatory mechanisms than would participants with shoulder pathology concurrent with a DRF. This mixed methods analysis shows that although participants who had shoulder pathology concurrent with a DRF did not have significantly more use of compensatory mechanisms than did participants with a DRF only, they did frequently report using compensatory mechanisms. Interview excerpts in Table 19 illuminate the use of compensatory mechanisms in individuals who had shoulder pathology concurrent with a DRF.

Table 19

Merged Analysis of Quantitative and Qualitative Results—Differences Between Strands With Use of Compensatory Mechanisms

Quantitative Results	Qualitative Results
No differences in shoulder pathology group compared to DRF only groups	Theme 1 (It's difficult to perform occupations and changes had to be made)

as measured via Compensatory Checklist from the Adelaide Questionnaire (Mann-Whitney U = 214.00, $p = 0.67$).	
	Oh, as simple as opening a bottle, because turning a bottle cap, I couldn't put pressure with this so I'd oftentimes have to maybe put it up underneath my arm to turn the cap. (Participant 1) You can't put a bra on. Right? That was the first one big realization. You have to it on and slide it up like a skirt. You know what I mean? (Participant 2) I can drive with one hand. This hand is the guide, and then this hand does the work. (Participant 3)
Using the Mann-Whitney U test, individuals with a DRF concurrent with shoulder pathology did not have significantly more use of compensatory mechanisms than did individuals with a DRF only.	Oh, definitely I'm doing a lot less with my left hand. Like, when I walk my dog, I hold the leash in my right hand. I'm trying to pick up my granddaughter, but I can only do it with my right hand. And then support it with my upper left arm. (Participant 4) Now I'm finally getting to the point where I can use my right hand a little bit to comb my hair. But other than that I've been doing all the combing my hair with my left hand, putting my makeup on with my left hand, brushing my teeth with my left hand. (Participant 5) I mostly would go and buy a few items. I remember doing one half shop at one point, for the two of us. But that was a drag. It took about twice as long. (Participant 6) So, any daily routine, whether it's making a bed, scooping kitty litter, anything with meal preparation as much as I can do myself, I just did with my left hand. (Participant 7)

Results of the Mann-Whitney U test found there was no significant difference in QuickDASH scores between individuals who have shoulder pathology concurrent with a DRF and participants who had a DRF only. Qualitative strand interview excerpts in Table 20 highlight the variety of difficulties participants had performing occupations. However, participants with shoulder pathology concurrent with a DRF were the only participants interviewed for this study. It cannot be concluded that participants with a DRF only would not have similar or more reported occupational performance problems than would participants with shoulder pathology concurrent with a DRF. This mixed methods analysis shows that although participants who had shoulder pathology concurrent with a DRF did not have significantly worse function than did participants with a DRF only, they did frequently report occupational performance problems.

Table 20

Merged Analysis of Quantitative and Qualitative Results—Differences Between Strands With Function

Quantitative Results	Qualitative Results
No differences in shoulder pathology group compared to DRF only groups as measured via QuickDASH (Mann-Whitney U = 162.50, $p = 0.10$).	Theme 1 (It's difficult to perform occupations and changes had to be made)
	I don't cook as much. I probably called my housekeeper more often. (Participant 1)
	I couldn't take earrings out. I just did that for the first time last night. I had just left these in all the time. (Participant 2)
	Washing everything. I have been having trouble even just washing my right arm with my left hand. (Participant 3)

Using the Mann-Whitney U test, individuals with a DRF concurrent with a shoulder pathology did not have significantly less function than did individuals with a DRF only	Because even after I got the cast on, I still couldn't type, I still couldn't really cut. (Participant 4) Yeah, laundry was really hard. I could wash it in the washer and put it in the dryer, but to fold it was really awkward, especially when it was painful at first. (Participant 5) Yeah. But I didn't start washing my hair again, probably five weeks in. (Participant 6) I can't write. She gave me a big round thing to stick a pen in, but it's about the angles of the wrist and the elbow and the shoulder. (Participant 7)

Mixed Methods Research Question Four

Results of the fourth research question expand on the understanding of the phenomenon of having shoulder pathology concurrent with a DRF by comparing the results of the qualitative interview data with the quantitative instrument data. To answer this question, Table 21 was constructed to merge the quantitative strand findings with interview excerpts that specifically illuminate those findings.

Table 21

Merged Analysis of Quantitative and Qualitative Results

Quantitative Results	Qualitative Results
Increased pain in shoulder pathology group (Measurement tool-VAS)	Degrees of misery every day. No relief from the shoulder and I thought it's funny, I broke my wrist, the wrist is the least of it. (Participant 7, Theme 3)

Increase in activity avoidance in shoulder pathology group (Measurement tool—Compensatory Checklist from the Adelaide Questionnaire)	Then, when I would go to my car I'd wait for somebody to come along and say, "Oh, could you please put this (shopping bag) in my trunk of my car." (Participant 1, Theme 1)
Participants with shoulder pathology that had higher pain intensity had less function (Measurement tools—VAS and QuickDASH)	But until recently, I couldn't even hold the toothbrush to twist the top off because any little movement I would feel it right up to the shoulder. (Participant 7, Theme 1, Theme 3, and Theme 4)
Participants with shoulder pathology that had higher pain intensity had more use of compensatory mechanisms (Measurement tools—VAS and Compensatory Mechanism from the Adelaide Questionnaire)	I can't really stop my life because of pain. And I have a high pain tolerance so I just change the way I do things. (Participant 4, Theme 1 and Theme 3)
Participants with shoulder pathology that had higher pain intensity had greater kinesiophobia (Measurement tools—VAS and TSK-11)	I think it's more in fear of having pain . . . I'm concerned about not lifting too much . . . I'm nervous about doing some of [my exercises], that it'll cause the pain. (Participant 5, Theme 1 and Theme 2)
Participants with shoulder pathology that had greater kinesiophobia had less function (Measurement tools—TSK-11 and QuickDASH)	I couldn't exercise, which bothered me . . . My knees hurt. It's like if you're not regularly working out your joints and stuff . . . The doctor says I can exercise, but I'm kind of afraid. (Participant 2, Theme 1, Theme 2, and Theme 4)
Participants with shoulder pathology that avoided activity more had less function (Measurement Tools—Compensatory Mechanism Checklist from the Adelaide Questionnaire and QuickDASH)	One of my neighbors had a open house type thing, and I couldn't open the bottles, but I could pour them. I had one of the guys to open the bottles, and I'd just pour. (Subject 3, Theme 1)

Quantitative results indicate that participants who had shoulder pathology concurrent with a DRF had greater pain intensity levels than did those who had a DRF only. Theme 3

coincides with this finding by describing how the severity of pain and how pain impacts the ability to move the injured upper extremity and perform occupations. Quantitative results also indicate that participants who had higher pain had worse function and more use of compensatory mechanisms. Theme 1 coincides with this finding by describing the various occupations that participants cannot participate in and how they compensated. Theme 2 coincided with this finding by describing the impact of pain and theme 4 coincided with this finding by describing how participants wanted to be back to normal but couldn't. Participants with shoulder pathology who had high pain also had greater kinesiophobia which coincided with theme 2 where participants described the fear of having pain while moving their injured upper extremity. In summary, high pain impacted the participants' ability to perform occupations; it made them fearful and uncertain about what they could do, and it made them use compensatory mechanisms more including avoiding activity more.

Quantitative results showed that participants who had shoulder pathology concurrent with a DRF had more use of the compensatory mechanism of avoiding activity for the 5 ADL/IADL tasks on the QuickDASH than did participants with a DRF only. This coincides with theme 1 where participants describe difficulty performing occupations and changes that had to be made in order to perform occupations. Quantitative results also show that participants who had worse function had greater kinesiophobia and more use of the compensatory mechanism avoiding activity. This coincides with theme 1 where participants describe difficulty performing occupation and changes had to made in order to perform occupations, theme 2 where participants describe their fear and uncertainty in relationship to their injury, and theme 4 where participants describe wanting to back to normal but can't be. In summary, participants who had shoulder pathology concurrent with a DRF had more difficulty performing occupation, had more fear and

uncertainty in moving and using their injured upper extremity, and used the compensatory mechanism avoid activity more.

Summary

Using a convergent parallel mixed methods design, each strand was analyzed separately and information was compared across dimensions of the study including the additional dimension in theme four from the qualitative analysis. The information from the quantitative strand and qualitative strand were merged using tables. Tables indicated how the qualitative results coincided and elaborated on the quantitative results, how the quantitative and qualitative results agreed and disagreed, and how new results emerged when comparing the quantitative and qualitative results.

In summary, participants who had shoulder pathology concurrent with a DRF had high levels of pain that affected their ability to move and use their injured upper extremity. High pain intensity had a negative impact on occupational performance and required the use of more compensatory mechanisms including avoiding activity more. Participants with shoulder pathology described that they were fearful and cautious when performing activity or moving the injured upper extremity. Additionally, they were fearful that moving the injured upper extremity would cause pain.

Participants who had shoulder pathology concurrent with a DRF had difficulties performing a wide variety of occupations including dressing, toileting, and household tasks. Participants described using a variety of compensatory mechanisms to perform occupations. Participants described a desire to function normally again but were hesitant to perform occupations especially if they felt that doing so would cause pain or reinjury. Therefore, participants who avoided activity had worse overall function.

Chapter 5: Discussion

The following chapter provides a summary and interpretation of the findings of this study and describes how the findings fit into the context of the current literature. This chapter also includes the implications of this study in the area of orthopedics and upper extremity rehabilitation as well as the limitations of the study and opportunities for future research. Because this is a mixed methods study, the discussion section provides an interpretation of the findings for each strand and for the mixed analysis. Interpreting results from each strand and the mixed analysis provides a more comprehensive picture of the population who had shoulder pathology concurrent with a DRF.

Quantitative Strand Discussion

Incidence of Shoulder Pathology

Of the 45 participants in this study, 16 (35.6%) presented with shoulder pathology. Of the participants who presented with shoulder pathology, 6 (37.5%) were due to the fall, and 10 (62.5%) were due to compensation or disuse. Only one study has reported shoulder pathology in individuals post DRF. Atkins et al. (1990) found that 12 (20%) of the 60 individuals in their study had shoulder pathology two to six weeks after cast removal. Of those individuals who had shoulder pathology, 5 (41.7%) were due to the fall and 7 (58.3%) developed the shoulder pathology sometime after the DRF (Atkins et al., 1990). When comparing the Atkins et al. (1990) study with this study, there are similarities and differences. Differences included that the Atkins et al. study diagnosed shoulder pathology by using goniometry but this study diagnosed shoulder pathology by clinical exam by the hand surgeon. This study had more participants with shoulder pathology, but a smaller sample size. Participants in this study were assessed at least four times for shoulder pathology while the Atkins et al. study assessed their participants only

one time. This may provide some explanation for the higher percentage of participants with shoulder pathology in this study. Similarities were that both studies included individuals who sustained shoulder pathology at the time of the fall as well as individuals who developed shoulder pathology later. Additionally, both studies had similar percentages of individuals who had shoulder pathology from the fall and who had developed shoulder pathology after the DRF. Finally, both studies had a higher number of individuals develop shoulder pathology after the DRF in comparison to those who sustained shoulder pathology from the fall, but this was not a statistically significant difference. The clinical implications of these two studies support the need for clinicians and physicians to continually assess the shoulder after the initial DRF to ensure that patients are monitored for subsequent shoulder pathology.

Average Days to Develop Shoulder Pathology

For the group that developed shoulder pathology after the DRF, shoulder symptoms started an average of 42.6 days after the injury, ranging from 3 to 67 days. It is important to clarify that two subjects reported that they did not have pain in the shoulder at the time of the fall, but reported that they had pain at their follow-up visit with the hand surgeon which was 3 and 4 days post injury. With a mean of 42.6 days and a median of 54 days, it is likely that the participants reporting development of shoulder pathology 3 and 4 days post injury were most likely outliers and the pathology may have occurred as a result of the fall. This is the first study to report when shoulder pathology symptoms started in each participant that developed shoulder pathology after a DRF. The study by Atkins et al. (1990) found that individuals in their study presented with shoulder pathology two to six weeks after cast removal. However, their study collected data only one time at 2-6 weeks post cast removal for all variables that were studied. Atkins et al. (1990) did not report how long their subjects were in a cast nor did they record

when subjects first complained of shoulder symptoms. Further, Atkins et al. (1990) reported that five subjects injured their shoulder at the time of the fall and did not give causation as to why the other seven subjects developed shoulder pathology or provide a shoulder diagnosis. The two hand surgeons who participated in the current study hypothesized that shoulder pathology would be most reported at 28 to 56 days post DRF. The average time that shoulder pathology symptoms began in the group that developed shoulder pathology after a DRF was 42.6 days. This result has important clinical relevance. This timeline gives clinicians guidance as to when shoulder symptoms may occur and length of time patients should be monitored. In terms of frequency of shoulder evaluation, the two hand surgeons examined the shoulder at every follow-up visit, which varied between weekly visits at the start of care to one visit every four weeks toward the end of care.

Types of Shoulder Pathology

In this study, two hand surgeons assessed shoulder function for a nine-week period following DRF. Shoulder pathology diagnoses included rotator cuff impingement/subacromial impingement, shoulder stiffness, and shoulder pain with some participants having more than one diagnosis. Some participants who presented with rotator cuff tendonitis/subacromial impingement were injured at the time of the fall although others developed shoulder pathology later due to compensation and disuse. Prior research supports these findings. Mall et al. (2013) found that a fall on an outstretched hand is the most common mechanism of injury for a rotator cuff injury or tear. Additionally, Bulthaup et al. (1999) and Yoo et al. (2010) found that compensation at the shoulder joint when the wrist is immobilized can lead to cumulative strain of the muscles of the shoulder including increased upper trapezius activity. Research indicates that increased upper trapezius activity can lead to subacromial impingement syndrome (Chester et al.,

2010; Cools et al., 2007; Lopes et al., 2015; Ludewig & Cook, 2000). This has clinical significance in rehabilitation. It is important that Occupational Therapists and Physical Therapists observe their patients performing activities after a DRF in order to assess whether or not the upper trapezius is being overused to compensate for wrist immobility. Early shoulder exercise and patient education may assist in avoiding subacromial impingement syndrome from developing. Further research on early patient education and shoulder exercise is warranted.

Shoulder stiffness and/or shoulder pain were both diagnoses given by the treating hand surgeon in this study. Some participants developed shoulder pain and/or stiffness due to compensation or disuse and some had shoulder pain and/or stiffness due to the fall. In the participants who developed shoulder pain and/or stiffness after the fall, literature supports that being immobilized in a cast or wrist orthosis has the potential to cause biomechanical changes to the shoulder joint (Adams et al., 2003; Chan & Chapparo, 1999; King et al., 2003; May-Lisowski & King, 2008; Mell et al., 2005) and/or changes in muscle activity at the shoulder (Ayhan et al., 2015; Ayhan et al., 2014; Murgia et al., 2010). These cumulative changes may cause injury to the shoulder complex (Bulthaup et al., 1999). In addition to biomechanical changes, patients post DRF frequently position the injured upper extremity in shoulder internal rotation and adduction with the elbow in flexion for protection (Michlovitz & Festa, 2011) or immobilize the shoulder in a sling (Laseter & Carter, 1996; Michlovitz & Festa, 2011). Shoulder immobilization can induce adhesion of the shoulder joint capsule (Liu et al., 2011) and limit functional use. It is important to talk to patients at each visit to discuss if they are experiencing any pain or stiffness at the shoulder joint. Early evaluation and treatment of the shoulder can assist in decreasing the severity and duration of shoulder symptoms. It could also be effective to teach patients post DRF early exercise and functional use of the injured upper extremity and educate them on good

biomechanics when using the injured side. This area requires further research to prove the effectiveness of early patient education and exercise.

Sling Use

Slings are frequently issued by physicians and hospitals to protect the arm after a DRF (Laseter & Carter, 1996; Michlovitz & Festa, 2011). In this study, 81.3% of participants in the shoulder pathology concurrent with a DRF group used a sling, and 50% of the participants in the DRF only group used a sling. Misuse of a standard sling can result in improper positioning of the forearm in a dependent position and can lead to hand edema, shoulder capsular tightness, elbow stiffness (Laseter & Carter, 1996; Weinstock, 1999), and decreased functional use of the upper extremity (Laseter & Carter, 1996). In this study, the average length of time participants in the shoulder pathology concurrent with a DRF used a sling was 10.3 days, and the average length of time participants in the DRF only group used a sling was 7.5 days. Immobilization in a sling encourages nonuse of the shoulder joint, which can lead to shoulder pathology (Pomeroy et al., 2011; Raghavan, 2015). No studies have examined if sling use can cause or contribute to developing shoulder pathology after a DRF. This study found that a higher percentage of the participants in the shoulder pathology concurrent with a DRF group used a sling and that they used the sling for a longer period of time than did the DRF only group. However, these differences were not found in this study to be statistically different. Differences in percentages may be have been because five of the six participants who injured their shoulder at the time of the fall used a sling. The average days in a sling for the group who sustained shoulder pathology at the time of the fall was 11 days and the average days in a sling for the group who developed shoulder pathology later was 6.8 days, showing that the participants who injured their shoulder at the time of the fall required the use of a sling for a longer period of time. These results suggest

that a sling may need to be used for a longer period of time if the individual injured the shoulder at the time of the fall. There were also outliers. For example, one participant used a sling for 21 days after the DRF and developed shoulder pathology at 50 days post DRF. This increased length of time that the individual used a sling may have contributed to that individual developing shoulder stiffness.

Functional Outcomes

There were no differences between functional outcome scores on the QuickDASH between the population who had shoulder pathology concurrent with a DRF and the population who had a DRF only. This finding could be explained by effect size. The shoulder pathology group had 16 participants and the DRF only group had 29 participants. Power analysis required 21 participants in the shoulder pathology group, and this was not achieved. A study with a larger sample size would have given a more precise estimate of effect, and that study may have shown a difference between groups for the variable of functional outcome. Another potential reason why there was no difference between groups was that there was a higher percentage of participants who fractured their nondominant side in the shoulder pathology group.

This was an unexpected finding for multiple reasons. First, participants who had shoulder pathology concurrent with a DRF had significantly more pain intensity than did participants with a DRF only. Second, there was a positive relationship between pain intensity and QuickDASH scores in the shoulder pathology group $r_s(14) = .585$, $p < .05$ meaning that participants who had higher pain intensity scores had higher QuickDASH scores, indicative of decreased function. High pain scores have been found to be a predictor of disability or decreased occupational performance in multiple studies (Cowie et al., 2015; Mehta et al., 2015a; Nielsen & Dekkers, 2013; Souer et al., 2008; Swart et al., 2012). The final reason that no difference

between groups for functional outcome was unexpected was because participants in the shoulder pathology group reported avoiding the 5 ADL/IADL tasks on the QuickDASH significantly more than did the DRF only group. It can be assumed that if an individual avoids participating in activity he or she will most likely have less function. However, the 5 ADL/IADL tasks on the QuickDASH make up only a small number of the occupations that individuals perform on a daily basis; therefore, this result does not give a full picture of a individual's function. There is no research on functional outcomes in the population who had shoulder pathology concurrent with a DRF; however, the qualitative strand discussion in the next section illuminates difficulties this population has performing occupations. A follow-up study with a larger sample size and a different functional outcome measure addressing a greater number of occupations would be beneficial to see if there are differences in functional outcome between the two groups.

Kinesiophobia

There was no significant difference between kinesiophobia avoidance, kinesiophobia harm, or kinesiophobia total scores on the TSK-11 between the population who had shoulder pathology concurrent with a DRF and the population who had a DRF only. This was an unexpected result because pain intensity was significantly higher in the shoulder pathology group than in the DRF only group. In addition, the Spearman rank correlation test found a positive relationship between pain intensity and the kinesiophobia harm score $r_s(14) = .611$, $p < .05$ and the kinesiophobia total score $r_s(14) = .621$, $p < .05$ in the shoulder pathology group. Although these statistical results support the fact that participants who had higher pain intensity also had greater kinesiophobia, this difference was not found between the DRF only and the DRF shoulder pathology group in this study. However, literature supports that individuals post DRF who have higher pain intensity also have worse fear of movement (Söderlund & Åsenlöf, 2010).

One explanation for this unexpected result is the fact that there were a few outliers who had very high pain levels, and those participants also had very high kinesiophobia scores. Again, a follow-up study with a larger sample size would be beneficial to see if results would be different.

One surprising correlation result was that individuals with a DRF only who had less kinesiophobia used more compensatory mechanisms. One could assume that if an individual had less kinesiophobia, he or she would not need to use compensatory mechanisms. However, participants who had less fear of movement may have used more compensatory mechanisms that used their injured hand such as using two hands or changing the way they lifted or gripped. Another surprising correlation result was that participants with a DRF only had a correlation between not having surgery and having higher kinesiophobia scores. This means that participants who were treated in a cast had higher kinesiophobia scores. One clear explanation for this could be that participants who had surgery were cleared by their physician to move their hand and wrist earlier than were participants who did not have surgery. Therefore, when kinesiophobia scores were collected at 5-7 weeks post DRF, participants who had surgery may have already started to use their injured hand and wrist more while participants who were in a cast were just getting out of their cast and were still experiencing fear of movement.

Pain Intensity

In this study, participants who had shoulder pathology concurrent with a DRF had higher reported pain intensity than did individuals who had a DRF only. This has clinical significance for multiple reasons. First, this is the first study to examine pain intensity when there is injury to both the shoulder and wrist. Second, no prior studies have studied outcomes for individuals who have injury to and potentially pain in both the shoulder and wrist. Finally, the relationship between pain and the development of shoulder pathology after a DRF has never been examined.

Because patients who report higher levels of pain have higher reported disability (Moore & Leonardi-Bee, 2008; Nielsen & Dekkers, 2013; Swart et al., 2012), pain could potentially result in less use of the shoulder complex. In this study, there was a positive relationship between QuickDASH score and pain intensity $r_s(14) = .585$, $p < .05$ meaning that participants in the shoulder pathology group who had worse pain also had worse functional outcomes. Prior studies have differing results when examining the relationship between pain and disability after a DRF. MacDermid et al. (2003) found that pain was reported at one year post DRF in 67% of their sample but 46% reported disability, suggesting that most individuals resume functional activities despite pain. In contrast, Moore and Leonardi-Bee (2008) found that although 63% of their sample had some degree of pain, 95% of their sample had some degree of disability suggesting that disability is a greater problem than pain. These studies suggest that pain can impact function but individuals may also have disability that is not due to pain. Results of this study had a separate finding in that participants who had shoulder pathology and higher pain also had worse function whereas participants with a DRF only did not have any correlations between pain and function. Therefore, pain may be the variable that impacts function in individuals with shoulder pathology concurrent with a DRF.

For the shoulder pathology group, pain intensity had positive relationships with four variables in addition to the QuickDASH. This is in contrast to the DRF only group where participants had a positive relationship only between pain intensity and the TSK-11 avoidance score $r_s(27) = .431$, $p < .05$. This is an interesting finding because it shows that high pain impacted multiple outcome measures for participants in the shoulder pathology group. For example, there was a positive relationship between kinesiophobia harm score and pain intensity $r_s(14) = .611$, $p < .05$, and kinesiophobia total score and pain intensity $r_s(14) = .621$, $p < .05$,

meaning that individuals in the shoulder pathology group who had higher pain intensity also had more fear of movement. Literature supports that higher pain-related fear is predictive of higher pain intensity (Parr et al., 2012) in patients with acute upper extremity injury. For example in one study, fear of movement was a strong predictor of pain intensity, and fear of movement explained the relationship between pain intensity and pain-related disability (Söderlund & Åsenlöf, 2010). The shoulder pathology group also had a positive relationship between pain intensity and compensatory mechanism total score $r_s(14) = .519$, $p < .05$ and between pain intensity and compensatory mechanism avoid activity $r_s(14) = .766$, $p < .01$ indicating that individuals who had higher pain intensity used more compensatory mechanisms and were more likely to avoid activity. According to Bialocerkowski (2008), compensatory mechanisms are used when individuals post wrist injury are limited in the activities they can perform and want to decrease the difficulty of performing those tasks. Pain, along with weakness and limited range of motion in the shoulder and wrist, were most likely to blame for activity limitations the shoulder pathology group experienced and explains why compensatory mechanisms were used.

Compensatory Mechanisms

In this study, the total number of compensatory mechanisms used for the five ADL/IADL tasks on the QuickDASH questionnaire was calculated. Specific compensatory mechanisms were also counted individually. Those compensatory mechanisms included: avoid activity, do activity with one hand, and take longer to perform the activity. There were no differences in the total number of compensatory mechanisms used between individuals who had shoulder pathology concurrent with a DRF and individuals who had a DRF only. Nor were there significant differences between these groups for the compensatory mechanisms do activity with one hand and take longer to perform the activity. This result was unexpected because one would

assume that injury to both the shoulder and wrist would require the use of more compensatory mechanisms. However, no literature supports that assumption. This study did find that participants who had shoulder pathology concurrent with a DRF reported the compensatory mechanism avoid activity significantly more than did participants who had a DRF only. Therefore, participants who had shoulder pathology concurrent with a DRF avoided opening a tight or new jar, doing heavy household chores, carrying a shopping bag or briefcase, washing the back, and using a knife to cut food more than did participants with a DRF only. Evidence supports that in individuals post DRF, avoiding activity is a frequently used compensatory mechanism (Bialocerkowski & Grimmer, 2004) and the most difficult activities to perform at eight weeks post DRF are hygiene/dressing, inside domestic activities, and lifting and carrying activities (Bialocerkowski & Grimmer, 2004). However, there is no prior research on what activities are avoided for individuals with shoulder pathology concurrent with a DRF. An explanation of this study's finding could be that participants avoided those 5 ADLs/IADLs more because they required the use of the shoulder. However, more research is needed to support this possible explanation.

Summary

The discussion section for the quantitative analysis took the results of the quantitative analysis and connected it to the current literature. Shoulder pathology occurred in more than one third of the sample in this study and similar results were found in the study by Atkins et al. (1990). Literature supports that there is substantial stress on the shoulder during a fall on an outstretched hand. In addition, there are biomechanical changes to the shoulder when an individual uses a sling or has his or her wrist immobilized after a DRF. This study expands on existing evidence supporting the fact that shoulder pathology can occur with a DRF.

Results of this study showed that individuals with shoulder pathology concurrent with a DRF have similar characteristics as individuals with a DRF only, but that they are also a unique population. Although scores on the QuickDASH, TSK-11, and compensatory mechanism checklist were not different between the groups, correlation testing supported the fact that participants who had higher pain intensity had worse function, worse kinesiophobia, and more use of compensatory mechanisms. Additionally, individuals with shoulder pathology concurrent with a DRF had more pain than did individuals with a DRF only. Clinically it is important to be aware of patients who present with high levels of pain. These individuals may need additional rehabilitation, pain control, and education on how to compensate without impacting the shoulder joint. Occupation-based rehabilitation can be encouraged with this population for multiple reasons. First, individuals with shoulder pathology may avoid activity more, and participating in ADLs and IADLs in the clinic may assist with performing those occupations at home. Second, performing occupation in the clinic helps the clinician to accurately identify the compensatory mechanisms being used and observe the biomechanics of the shoulder. Finally, in individuals who have pain in both the wrist and shoulder, performing occupations in the clinic may decrease the fear that those occupations would be too painful to perform at home.

Qualitative Strand Discussion

The qualitative strand of this study explored the lived experience of seven women with shoulder pathology concurrent with a DRF. Phenomenological inquiry was used to describe how individuals who had a DRF with shoulder pathology perceived their experiences within their environment. Interviews for the qualitative strand were performed with seven women at 5-9 weeks post DRF. The purpose of the phenomenological interview was to draw from participants a vivid picture of their lived experience including the context which shapes the experience with

the goal being to obtain a narrative or story from the participant (Sorrell & Redmond, 1995). Four themes were discovered from the qualitative analysis. All themes will be discussed within the context of the current qualitative literature. Additionally, any implications for Occupational Therapy clinical practice will be reported in the following discussion section. The qualitative literature used in this discussion section describes individuals with a DRF only. Please note that there is currently no literature that has specifically examined individuals with shoulder pathology concurrent with a DRF.

Theme One: It's Difficult to Perform Occupations and Changes Had to be Made

All the participants in this study reported that ADLs and IADLs were more challenging because of their injuries, and they either avoided performing those occupations or adapted the way they were performed. Previous qualitative research indicates that both ADLs and IADLs are difficult for individuals post DRF and that multiple compensatory mechanisms are used by individuals including using two hands, using the nonaffected contralateral hand, altering the type of grip used, avoiding the activity, getting assistance from another person, and taking a longer time to complete the task (Bialocerkowski, 2002). Prior to this study, no studies reported ADLs that are difficult for individuals who have injuries to both the wrist and shoulder. This study highlighted the difficulties that this population experienced with dressing. Dressing tasks such as pulling shirts overhead, pulling on tight shirts, and donning a bra were reported as more difficult for this population. One participant described this when she said: "I couldn't wear a lot of clothes and anything that had a sleeve to it or something I couldn't get my arm through it. So, I ended up wearing a kimono, so it was kind of frustrating." Participants in this study had to change clothing choices through adaptations such as wearing oversized clothes, sports bras, and slip-on shoes. In addition to having difficulty with dressing, participants with shoulder

pathology concurrent with a DRF reported avoiding or having difficulty performing occupations such as styling hair, feeding, household tasks, lifting, and exercise. One participant described this when she said "I was literally on a business trip eating with my hands . . . Because we were at a Brazilian steakhouse and there was nothing but steak, and I couldn't cut it . . . I got so that I would only order food I didn't have to cut, because I couldn't cut anything." Multiple participants reported that since their injury they had made changes to the way they ate. One participant reported using a spoon instead of a fork when feeding herself, and some participants were still using a wrist orthosis during feeding. The inability to perform feeding, grooming, or exercising created stress for some participants. One participant described this in more detail when she said: "I couldn't exercise, which bothered me." For participants who had shoulder pathology concurrent with a DRF, occupations had meaning to them and the inability to perform occupations such as styling hair, exercise or cooking "bothered" many of the participants. They didn't like relying on others or eating out all the time, and many felt like they had gained weight because of the inability to exercise and eat at home. This finding highlights how the inability to perform meaningful and purposeful activities negatively affects this patient population and the important role of Occupational Therapy in returning patients to performing those occupations as well as providing psychological support.

Multiple participants reported that they had learned to perform everyday tasks with only their uninjured upper extremity in order to avoid using their injured upper extremity. A qualitative study by Bialocerkowski (2002) found that many of their subjects with wrist disorders used the other hand to perform activities such as hygiene, dressing, feeding, household tasks, work, and transportation. One participant describes combing hair, brushing teeth, and putting on makeup with the uninjured upper extremity for the first 9 weeks of her injury because of pain in

the injured upper extremity. Another participant added to this when she reported: "So, any daily routine, whether it's making a bed, scooping kitty litter, anything with meal preparation as much as I can do myself, I just did with my left hand." Participants using only the uninjured upper extremity for occupation has multiple implications in this study. First, this demonstrates how participants performed occupations slower and with more difficulty because they wanted to feel more independent in their daily life. Second, participants who reported not using their injured upper extremity developed shoulder pathology on that side. This finding suggests that Occupational Therapists may need to provide shoulder exercises or encourage more functional use if an individual is unable or unwilling to use the injured upper extremity. Finally, although some participants were performing their ADLs, they were not performing those ADLs as they did prior to their injury. The use of occupation-based interventions may provide individuals with the confidence to try to use their injured upper extremity for ADLs and get back to their premorbid status.

In this study, deficits in ADL and IADL tasks required many participants to change the way they performed occupations including having to receive assistance from other individuals. Similarly, Bialocerkowski (2002) found that many wrist-injured individuals get assistance from others after their injury. One participant described how her husband had to take on chores: "He also did more shopping and stuff like which I normally do." Although participants received assistance from others, they did not like asking for help. Participants described wanting to be "independent" and one participant said: "I don't like being dependent on my husband." The changes that were made in these households contributed to some participants feeling a loss of independence. Psychosocial effects of injury are important to address when providing rehabilitation and can be ignored by health care professionals. Further inquiry would be

beneficial in understanding if individuals who require assistance from others have more depression symptoms and if individuals who have shoulder pathology concurrent with a DRF require more assistance from others. It is also important for Occupational Therapists to explain to patients that they will not need assistance from others long term. Results of this study indicate that as the participants' conditions improve, the compensatory mechanisms they used changed and less compensatory mechanisms were needed. One participant described this well when she said: "I felt much better. I started to do more."

Multiple participants indicated that they had to perform activities slower, and that they had to allow a longer time to perform activities. Taking a longer time to complete tasks is a compensatory mechanism reported in a qualitative study that examined individuals post wrist injury (Bialocerkowski, 2002). Additional time is most likely due to primarily using only one hand to perform morning ADLs such as dressing and hygiene. One participant described this when she said: "A lot of things can be done with the left hand. Just takes longer." Further, ADLs and IADLs can be painful, therefore adding additional stress or anxiety. In the population who had a DRF concurrent with shoulder pathology, additional time in the morning was required for some participants because of the additional pain and limited movement in the shoulder. One participant described this: "Can't really brush my hair without it feeling in the shoulder, but I do sort of simple movements . . . . So, in the morning, I'll take my coffee and then walk back to the kitchen. Then I'll take my plate in and walk back to the kitchen. You know, everything is several trips. Which is fine, it's an adjustment. I'm very lucky. I'm 71. I'm retired. So, I don't have to get up and function at a job." This finding provides evidence that additional time requirements are required for an individual recovering from an injury that includes both the wrist and the shoulder, and changes such as getting up earlier may need to be made. It is important for

Occupational Therapists to discuss with patients that it is normal for ADLs to take longer and that it is important to start utilizing the injured side even if it takes much longer. Additional time may impact their daily schedule early on, but this may be only temporary. Occupational Therapists can work with individuals to help alleviate any stress or anxiety that may occur due to occupations being difficult and time consuming to perform.

Multiple participants reported that since their injury they had made changes to the way they slept or used medication to sleep. The findings of this study suggest that in the population who had a DRF concurrent with a shoulder pathology sleeping can become a difficult problem due to pain when positioning both a shoulder injury and a wrist injury. One participant describes this in detail when she said "So pillows made a big difference. Without those, it would be really bad, but the first seven weeks no matter what I did, pillows made a little bit better, but there was always something." Difficulty sleeping or adaptations that are required to sleep were not frequently mentioned in any literature describing functional activities that are problematic after a DRF. AOTA defines the role of sleep as the foundation for optimal occupational performance, participation, and engagement in daily life (AOTA, 2014). Therefore, lack of sleep in this population can have an affect on both emotional health and occupational performance. This is the first study to highlight how difficult it is to sleep in the population who had shoulder pathology concurrent with a DRF. The occupation of sleep can be overlooked when examining an individual's ability to perform ADLs. It is essential that Occupational Therapists consult individuals at their initial evaluation on sleep positions that alleviate pain at the shoulder and wrist or consult their physician if they are unable to sleep.

Theme Two: There is Fear and Uncertainty

All of the participants reported that they experienced fear while moving their injured

upper extremity and that they felt uncertain that moving or using the injured upper extremity was safe. Additionally, all participants in this study reported feeling reluctant to use the arm because of a fear of pain or reinjury. Participants in this study reported feeling scared or nervous that using the injured upper extremity would be detrimental. One participant described this when she said "Okay, I just have a fear of stumbling, and falling on my . . . and reinjuring or injuring something else. What's the word I want to use? I'm just a little bit afraid of reinjuring." Many participants in this study describe not feeling like themselves, feeling fragile and having hypervigilance when performing activity with one participant referring to feeling like "a little old lady." Occupational Therapists play a large role in providing psychological support for individuals post DRF. It is important that Occupational Therapists provide an environment that supports occupational engagement by giving encouragement and support so that individuals can overcome their fears of participating in occupations. An important teaching moment for the primary investigator was that participants reported that they were not educated on what they were allowed to do. This finding suggests that health care professionals may not be providing the education to individuals post DRF that they need in regard to what they are allowed to do with their injured upper extremity. It is vital that Occupational Therapists provide educational resources to patients so that patients are not fearful that performing occupations will be harmful to them.

Hypervigilance and safety seeking behaviors were present in many participants because of fear of using the injured upper extremity. One participant reported that she is using her uninjured upper extremity for almost all of her daily activities. She said: "I do all activity with my left hand and completely avoid 95% of activity with my right hand/arm." Even after the fracture has healed, participants described being nervous about using their injured side especially

going back to weight-bearing activities or exercise. One participant describes her fear when she says: "The doctor says I can exercise, but I'm kind of afraid . . . I've always been kind of clumsy, quite frankly . . . so I'm a little psychologically tentative." This is the first study to examine kinesiophobia or fear of movement in the population who had shoulder pathology concurrent with a DRF. It is vital that individuals who have kinesiophobia be treated early and so they do not develop avoidance behaviors. Having a team approach with the treating physician can facilitate the opportunity to treat those individuals early and to communicate to the patients what activities they are allowed to safely perform. By doing this, patients may not feel the uncertainty when performing occupations. Further research in using the TSK to target individuals with high levels of kinesiophobia early could benefit many upper extremity injured individuals.

Finally, findings of this study indicated that some participants could have developed shoulder pathology after the DRF due to fear of moving the injured upper extremity. Avoiding using the affected upper extremity for daily activity can have a negative impact on the shoulder joint. One participant said: "I'm feeling very protective of it" and she went on to explain that she avoided any movements that hurt such as supination. Avoiding supination will in turn change the biomechanics of the shoulder joint when using the injured upper extremity. It would be beneficial for Occupational Therapists to assess if the shoulder is compensating for lack of movement at the wrist or forearm when the individual is performing occupations.

Theme 3: Impact of Pain

Participants in the study had varying descriptions of the pain they felt in the affected upper extremity and varying descriptions of how their pain impacted functional use of the upper extremity. One participant described her shoulder pain as much worse than the wrist pain. She said "Degrees of misery every day. No relief from the shoulder, and I thought it's funny, I

broke my wrist, the wrist is the least of it." In contrast, other participants reported their hand and wrist pain as most substantial and did not mention the shoulder when describing their pain. Due to pain being worse in the shoulder for some participants, the impact of pain on daily activities differed between individuals. For example, one participant with significantly worse shoulder pain described the pain she had with movement and activity. She said: "Certain movements, then I would get that ax feeling. The shoulder has not let up. I can't put my arm behind my back to do simple daily exercises like hook a bra, hair care." This is in contrast to individuals who described more hand and wrist pain. Those individuals described pain that inhibited participation in activities that required dexterity such as writing. All participants described being unable to lift because of pain and that shoulder pain negatively impacted their ability to sleep. This signifies two activities that require the use of and positioning of both the shoulder and wrist. Overall, findings of this study support early referral to rehabilitation services. The use of modalities for pain control and utilization of occupation-based hand rehabilitation may enable an individual to participate in daily activities with less pain. Rehabilitation for the shoulder may be beneficial for individuals who report high levels of pain in the shoulder after their trauma. Finally, individuals who report high levels of pain in the wrist and hand may benefit from early rehabilitation so that they can start functional use of the injured upper extremity and avoid starting a pattern of disuse. It would be beneficial for Occupational Therapists to educate the treating physicians so they refer individuals to rehabilitation if they have complaints of high levels of pain.

There is currently no literature that has reported descriptions of pain or the impact of pain in the population who had shoulder pathology concurrent with a DRF. Some participants reported that their pain did not significantly affect their ability to do what they wanted or needed

to do although others could not perform any activity with the injured upper extremity due to pain. This was most likely because many participants did not fracture their dominant hand, making it easier for them to perform activities without pain. For individuals who do injure their dominant side, an important priority could be to encourage use of the affected side and to minimize pain early so that use of the upper extremity can be performed. Participants realized the impact of pain on daily life when they tried to move or use their injured upper extremity. This finding is the most important within this theme. It is vital that health care practitioners assess pain early and provide pain management interventions. This will assist in avoiding disuse patterns in an injured upper extremity. It is also important that rehabilitation services be provided early in order to enable functional use of the injured upper extremity.

Theme Four: Tried to be Normal, but Couldn't

Theme four emerged when participants talked about the effect of their injury on their daily life. In theme four, participants reported that they wanted to live their lives like they used to. They reported that they wanted to "be normal," "be independent," and "resume their life." Participants described how they felt a loss of identity because of an inability to fulfill their roles. When trying to perform activities, participants described feeling "frustrated" and described activities as "challenging" and "awkward." Many participants felt discouraged and upset when they found they were unable to perform the activities that were meaningful and purposeful to them. For some participants, their quality of life was directly affected by their injury. In this study, participants who had more functional deficits and more difficulty fulfilling roles reported feeling more frustration with daily life. For example, one participant became tearful when talking about how much she missed caring for her grandchildren and seeing her daughter. She said: "I mean we still see each other all the time. My daughter is like my Siamese twin, very,

very close. But you know I just want that back." Another participant described her frustration and anger with not being able to work because she can't lift enough weight yet. She said: "Have you ever seen a flight attendant with a cast on her? I have to be able to lift a 58 pound window." Some frustration from participants came from their inability to socialize with others and feeling like they were at home more often, which was a deviation from their normal routine. The inability to perform ADLs, as reported in a prior section, may be the reason why some participants could not participate in leisure activities or fulfill certain roles. For example, if individuals are unable to dress themselves in the clothing they prefer, they may be unmotivated to fulfill social roles. This may in turn negatively affect their quality of life. This finding provides additional evidence that having shoulder pathology concurrent with a DRF may have an impact on an individual psychosocially. Results of the study suggest that Occupational Therapists may want to provide a positive environment so that individuals feel enabled to improve their quality of life. For example, using occupation-based rehabilitation in the hand clinic such as practicing dressing or using the steering wheel can provide individuals with the confidence to dress and drive so that they may leave their home and participate in social gatherings or events.

In this theme, individuals verbalized a desire or need to be normal again and with that verbalized a frustration with being unable to participate in the activities they want to perform. This theme signifies that individuals may need additional emotional support and guidance throughout the rehabilitation process. It may be beneficial for Occupational Therapists to educate individuals that recovery is a process and they will get back to participating in the activities that are meaningful and purposeful to them. Findings of this study also suggest that participants who had a DRF concurrent with shoulder pathology may have similar quality of life

changes as individuals with a DRF only. For some participants, high pain and the inability to perform activities with the injured upper extremity may have impacted the ability to participate in social events. For example, the inability to perform activities such as cutting food or opening a drink may impact motivation to participate in social events that require those skills.

Summary

This is the first study to interview individuals who had experienced shoulder pathology concurrent with a DRF. The qualitative strand results illuminated important aspects of this group and the important role of Occupational Therapy in providing treatment. This study highlighted how the inability to perform meaningful and purposeful activities required the use of compensatory mechanisms. Utilization of some compensatory mechanisms, such as asking others for help, had a negative impact on some participants who wanted to feel more independent. Fear of moving the injured upper extremity resulted in some in participants reporting disuse of that upper extremity. Those participants felt uncertain about what activities they were allowed to perform and were fearful that activity could be harmful to them. Due to pain being worse in the shoulder for some participants, the impact of pain on daily activities differed between individuals. Some participants who were unable to perform activity had a feel of loss due to the inability to fulfill their roles. Many participants had the desire to be normal again but couldn't.

The OA Model

The OA model (Schkade & Schultz, 1992; Schultz & Schkade, 1992) provided a theoretical context for examining challenges and adaptations used by individuals with shoulder pathology concurrent with a DRF. This section will discuss how the components of the model were illustrated in the qualitative findings of this study. Participants in this study had to adapt in

order to have successful occupational performance. For the participants in this study, occupations such as dressing, grooming, housekeeping, and food preparation presented as difficult occupations to perform and adaptations such as using two hands, using the nonaffected contralateral hand, altering the type of grip used, avoiding the activity, getting assistance from another person, and taking longer time to complete the task were adaptations utilized by participants for occupational performance.

Person

One assumption of the OA model is that the sensorimotor, cognitive, and psychosocial subsystems are present and active for an occupational response (Schkade & Schultz, 1992). Participants in this study complained of having sensorimotor problems including pain and decreased strength in the upper extremity. Cognition was not affected in this population; however, psychosocial problems did exist such as kinesiophobia and anxiety. Factors such as pain, decreased strength, anxiety, and kinesiophobia became barriers to occupational performance for many of the participants in this study. For example, participants in the qualitative strand reported that decreased strength made it difficult to brush their hair or vacuum. One participant said: "I tried to take a vacuum apart today just to empty it, and I did take it apart, put it back together, but then I forgot, and I switched hands, and I tried to hold it in my left hand, and I just dropped. I couldn't do it. I just had no strength in it."

Occupational Environment

The occupational environments in which occupations occurred for the participants in this study included home, work, restaurants, and various travel destinations. These environments included family, friends, and colleagues. For one participant in this study,

the work environment required her to be able to function within it by performing all her work duties including lifting. However, she was unable to function within her work environment due to her injury. Another example of the occupational environment influencing participants in this study is that the home environment included cookware that could not be manipulated resulting in participants' inability to prepare meals. Additional environmental barriers reported included a heavy iron, heavy bags of garbage, heavy groceries, and tight sheets.

Role Expectations

Occupational challenges occur within a person's occupational role and carry with it certain expectations (Schkade & Schultz, 1992). For example in this study, a grandmother is expected to provide childcare to her grandchild, and the occupation of caregiving has become an occupational challenge after her injury. Participants in this study identified and described a variety of roles including caregiver, friend, worker, and homemaker. Many occupational challenges were present in this population and resulted in the inability to meet role expectations. For example, one participant described how she was unable to be as productive at work due to her hectic schedule and had to delegate more tasks to colleagues. Another participant reported that she instructed her husband on how to cook meals because she was unable to cook and fulfill her role as homemaker.

The Process Flow

When looking at the OA model, adaptations used by participants follow specific processes. First is the adaptive generation subprocess. Utilizing the example of the participant who wanted to fulfill her role as grandmother, the participant first understands the challenges that caring for a child entails and her role expectations as the grandmother. Second, she needs to

decide on the adaptive response mechanism she is going to choose. This participant has chosen to have her daughter care for her own children. Therefore she chose a less sophisticated compensation pattern meaning that it takes no adaptive energy to perform. Some participants chose to change the mode in which they adapted. Those changed modes included modified modes and new modes. For example, one participant enjoyed cooking her own dinner. That was her existing mode. However after her injury, it took her twice as long to cook a meal. Cooking independently would be considered a primary adaptive level because it depleted energy more quickly. The participant reported that she started ordering takeout regularly because cooking while she was injured became too arduous and time consuming. This is a good example of how a new mode of eating out started due to an inability to achieve relative mastery with cooking. Other participants reported using new modes because washing and styling their hair was so arduous and taxing on their injured upper extremity that they started going to the hair salon more often.

In the OA model, adaptive response behaviors are utilized when there are deficits within the person systems. Because all participants in this study have deficits within the sensorimotor system, the adaptive response behavior used by participants will be discussed within the sensorimotor system. Multiple participants in this study reported not using their injured upper extremity for daily activities. Hyperstabilized or primitive behaviors in the sensorimotor system are seen through frozen postures (Schkade & Schultz, 1992). It is possible that hyperstable adaptive response behaviors may lead to the development of shoulder pathology. This is seen in individuals who avoid daily activity and hold their injured upper extremity in a frozen posture. By not using the affected upper extremity for daily function, changes can occur to the nonaffected, nontraumatized joints such as the shoulder. Shoulder immobilization can induce

adhesion of the joint or capsular contracture (Liu et al., 2011).

The adaption gestalt configures the output for the adaptive response mechanism and puts a plan in place for the person systems. In this study, many participants reported getting assistance from others for dressing and household tasks. The adaptation of requiring assistance from others involves less sensorimotor and cognitive involvement and could negatively impact the psychosocial subsystem. Although no participants reported depression due to the need to ask others for assistance, multiple participants reported changes within themselves moving from being active and independent to being anxious or nervous. In a study that examined occupational performance after cast removal post DRF, middle-aged adults demonstrated emotional problems, such as depression and anxiety, that interfered with occupational performance (Morris, 2000). Four out of seven of the participants interviewed for this study are considered middle aged, meaning they are between the ages of 45 and 65.

In this study, the adaptive response evaluation subprocess was demonstrated through participants comparing the adaptation gestalt to the effect on the occupational response, and eventually experiencing relative mastery. An example of this in this study was the participant who wanted to start typing for work to fulfill her role as a journalist. Due to the decreased strength in her digits she frequently had typos and typing took much longer. But as her sensorimotor function improved and she regained more strength and endurance in her digit muscles, she was able to type faster with fewer errors and eventually reached relative mastery with typing. During the adaptive response evaluation subprocess, some participants in this study chose to adapt, or to perform occupations with dysadaptation. Dysadaptation could be defined as either an inability to adapt in order to perform an occupation or adapting and causing injury to the shoulder. For example, some participants were not using the affected upper extremity for

daily activity due to kinesiophobia, and they developed shoulder stiffness. The OA model would categorize kinesiophobia as a barrier to achieving relative mastery in occupational performance, and this could subsequently result in dysadaptation. Use of adaptive strategies such as compensating with the shoulder joint or using the nonaffected side can result in relative mastery in occupational performance. However, compensatory mechanisms may predispose individuals to other injuries (Bialocerkowski, 2002).

The adaptive response integrative subprocess was the final step in the OA adaptation process for participants in this study. During this subprocess, the person integrated all of the steps of the adaptive response into the person systems and modifications occurred. In this study, all participants adapted differently based on their desire to participate in the occupation and their sensorimotor and psychosocial function. For example, many participants avoided activity initially because of high levels of pain. As pain resolved the participants started performing the activity but took longer to perform it. Bialocerkowski and Grimmer (2004) also found that individuals post DRF may avoid an activity at 8 weeks post DRF then take a longer time to perform that same activity at 24 weeks. Therefore, as person systems improve, compensatory mechanisms used can also change. Multiple participants reported that initially they could not cut using a knife and had to ask others for assistance or that they avoided food entirely that needed cutting. As they recovered and pain decreased, their ability to use a knife with their injured hand improved.

Summary

The OA model guided this study in examining how participants used adaptations or compensatory mechanisms to function within their environments, how constructs such as pain and kinesiophobia became barriers to occupational performance, how the use of some

adaptations or compensatory mechanisms can lead to injury to the shoulder joint, and how the loss of function and loss of identity can have a negative impact on quality of life. No generalizations can be made for the entire population who had shoulder pathology concurrent with a DRF. However, this phenomenological analysis has provided a description of the collective experience of the seven women who were interviewed and the findings of this study give insight into the lived experience of this population. It is important to note that no participants from the DRF only group were interviewed; therefore, no qualitative interviews were compared between groups. However, according to the current literature, individuals with a DRF concurrent with shoulder pathology use multiple compensatory mechanisms similarly to individuals with a DRF only. Individuals with shoulder pathology concurrent with a DRF may use more compensatory mechanisms due to pain or stiffness when moving the shoulder and wrist joint. Compensatory mechanisms required different levels of adaptive energy and were chosen based on the difficulty of the task. All participants adapted the way they performed activities over time, and as their condition improved they used fewer compensatory mechanisms. Pain negatively affected occupational performance for some participants more than others with pain symptoms varying between participants. Kinesiophobia was reported by all participants in this study and affected their ability to perform daily activities. Participants reported feeling anxious and nervous about participating in occupation but overall had a strong desire to feel normal again. Although most of the qualitative results were expected due to the PI's history of working with this population, unexpected results included the fact that participants did not feel informed on what they could or could not do, and that they needed an abundance of psychological support during the rehabilitation process. In addition, another unexpected result was that participants continued to avoid using the injured side even after their condition improved.

Mixed Methods Discussion

This section will discuss the findings of the mixed methods analysis within the context of the current literature and provide an explanation as to why the findings contribute to Occupational Therapy clinical practice. The four main constructs that guided this study were: functional outcome, kinesiophobia, pain, and compensatory mechanisms. These constructs were developed based on an extensive literature review and the PI's 17 years of clinical experience. These constructs were evaluated using a Mann-Whitney U test in the quantitative strand and were reported in themes in the qualitative strand. However, theme four did not specifically fit into any of the four constructs. Theme four specifically relates to the psychological effects of an individual's loss of function, loss of identity, and change in quality of life. The mixed methods analysis combined the results of both strands by answering four mixed methods research questions. This discussion section will be organized by the four mixed methods research questions.

Mixed Methods Research Question One

How do the qualitative interview results *coincide* with the results of the visual analog scale; compensatory mechanisms checklist; Quick Disabilities of the Arm, Shoulder, and Hand; and TSK-11?

Increased pain correlated to worse function and worse kinesiophobia in the shoulder pathology concurrent with a DRF group. Additionally, in this group, those individuals who had worse kinesiophobia also had worse function. This represents a fear avoidance model of pain. In the fear avoidance model of pain, pain can be interpreted two different ways: that the pain is nonthreatening and daily activity can be performed; or that pain is dangerous and activities are to be avoided (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Vlaeyen, Kole-Snijders, Rotteveel, et

al., 1995; Vlaeyen & Linton, 2000). Participation in daily activity promotes functional recovery for the patient (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Vlaeyen, Kole-Snijders, Rotteveel, et al., 1995; Vlaeyen & Linton, 2000). In contrast, when pain is misinterpreted as dangerous it can promote pain-related fear and associated safety-seeking behaviors such as avoidance and hypervigilance (Vlaeyen, Kole-Snijders, Boeren, et al., 1995; Vlaeyen, Kole-Snijders, Rotteveel, et al., 1995; Vlaeyen & Linton, 2000). One participant describes this: "I think it's more in fear of having pain . . . I'm concerned about not lifting too much . . . I'm nervous about doing some of [my exercises], that it'll cause the pain." Another participant described this when she reported: "I think it's more in fear of having pain. No, just some things. I think it's more things that involve my hand and I'm concerned about not lifting too much or just I don't feel as physically out there or aggressive or normally as aggressive as I was before." This finding provides some explanation for why individuals with shoulder pathology concurrent with a DRF who have high pain and/or high kinesiophobia should get earlier referrals to rehabilitation. Using occupation-based rehabilitation, pain management techniques, and psychological support may assist in enabling this population to perform occupations and feel less fearful participating in those activities.

Mixed Methods Research Question Two

How do the qualitative interview results *elaborate* on the results of the visual analog scale; compensatory mechanisms checklist; Quick Disabilities of the Arm, Shoulder, and Hand; and TSK-11?

Patients with shoulder pathology concurrent with a DRF have more pain and avoid opening jars, doing heavy household chores, carrying shopping bags, washing the back, and using a knife significantly more than do individuals with a DRF only. Evidence supports that

high pain is a predictor of worse functional outcomes in individuals post DRF (Cowie et al., 2015; Mehta et al., 2015a; Nielsen & Dekkers, 2013; Souer et al., 2008; Swart et al., 2012). One participant describes how she couldn't perform bathing because of pain: "I could start to do things like even with the cast on, like maybe take the shampoo cap off or something right? I couldn't do that the majority of the time because it hurt." Although participants varied on their descriptions and severity of pain, pain was worse for this population and may have contributed to avoiding activity. However, qualitative analysis showed that participants didn't always report that pain was the reason they avoided activity. Many participants reported that they just "couldn't" perform the activity. For example, one participant said "I tried to slice some meat at one point, couldn't do it. The only thing I could do is eat cereal and go back to bed." Another participant described this with household tasks when she said: "I couldn't make a bed. Maybe I can make a bed, like fold the sheets down, but I couldn't change the sheets on a bed. I couldn't fold laundry." It is important for Occupational Therapists to perform activity analysis in order to understand why patients cannot participate in activity. Occupational Therapists should be able to identify if the problem is coming from shoulder and/or wrist and if the problem is pain, kinesiophobia, weakness, stiffness, or a combination. Finally, occupation-based rehabilitation may assist in engaging this population in performing occupations again.

Mixed Methods Research Question Three

To what extent do the results of the visual analog scale; compensatory mechanisms checklist; Quick Disabilities of the Arm, Shoulder, and Hand; and TSK-11 *disagree* with the qualitative interview results?

Participants who had shoulder pathology concurrent with a DRF did not have significantly different functional outcomes, kinesiophobia, and total number of compensatory

mechanisms used than did individuals who had a DRF only. However, in the qualitative strand, participants who had shoulder pathology concurrent with a DRF gave multiple examples of having difficulties performing occupations, having high levels of kinesiophobia, and using many compensatory mechanisms in their interviews. It is important to note that because the DRF only group was not interviewed direct comparisons of their experiences could not be performed. It was surprising to the primary investigator that the shoulder pathology group did not have worse functional outcomes because of the important role of the shoulder in performing ADLs. Qualitative results illuminated the fact that ADLs and IADLs that required more shoulder mobility may be more difficult following a shoulder injury concurrent with a DRF. One participant said: "I always like would wrap the towel around me before my injury and comb my hair. It's your routine, right? Brush my teeth or whatever. Do other stuff. You tuck the towel like a wrap. I couldn't do it." Further, it is reasonable to think that an individual would have more fear of moving the upper extremity if both the shoulder and wrist were injured. There is no prior literature to support that claim and in this study, the quantitative strand additionally did not support that claim. However, in the qualitative strand, participants reported that fear of reinjury made them more physically cautious. One participant reported this in detail when she said: "The doctor says I can exercise, but I'm kind of afraid." Finally, it was also surprising that although participants had an injury to both the shoulder and wrist they did not use more compensatory mechanisms than did participants with a DRF only. However no studies have ever examined the use of compensatory mechanisms in individuals with shoulder pathology concurrent with a DRF. A follow-up study looking at participants over a longer period of time and/or collecting data at two different periods of time would be beneficial.

Mixed Methods Research Question Four

When comparing the results of the qualitative interview data with the quantitative instrument data, what information emerges that expands the understanding of the phenomenon of having shoulder pathology concurrent with a DRF?

Pain intensity was correlated with functional outcome, kinesiophobia, total number of compensatory mechanisms used, and the compensatory mechanism avoid activity in the quantitative analysis of this study. Participants in the qualitative strand who had higher pain reported more difficulties performing daily activities, more fear of moving the injured limb and more use of compensatory mechanisms, specifically, avoiding certain activities. These relationships describe what participants who have shoulder pathology concurrent with a DRF may experience especially if they have high levels of pain. There is no prior evidence supporting this study's finding that individuals who had shoulder pathology concurrent with a DRF who had high pain intensity had worse functional outcomes, worse kinesiophobia, or more avoidance of activity. Additionally, there is no prior evidence supporting this study's finding that occupations such as sleeping are difficult for individuals who had shoulder pathology concurrent with a DRF. However, there is evidence that individuals post DRF have similar attributes. Literature shows that individuals post DRF who have high pain intensity have worse functional outcomes (Moore & Leonardi-Bee, 2008; Nielsen & Dekkers; 2013; Swart et al., 2012), and worse fear of movement (Söderlund & Åsenlöf, 2010). Additionally, evidence supports the use of a number of compensatory mechanisms for performance of occupation following a DRF (Bialocerkowski & Grimmer, 2004). Therefore, the findings of this study suggest that although individuals who had shoulder pathology concurrent with a DRF had more pain and avoided some activities more, they have very similar attributes to individuals with a DRF only. Although qualitative analysis

illuminated some of the struggles this population has, it is unclear if individuals with a DRF only would verbalize the same struggles because they were not interviewed. However, one participant described her lived experience the best when she said: "The shoulder has not let up. I can't put my arm behind my back to do simple like do simple exercise like hook a bra, hair care. I have become very skilled with my left hand."

Summary

Mixing the quantitative and qualitative strands provided a more comprehensive view of the population who had shoulder pathology concurrent with a DRF. Findings of this study suggest that individuals who had shoulder pathology concurrent with a DRF are very similar to participants with a DRF only. Clinically, these findings suggest that it would be beneficial for Occupational Therapists to evaluate the shoulder throughout the rehabilitative process and interview the patient in order to understand if shoulder pathology is directly impacting the performance of any ADLs and IADLs. It is important that Occupational Therapists utilize interventions that facilitate mobility to the shoulder joint, and they should write goals and provide interventions that facilitate participation in avoided or difficult occupations. In relation to the construct of kinesiophobia, the findings of this study support the need for Occupational Therapists to provide more emotional support to individuals who present with kinesiophobia and use more occupation-based interventions to facilitate participation in occupation. In relation to the construct of pain, the findings of this study support the importance of Occupational Therapists assessing pain frequently and evaluating the role of pain in occupational performance. Additionally, it would be beneficial for individuals who have high levels of pain to receive early referrals to rehabilitation. Finally, in relation to the construct of compensatory mechanism, the findings of this study support the fact that use of compensatory mechanisms are needed for

successful occupational performance. However, it is important that Occupational Therapists observe individuals performing occupation to assess if they are compensating at the shoulder joint or avoiding use of the injured side.

Implications for Practice

The results of this study provide new evidence that shoulder pathology occurs with a DRF, with the shoulder pathology occurring either at the time of fracture or later. Shoulder pathologies that may occur include rotator cuff tendonitis/impingement syndrome, shoulder pain, and shoulder stiffness. The results of this study may influence how physicians and clinicians treat individuals with DRF in that there is now evidence that the shoulder complex can be affected in the DRF population. Furthermore, results of this study support the need to assess shoulder pain and function immediately after a DRF so that shoulder injuries can be diagnosed and treated early. Additionally, results of this study support the need to monitor the shoulder at each follow-up visit because shoulder pathology may not be present initially but may occur over time. There is currently no best practice protocol for rehabilitating patients following a DRF (Handoll & Elliot, 2015; Valdes et al., 2014). Some rehabilitation protocols include active range of motion to the shoulder (Christiesen et al., 2001; Krischak et al., 2009; Michlovitz & Festa, 2011) although other protocols do not include any range of motion to the proximal joints of the upper extremity (Souer et al., 2011; Wakefield & McQueen, 2000). Recent studies have suggested that, after a DRF, patients can regain the same function with a home program as they can by attending therapy (Christensen et al., 2001; Krischak et al., 2009; Souer et al., 2011; Wakefield & McQueen, 2000). However, these studies eliminated patient complexities that require skilled interventions by a therapist (Handoll & Elliot, 2015; Valdes et al., 2014). This study supports the need to assess the shoulder complex at the time of the fall and throughout the

rehabilitative process. Occupational Therapists should also assess occupational performance and participation in daily activities on the initial visit and throughout the patient's treatment to ensure that any difficulties performing occupations are being addressed. Less than 10% of patients post DRF are referred to therapy during the immobilization period (Michlovitz et al., 2001). This study supports the importance of early referrals to rehabilitation post DRF especially if an individual presents with shoulder pathology or high levels of pain.

When treating individuals who have shoulder pathology concurrent with a DRF, clinicians will now have the knowledge that these individuals may have higher pain intensity than do individuals with a DRF only. This can direct treatment because clinicians can work on managing pain in order to improve functional use of the injured upper extremity. Further, clinicians will now know that individuals with shoulder pathology and high levels of pain may present with greater kinesiophobia, worse functional outcomes, and more use of compensatory mechanisms. It would be beneficial for Occupational Therapists to use the VAS and TSK-11 to identify individuals who may have high levels of pain and kinesiophobia and work with these individuals psychosocially along with utilizing occupation-based rehabilitation and pain management techniques. Clinicians can also interview patients to find out what compensatory mechanisms are being used and educate patients on how to start using their injured upper extremity for occupation. Additionally, it is important that clinicians identify movement patterns that may aggravate the shoulder complex when the individual performs activity. Finally, additional shoulder pathology may cause stress and anxiety to an individual. It is vital that clinicians educate individuals on how to cope with the additional impairments and educate them as to what they can expect in the rehabilitation process.

Implications for Future Research

Prior to this study, there was only one study relating to the incidence of shoulder pathology in patients with DRF, and no studies pertaining to how shoulder pathologies occur after a DRF, or the impact of shoulder pathology on occupational performance. Future research could follow many different avenues. First, this study could be replicated using the same variables and also including more variables. After completing this research, important variables came to light that could have further informed this study. For example, it would have been beneficial to collect information regarding the variable of ulnar styloid fracture. Frequently, patients who have ulnar styloid fractures have more difficulty or pain supinating the forearm. Evidence supports that the shoulder's external rotation and elevation is increased to avoid supination (Murgia et al., 2010). This may have been a useful variable to describe the population who had shoulder pathology concurrent with a DRF. Another variable that would have been beneficial to examine was whether subjects were pre- or post-menopausal. Evidence supports muscular changes in individuals who are both osteoporotic and postmenopausal (Sjöblom et al., 2013; Walsh, Hunter, & Livingstone, 2006). Although most participants in this study were most likely post menopausal, this variable was not collected. Other variables that also would have been beneficial to collect includes body mass index, and whether the individual has diabetes.

Another area of future research would be to determine how a sling contributes to developing shoulder pathology or how different sling types may be less detrimental to the shoulder joint. Misuse of a standard sling can result in improper positioning of the forearm in a dependent position and can lead to hand edema, shoulder capsular tightness, elbow stiffness (Laseter & Carter, 1996; Weinstock, 1999), and decreased functional use of the upper extremity (Laseter & Carter, 1996). Research could also be performed to understand how a home exercise

program for the shoulder would be effective in preventing the development of shoulder pathology after a DRF. In this study, 10 of the 16 participants who had shoulder pathology concurrent with a DRF developed shoulder pathology after the DRF occurred. It is of interest to understand whether or not exercises that are generally prescribed to treat subacromial impingement could also prevent subacromial impingement from occurring. Additionally, it is of interest to understand whether or not range of motion exercises to the shoulder joint or occupation-based activities could prevent shoulder stiffness. Future research could also include whether early screening of the shoulder post DRF may be effective in early treatment and recovery of shoulder pathology post DRF. The effectiveness of patient education after fracture could also be an additional area of research. Handouts or a website explaining safe use of an injured wrist after DRF could assist individuals in using fewer compensatory mechanisms and having less kinesiophobia. Patient education on what overuse of a shoulder looks or feels like (i.e., shoulder shrugging or pain in the shoulder) may prevent shoulder pathology from occurring or assist in early diagnosis. Another study following individuals post DRF to see when shoulder pathology symptoms start, and if having surgery, injuring the dominant side, or the severity of the fall is related to specific outcomes would be beneficial in providing additional evidence. Finally, another study examining the relationship between DRFs, sleep, pain intensity, and occupational performance may be beneficial.

Strengths, Limitations, and Delimitations of the Study

Strengths

One of the strengths of this study is the study design. The convergent parallel mixed methods design treats both the qualitative and quantitative data with equal priority so that both can play an equally important role in addressing the research questions (Creswell, 2014;

Creswell & Plano Clark, 2011; Tashakkori & Teddlie, 1998; Teddlie & Tashakkori, 2009). Four main constructs guided this study. These constructs were functional outcome, kinesiophobia, pain, and compensatory mechanisms, and were developed based on an extensive literature review and the PI's 17 years of clinical experience. "The key idea with this design is to collect both forms of data using the same or parallel variables, constructs, or concepts" (Creswell, 2014, p. 222). Analyzing the quantitative strand and qualitative strand separately, then putting the analysis together by mixing the strands, offered a comprehensive view of this population from different angles. Comparing and contrasting quantitative statistical results with qualitative findings allowed the researcher to triangulate the data for corroboration and validation purposes and results in a more complete understanding of the phenomenon (Creswell, 2014; Creswell & Plano Clark, 2011).

Another strength of this study is that a large number of variables were collected in a sample of 45 participants. This gave the study the ability to provide a lot of meaningful data. This study also had four outcome measures, two of which gave additional outcome scores. For example, the TSK-11 gave an avoidance score, a harm score, and a total score. The compensatory mechanism checklist from the Adelaide questionnaire offered the opportunity to sum up specific compensatory mechanisms for statistical testing. This was done for the compensatory mechanisms of use one hand only, take more time to complete an activity, and avoid activity. Having more variables gave the PI the opportunity to understand more about the differences between the population who had shoulder pathology concurrent with a DRF and the population who had a DRF only.

Limitations

Forty-five subjects were recruited for this study over a one-year time frame. The power analysis for this study required 21 participants with shoulder pathology and 21 participants without shoulder pathology. At the end of this study only 16 subjects had shoulder pathology and 29 did not have shoulder pathology. Because there were not 21 participants in the shoulder pathology group, effect size may have impacted some of the results.

Nonprobability convenience sampling was the sampling strategy used in this study. This sampling strategy makes it difficult to generalize findings about the population of individuals who experience DRFs. This study had a sample that was not representative of the population. Facilities where participants were recruited accepted only Medicare and Workers' Compensation insurance. For this reason, individuals with commercial insurance, Medicaid, or no insurance had to pay out of pocket to be treated by a physician or occupational therapist. Although insurance plan was not part of data collection, the lack of accepting certain insurance plans impacted who was represented in the sample. For the qualitative strand, individuals interviewed were all women and included only one minority. Further, of the individuals interviewed, only one had a manual labor job. Many of the individuals interviewed had help at home from either a spouse or paid employee. In the sample for the quantitative strand, there were only 7 males versus 38 females. All of the participants came from the same geographical area. Additionally, there were only 4 minorities in the 45 participant sample.

Another limitation of the study is that three participants reported having shoulder pathology after 56 days or the end of the 7th weeks post DRF. All of those subjects were placed into the shoulder pathology group. This is a limitation of the study because it is unclear if the health status variables that were collected at 5-7 weeks reflected all of the participants who

developed shoulder pathology after a DRF. The fourth limitation of the study is that the shoulder could potentially have been injured at the time of the DRF and diagnosed later making it seem like the shoulder pathology is due more to compensation rather than trauma concurrent with the DRF. This may have occurred with two participants in this study. Two participants reported to the hand surgeon that they did not have pain in the shoulder at the time of the fall but had symptoms 3 and 4 days post injury. Those individuals were placed in the compensation/disuse category. The final limitation was that participants who had a DRF only were not interviewed for the qualitative strand. Because of this, qualitative data could not be compared between the DRF only group and the shoulder pathology group.

Delimitations

Although the PI took steps to ensure the integrity of the data, errors in data collection occurred, and this was a delimitation of the study. There were four data collectors for this study and although each data collector was instructed to check that all questionnaires were completed, data were missing from two participants. Due to the missing data, both participants had to be dropped from this study. Another delimitation of this study was that this study was not a prediction study. In other words, the results of this study did not discuss the factors that could predict shoulder pathology. Instead this study described the experiences of the individuals who had shoulder pathology concurrent with a DRF and demonstrated how those individuals differed from individuals who did not have shoulder pathology.

Summary

This study has presented a very comprehensive view of the population who had shoulder pathology concurrent with a DRF. The study constructs of functional outcome, kinesiophobia, pain, and compensatory mechanisms were interconnected in various ways showing that these

constructs describe this population. Literature was presented that supported the study's finding that shoulder pathology can occur after a DRF. This is the first study to specifically examine the occurrence of shoulder pathology in individuals with a DRF and to describe the impact of having shoulder pathology. This is also the first study to interview a group of individuals who have experienced shoulder pathology concurrent with a DRF. Results of this study have multiple clinical implications including the important role of sleep and how the variable of pain can assist in identifying individuals who may have or develop shoulder pathology.

In the mixed methods discussion, literature was presented supporting the fear avoidance model of pain seen in this population. For individuals with shoulder pathology concurrent with a DRF, pain-related fear is associated with avoidance of activity which may lead to poor occupational performance. The participation in daily activity by utilizing compensatory mechanisms supports functional recovery for this population. However, literature supports that disuse or compensation at the shoulder can cause injury to the shoulder. Literature also supports the fact that individuals with a DRF only have similar attributes to individuals with shoulder pathology concurrent with a DRF when describing the constructs of functional outcome, kinesiophobia, pain, and compensatory mechanism. This study provides evidence that although these groups are similar, they may require different interventions. Finally, shoulder pathology occurred in over one third of the sample in this study. This phenomenon requires additional research to describe the characteristics of this condition and potential treatment.

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Appendix A

QuickDASH

Institute of Work and Health. (2013b). About the QuickDASH. Retrieved from http://www.dash.iwh.on.ca/about-quickdash

Appendix B

Tampa Scale of Kinesiophobia-11 (TSK-11)

Instrument removed to protect copyright

Woby, S. R., Roach, N. K., Urmston, M., & Watson, P. J. (2005). Psychometric properties of the TSK-11: a shortened version of the Tampa Scale for Kinesiophobia. *Pain, 117*(1), 137-144. doi:10.1016/j.pain.2005.05.029

Appendix C

Visual Analog Scale

Instrument removed to protect copyright

Jensen, M. P., Chen, C., & Brugger, A. M. (2003). Interpretation of visual analog scale ratings and change scores: A reanalysis of two clinical trials of postoperative pain. *The Journal of Pain, 4*(7), 407-414. doi:http://dx.doi.org/10.1016/S1526-5900(03)00716-8

Appendix D

The Compensatory Section of the Adelaide Questionnaire

Instrument removed to protect copyright

Bialocerkowski, A. E., Grimmer, K. A., & Bain, G. I. (2003a). Development of a patient-focused wrist outcome instrument. *Hand Clinics, 19*(3), 437-448. Retrieved from http://dx.doi.org/10.1016/S0749-0712(02)00149-X

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Appendix E

Qualitative Interview Guide

1. What is the lived experience of having shoulder pathology at the same time as a DRF? What is it like living with your injury?
    a. Has your injury affected your ability to perform the activities that you do everyday? If so, how?
    b. Has your injury affected your ability to fulfill your roles with family, community, or other groups? If so, how?
    c. Has your injury affected your ability to perform your job? If so, how?
    d. Can you describe how you feel when you try moving or using your injured arm?
    e. Do you have pain? If so, can you describe your pain? How does pain effect your day? How does pain effect your ability to do what you need or want to do?
    f. How have you had to change the way you do things since your injury? If so, can you describe what has been different or how you have had to change how you do things?

Appendix F

Questionnaire Week 1-2

1. What was the date of your injury? _____

2. What side did the fracture occur? Please circle

   Right Left

3. What side is your dominant side?

   Right Left

4. What is your age? _____

5. What is your gender? Please circle

   Male Female

6. What is your race? Please circle

   Caucasian African American Hispanic Other

   If Other Please Specify _____

Appendix G

Questionnaire Week 5-7

1. Do you have a willing and able caregiver providing assistance to you at this time? Please circle

   Yes No

2. What is your productive role at this time? Please circle all that apply and rate the ability to perform each role

Paid Employment	Full	Modified	Unable to Perform
Homemaker	Full	Modified	Unable to Perform
Volunteer	Full	Modified	Unable to Perform
Student	Full	Modified	Unable to Perform

3. Did you have surgery? Please circle

   Yes No

4. Did you use a sling? Please circle

   Yes No

5. Approximately how many days did you use the sling? _____
6. Have you been diagnosed with osteoporosis? Please circle

   Yes No

7. How has your injury impacted your activities of daily living?

Appendix H

Physician Shoulder Pathology Form

Date _____

Follow up visit _____weeks post DRF

1. Does the participant present with shoulder pathology?

   Yes

   No

2. If yes, what is the diagnosis
   a. Subacromial Impingement/Rotator Cuff Tendonitis
   b. Adhesive Capsulitis
   c. Shoulder Stiffness
   d. Shoulder Pain
   e. Other _____
3. What is the date the shoulder symptoms started? _____
4. The shoulder pathology is due to:
   a. Injury at the time of the DRF
   b. Compensation by the shoulder or disuse of the shoulder
   c. Other _____

Appendix I

List of Study Procedures and Data Analysis

- 1-2 weeks post DRF- Informed consent obtained from participants.
- 1-2 weeks post DRF- First questionnaire given. Questionnaire collected demographic information including age, gender, and race. Some fracture status information was also collected including date of injury, what side the fracture is located on, and if the dominant extremity was fractured.
- Participants were assessed for shoulder pathology at all follow-up visits with either the hand surgeon or occupational therapist from the day informed consent is signed up to 9 weeks post DRF. Shoulder pathology was only diagnosed by the participant's hand surgeon. Shoulder diagnoses included rotator cuff tendonitis/subacromial impingement, adhesive capsulitis, shoulder stiffness, and shoulder pain. The hand surgeon recorded the date the shoulder symptoms started and if the shoulder pathology was due to injury at the time of the fall, or compensation and disuse.
- If any participant presented with shoulder pathology from the day informed consent was signed up to 9 weeks post DRF then that patient was placed in the shoulder pathology group.
- Any participant who presented with shoulder pathology from the day informed consent was signed up to 9 weeks post DRF was asked to participate in the qualitative strand of the study. This included participating in an audio-taped interview. A total of 7 participants participated in the qualitative strand.
- 5-7 weeks post DRF- Questionnaires were given to all participants. Questionnaires collected demographics, employment and work status, fracture status, and health status.

Questionnaires will include the Quick Disabilities of the Arm, Shoulder, and Hand; Tampa Scale of Kinesiophobia-11; Visual Analog Scale; and Compensatory Section of the Adelaide Questionnaire.

- After performing a power analysis, at least 21 participants needed to be in the shoulder pathology group and at least 21 participants needed to be in the nonshoulder pathology group. Data collection for the quantitative strand ended with 16 participants in the shoulder pathology group and 29 in the nonshoulder pathology group.
- Data collection for the qualitative strand was complete once 7 participants who had developed shoulder pathology had participated in audio-taped interviews.
- Using a convergent parallel mixed methods design, after data collection for both strands was complete, data analysis was performed for each strand separately.
- For the quantitative strand, descriptive statistics were used to describe the demographics, patient characteristics, and clinical factors of the population who had shoulder pathology concurrent with a DRF. An independent samples Mann-Whitney U test was used to determine if participants with shoulder pathology concurrent with a DRF had significantly worse function, higher kinesiophobia and pain, and more use of compensatory strategies then patients with no shoulder pathology. Additional correlation testing was also performed between outcome measures.
- Data analysis of the qualitative strand included phenomenological reflection and interpretation of the codes followed by clustering codes and forming themes.
- Data integration of both strands will be performed using a side by side comparison to compare results of the quantitative and qualitative strands.

Appendix J

Informed Consent Form

Consent Form for Participation in the Research Study Entitled "The Impact of Shoulder Pathology in Individuals with Distal Radius Fracture"

Funding Source- American Hand Therapy Foundation
The Ben Shaffer Sports Medicine Endowment Fund

IRB protocol #: 2017-116-Non-NSU Health Care Institution

Principal investigator
Sarah Wilson, Doctor of Philosophy in Occupational Therapy

For questions/concerns about your research rights, contact:
Human Research Oversight Board (Institutional Review Board or IRB)
Nova Southeastern University
(954) 262-5369/Toll Free: 866-499-0790
IRB@nsu.nova.edu

Site Information

Washington Orthopedics and Sports Medicine
Smartherapy

What is the study about?
This is a research study that will examine people that have broken the wrist. The researcher would like to learn more about this group. Some people may have shoulder problems after breaking their wrist. The researcher would like to learn more about the differences in characteristics between people who have shoulder problems after breaking their wrist and those who do not.

Why are you asking me?
The reason for asking you to join the study because you recently broke your wrist. We would like to learn more about what life is like after a person breaks their wrist. Information obtained during your recovery can help to create a better understanding of the experiences of patients who have fractured the wrist.

What will I be doing if I agree to be in the study?
You will be in the study for no more than 9 weeks. During your follow up visits for your broken wrist, either your WOSM orthopedist or Smartherapy occupational therapist will evaluate your shoulder for pain and stiffness. Between the 5th and 7th weeks you will asked some information about your daily life, your ability to function, fear of moving the injured arm, pain you have experienced, and ways you have compensated in order to perform daily activities. The five

questionnaires will take you 20 minutes or less. If you develop pain or stiffness in the shoulder during your recovery from your broken wrist then you may be asked to participate in an interview. You will be asked during the interview to describe what your shoulder problem is and what it is like to have a problem with your shoulder.

Is there any audio or video recording?
This research study will include audio recording of interviews with participants who are chosen and agree to being interviewed. Interviews will include each participant describing their experiences with their shoulder problem. Interviews will be recorded. The audio recording will be transcribed by Sarah Wilson. The recording will be deleted immediately after it is transcribed and transcription will be kept on a password secured computer. The transcription will be kept for 3 years and then destroyed by deleting all documents. Because your voice will be potentially identifiable by anyone who hears the recording, your confidentiality for things you say on the recording cannot be guaranteed although the researcher will try to limit access as described in this paragraph.

What are the dangers to me?
The procedures or activities in this study may have unknown or unforeseeable risks.

If you have any questions about the research, your research rights, or have a research-related injury, please contact Sarah Wilson. You may also contact the IRB at the numbers indicated above with questions as to your research rights.

Are there any benefits for taking part in this research study?
There are no direct benefits to participating in this study.

Will I get paid for being in the study? Will it cost me anything?
You will not be paid for being in this study. It will not cost you anything to be in the study.

How will you keep my information private?
All consent forms and questionnaires will be kept in a locked cabinet. You will be assigned a number so that your name will not be used on questionnaires. All data from the questionnaires will be kept on a password secured computer using only your identification number. If you participate in the audio taped interviews, all interviews will be deleted from the digital recorder once transcription is complete. After 3 years, all data will be destroyed including all consent forms, questionnaires, and transcriptions.

All information obtained in this study is strictly confidential unless disclosure is required by law. The IRB, regulatory agencies, and dissertation chair/thesis adviser may review research records at any time.

What if I do not want to participate or I want to leave the study?

You have the right to leave this study at any time or refuse to participate. If you do decide to leave or you decide not to participate, you will not experience any penalty or loss of services you have a right to receive. If you choose to withdraw, any information collected about you **before**

the date you leave the study will be kept in the research records for 3 years from the conclusion of the study and may be used as a part of the research but you may request that it not be used.

Other Considerations:

If significant new information relating to the study becomes available, which may relate to your willingness to continue to participate, this information will be provided to you by the investigators.

Voluntary Consent by Participant:
By signing below, you indicate that

- this study has been explained to you
- you have read this document or it has been read to you
- your questions about this research study have been answered
- you have been told that you may ask the researchers any study related questions in the future or contact them in the event of a research-related injury
- you have been told that you may ask Institutional Review Board (IRB) personnel questions about your study rights
- you are entitled to a copy of this form after you have read and signed it
- you voluntarily agree to participate in the study entitled "The Impact of Shoulder Pathology in Individuals with Distal Radius Fracture"

Participant's Signature: _____ Date: _____

Participant's Name: _____ Date: _____

Signature of Person Obtaining Consent: _____

Date: _____

Appendix K

Oral Recruitment Form

NSU IRB APPROVED:
Approved: February 20, 2017
Expired: February 19, 2018
IRB#: 2017-116-Non-NSU Health Care Institution

Oral Recruitment Script

We are doing a study at our facility and your diagnosis of a broken wrist makes you eligible to participate in the study. We are interested in learning more about individuals who may have shoulder problems while recovering from a broken wrist. All the data we need will be collected during your time with either the physician or the occupational therapist at any of the WOSM or Smartherapy locations. If you are interested in the study, we can review the consent form together or if you would like to think about it you can contact the primary investigator, Sarah Wilson. This research is being performed in association with Nova Southeastern University. Your decision to participate or not participate in this study will have no influence on the care you receive at our facility.

***The informed consent form with the PI's information will be given to all patients being recruited.**

Appendix L

Authorization Letter From WOSM

Washington Orthopedics and Sports Medicine/Smartherapy
5215 Loughboro Rd NW
Washington, DC 20016
Suite 200
202-787-5601

Nova Southeastern University
3301 College Avenue
Fort Lauderdale, FL 33314-7796

Subject: Site Approval Letter

To whom it may concern:

This letter acknowledges that I have received and reviewed a request by Sarah Wilson to conduct a research project entitled "The Impact of Shoulder Pathology on Individuals with Distal Radius Fracture" at Washington Orthopedics and Sports Medicine/Smartherapy and I approve of this research to be conducted at our facility.

When the researcher receives approval for his/her research project from the Nova Southeastern University's Institutional Review Board/NSU IRB, I agree to provide access for the approved research project. If we have any concerns or need additional information, we will contact the Nova Southeastern University's IRB at (954) 262-5369 or irb@nova.edu.

Sincerely,

Richard Barth MD
Physician Washington Orthopedics and Sports Medicine
rw.barth@verizon.net

Appendix M

Protected Health in Research Authorization Form

Washington Orthopedics and Sports Medicine and Smartherapy
Authorization for Use and Disclosure of Protected Health Information in Research Form

1. Study Information

Title of Study: "The Impact of Shoulder Pathology on Individuals with Distal Radius Fracture"
NSU IRB Protocol No.: 2017-116-Non-NSU Health Care Institution
Principal Investigator: Sarah Wilson MSOTR/L, CHT, CLT
Co-Investigator(s): David Moss MD, Richard Barth MD, Madeline Fetzko OTR/L, Jacqueline Reese Walter PhD, OTR/L, CHT, CEAS
Research Site Information:
Washington Orthopedics and Sports Medicine:
Smartherapy:
Funding Source/Sponsor: American Hand Therapy Foundation
The Ben Shaffer Sports Medicine Endowment Fund

2. What is Protected Health Information?

Protected health information (PHI) refers to demographic information, medical history, test and laboratory results, insurance information and other data that healthcare professionals or researchers collect and can be linked to a specific individual.

3. What is the purpose of this form?

This form is required by the Health Insurance Portability and Accountability Act (HIPAA) of 1996. Specifically, it describes what protected health information will be collected during this study about you and who may use, disclose and/or receive your health information about you for the research study identified above, which has been approved by the Nova Southeastern University (NSU) Institutional Review Board.
By signing this form, you agree that designated health information may be used and disclosed during this study. We will only collect information that is needed for the study. Your health information will only be used and given out as explained in this Authorization Form or as permitted by law.

4. What protected health information do the researchers want to use?

- Medical and mental health treatment and related information, including, but not limited to: personal and family medical history, information from laboratory and diagnostic tests, psychological tests, blood and urine tests, x-rays, physical exams and other tests or medical procedures performed as part of this research study.
- Protected Health Information obtained during telephone calls, surveys, questionnaires and/or office visits conducted as part of this research study;
- Protected Health Information in medical records located either in your health care provider's office at NSU and/or at other health care facilities where you have received treatment.

5. Why do the researchers want my protected health information?

The reason we are asking for your authorization to use and disclose your protected health information is:

- To allow participation in this research study
- To allow the University, regulatory agencies and study sponsors to assess and/or assure compliance with the study protocol
- To evaluate the effectiveness of the study
- To provide protection to you as a research study participant

6. Who will be able to use my protected health information?

The Principal Investigator and other research staff will use your health information for research. As part of this research, they may give your information to the following groups taking part in the research. The researchers may also permit these groups to come in to review your original records that are kept so that they can monitor their research study. These may include:

- Human Research Oversight Board (Institutional Review Board) and its staff
- Federal and state agencies that have oversight of the study or to whom access is required under the law.
- If any study procedures are billed to your insurer, then your healthcare insurer (including Medicare and Medicaid) and their intermediaries (companies contracted to process claims) may also have access to your medical and billing records related to the study.
- The following researchers, companies and/or organization(s) outside of Nova Southeastern University may also use, share and/or receive your health information in connection with this study: David Moss MD, Dr. Richard Barth MD, Madeline Fetzko OTR/L
    - Health care facilities, research site(s), researchers, health care providers, or study monitors involved in this study.
    - Private laboratories and other persons and organizations that analyze your health information in connection with this study.
    - The Research Sponsor and companies owned by or connected with the Sponsor.
    - Independent data and safety monitoring boards and others who monitor the conduct of the study.
    - Contract Research Organization (CRO) or Coordinating Center, if applicable.

7. How will information about me be kept private?

All patient information will be kept private to the extent possible. Only researchers working with the study and those listed in this form will have access to your information. No personal health information about you will be released to others except as authorized or required by law. However, once your information is given to other organizations that are not required to follow federal privacy laws, we cannot assure that the information will remain protected.

8. What happens if I do not sign this authorization form?

If you do not sign this authorization form, you will not be able to take part in the research study for which you are being considered.
Medical treatment will not be conditioned on signing this authorization, unless the treatment is related to the research study described above.

9. If I sign this form, will I automatically be entered into the research study?

No, you cannot be entered into any research study without further discussion and separate consent. After discussion, you may decide to take part in the research study. At that time, you will be asked to sign an informed consent form that will detail your participation in the research study.
Treatment by your physician will not be affected by whether you provide authorization for the requested use or disclosure except if your treatment is related to research.

10. What happens if I want to withdraw my authorization?

Even if the terms of the consent say otherwise, this authorization does not expire, unless you revoke your authorization in writing. You can change your mind at any time and withdraw your authorization to allow your protected health information to be used in the research. If this happens, you must withdraw your authorization in writing.
Beginning on the date you withdraw your authorization, no new protected health information will be used for research. However, researchers may continue to use the protected health information that was provided before you withdrew your authorization.
If you sign this form and enter the research study, but later change your mind and withdraw your authorization, you will be removed from the research study at that time.
To withdraw your authorization, please contact the person below. They will make sure your written request to withdraw your authorization is processed correctly.
Contact Name: Sarah Wilson

11. How long will this authorization last?

If you agree by signing this form that researchers can use your protected health information, this authorization has no expiration date. However, as stated above, you can change your mind and withdraw your authorization at any time by informing the Principal Investigator in writing.

12. What are my rights regarding access to my personal health information?

You have the right to refuse to sign this authorization form. You have the right to inspect and/or copy your protected health information to be used or disclosed as permitted under federal law (or state law to the extent the state law provides greater access rights). You do not have the right to review and/or copy records kept by the researchers associated with the research study.
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Signatures

I agree that my protected health information may be used for the research purposes described in this form.
Patient Name (Print): _____Date: _____

Patient Signature: _____ Date: _____
Or
Legal Representative (Print): _____

Date: _____
Legal Representative Signature: _____

Date: _____

Appendix N

Nonsignificant Correlations

Table N1

Non Significant Kendall tau b Tests Between Having Surgery and Outcome Measures—DRF Only Group

Variables compared		Coefficient	*p* value
Surgery	QuickDASH	*r (27) = -.117	p = .458
Surgery	TSK-11 harm score	*r (27) = -.253	p = .131
Surgery	Compensatory mechanism (total # used for 5 ADL/IADL tasks)	*r (27) = -.050	p = .758
Surgery	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	*r (27) = -.080	p = .644
Surgery	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	*r (27) = -.082	p = .625
Surgery	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	*r (27) = -.185	p = .273

*r = Kendall tau b

Table N2

Non Significant Spearman Rank Correlation Tests Between Having Surgery and Pain Intensity—DRF Only Group

Variables compared		Coefficient	*p* value
Surgery	VAS	r_s (27) = -.070	*p* = .717

r_s = Spearman rank

Table N3

Non Significant Kendall tau b Tests Between Having Fracture Side Being Dominant Side and Outcome Measures—DRF Only Group

Variables compared		Coefficient	*p* value
Fracture Side is Dominant Side	QuickDASH	**r* (27) = -.199	*p* = .208
Fracture Side is Dominant Side	TSK-11 avoidance score	**r* (27) = -.208	*p* = .203
Fracture Side is Dominant Side	TSK-11 harm score	**r* (27) = -.115	*p* = .493
Fracture Side is Dominant Side	TSK-11 total score	**r* (27) = -.166	*p* = .300
Fracture Side is Dominant Side	Compensatory mechanism (total # used for 5 ADL/IADL tasks)	**r* (27) = -.007	*p* = .964
Fracture Side is Dominant Side	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	**r* (27)= -.132	*p* = .446
Fracture Side is Dominant Side	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	**r* (27) = -.050	*p* = .766

Fracture Side is Dominant Side	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	*r (27) = .163	p = .334

*r = Kendall tau b

Table N4

Non Significant Spearman Rank Correlation Tests Between Having Surgery and Pain Intensity—DRF Only Group

Variables compared		Coefficient	p value
Fracture Side is Dominant Side	VAS score	r_s (27) = .021	p = .913

r_s = Spearman rank

Table N5

Non Significant Spearman Rank Correlation Tests Between Pain and All Outcome Measures—DRF Only Group

Variables compared		Coefficient	p value
VAS score	QuickDASH score	r_s (27) = .068	p = .724
VAS score	TSK-11 harm score	r_s (27) = .085	p = .661
VAS score	TSK-11 total score	r_s (27) = .309	p = .103
VAS score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	r_s (27) = .180	p = .350

VAS score	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	r_s (27) = .083	p = .670
VAS score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (27) = .292	p = .124
VAS score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (27) = .014	p = .943

r_s = Spearman rank

Table N6

Non Significant Spearman Rank Correlation Tests Between Pain and All Outcome Measures—DRF Only Group

Variables compared		Coefficient	p value
VAS score	QuickDASH score	r_s (27) = .068	p = .724
VAS score	TSK-11 harm score	r_s (27) = .085	p = .661
VAS score	TSK-11 total score	r_s (27) = .309	p = .103
VAS score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	r_s (27) = .180	p = .350
VAS score	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	r_s (27) = .083	p = .670
VAS score	Compensatory mechanism—use	r_s (27) = .292	p = .124

	one hand only (# used for 5 ADL/IADL tasks)		
VAS score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (27) = .014	p = .943

r_s = Spearman rank

Table N7

Non Significant Spearman Rank Correlation Tests Between All Outcome Measures—DRF Only Group

Variables compared		Coefficient	p value
QuickDASH score	TSK-11 avoidance score	r_s (27) = .058	p = .764
QuickDASH score	TSK-11 harm score	r_s (27) = -.186	p = .333
QuickDASH score	TSK-11 total score	r_s (27) = -.043	p = .825
QuickDASH score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	r_s (27) = -.082	p = .672
QuickDASH score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (27) = -.125	p = .518
QuickDASH score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (27) = -.193	p = .316

TSK-11 avoidance score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	r_s (27) = -.287	p = .132
TSK-11 avoidance score	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	r_s (27) = .099	p = .609
TSK-11 avoidance score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (27) = -.155	p = .421
TSK-11 avoidance score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (27) = -.259	p = .175
TSK-11 harm score	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	r_s (27) = -.141	p = .466
TSK-11 harm score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (27) = -.268	p = .161
TSK-11 harm score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (27) = -.239	p = .212
TSK-11 total score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	r_s (27) = -.327	p = .083
TSK-11 total score	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	r_s (27) = .048	p = .804

TSK-11 total score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (27)= -.156	p = .419
TSK-11 total score	Compensatory mechanism-take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (27) = -.291	p = .126

r_s = Spearman rank

Table N8

Non Significant Kendall tau b Tests Between Having Surgery and Outcome Measures—Shoulder Pathology Group

Variables compared		Coefficient	p value
Surgery	QuickDASH	*r (14) = .067	p = .761
Surgery	TSK-11 avoidance score	*r (14) = -.068	p = .760
Surgery	TSK-11 harm score	*r (14) = .278	p = .219
Surgery	TSK-11 total score	*r (14) = .123	p = .582
Surgery	Compensatory mechanism (total # used for 5 ADL/IADL tasks)	*r (14) = -.201	p = .362
Surgery	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	*r (14) = .043	p = .852
Surgery	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	*r (14) = -.204	p = .381

Surgery	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	*r (14) = -.230	p = .320

*r = Kendall tau b

Table N9

Non Significant Spearman Rank Correlation Tests Between Having Surgery and Pain Intensity—Shoulder Pathology Group

Variables compared		Coefficient	p value
Surgery	VAS score	r_s (14) = .344	p = .191

r_s = Spearman rank

Table N10

Non Significant Kendall tau b Tests Between Having Fracture Side Being Dominant Side and Outcome Measures—Shoulder Pathology Group

Variables compared		Coefficient	p value
Fracture Side is Dominant Side	QuickDASH	*r (14) = .320	p = .145
Fracture Side is Dominant Side	TSK-11 avoidance score	*r (14) = .068	p = .760
Fracture Side is Dominant Side	TSK-11 harm score	*r (14) = .000	p = 1.00

Fracture Side is Dominant Side	TSK-11 total score	*r (14) = .096	p = .669
Fracture Side is Dominant Side	Compensatory mechanism (total # used for 5 ADL/IADL tasks)	*r (14) = -.188	p = .395
Fracture Side is Dominant Side	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	*r (14) = .072	p = .756
Fracture Side is Dominant Side	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	*r (14) = -.131	p = .573
Fracture Side is Dominant Side	Compensatory mechanism-take longer to perform the activity (# used for 5 ADL/IADL tasks)	*r (14)= -.172	p = .456

*r = Kendall tau b

Table N11

Non Significant Spearman Rank Correlation Tests Between Fracture Side Being Dominant Side and Pain Intensity—Shoulder Pathology Group

Variables compared		Coefficient	p value
Fracture Side is Dominant Side	VAS score	r_s (14) = -.094	p = .729

r_s = Spearman rank

Table N12

Non Significant Spearman Rank Correlation Tests Between Pain and All Outcome Measures—Shoulder Pathology Group

Variables compared		Coefficient	*p* value
VAS score	TSK-11 avoidance score	r_s (14) = .388	*p* = .138
VAS score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (14) = .424	*p* = .102
VAS score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (14) = .434	*p* = .093

r_s = Spearman rank

Table N13

Non Significant Spearman Rank Correlation Tests Between All Outcome Measures—Shoulder Pathology Group

Variables compared		Coefficient	*p* value
QuickDASH score	TSK-11 avoidance score	r_s (14) = .382	*p* = .145
QuickDASH score	TSK-11 harm score	r_s (14) = .357	*p* = .174
QuickDASH score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	r_s (14) = .361	*p* = .169
QuickDASH score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (14) = .269	*p* = .313

QuickDASH score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (14) = .353	p = .179
TSK-11 avoidance score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	r_s (14) = -.027	p = .922
TSK-11 avoidance score	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	r_s (14) = .201	p = .456
TSK-11 avoidance score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (14) = -.001	p = .998
TSK-11 avoidance score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (14) = -.126	p = .641
TSK-11 harm score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	r_s (14) = .076	p = .779
TSK-11 harm score	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	r_s (14) = .428	p = .099
TSK-11 harm score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (14) = -.162	p = .548
TSK-11 harm score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (14) = .119	p = .661

TSK-11 total score	Compensatory mechanisms (total # used for 5 ADL/IADL tasks)	r_s (14) = .103	p = .703
TSK-11 total score	Compensatory mechanism—avoid activity (# used for 5 ADL/IADL tasks)	r_s (14) = .418	p = .107
TSK-11 total score	Compensatory mechanism—use one hand only (# used for 5 ADL/IADL tasks)	r_s (14) = -.113	p = .678
TSK-11 total score	Compensatory mechanism—take longer to perform the activity (# used for 5 ADL/IADL tasks)	r_s (14) = .079	p = .771

r_s = Spearman rank