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Exploring Robotic Devices for the Neuromuscular Population

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BITS in use (Collins, 2022).

Patient using Bioness H200 for grasp and release of pegs (Collins, 2022).

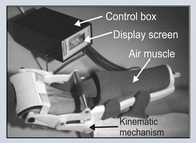
INTRODUCTION

- Cerebral palsy (CP), cerebrovascular accident (CVA), traumatic brain injury (TBI), spinal cord injury (SCI), etc. are multi-faceted and require multi-dimensional care.
- The increase of technology has provided unique therapeutic opportunities.
- Task-oriented repetitive training and occupation-based training using robot-assisted technology has evidence supporting the use with more research needed to determine generalization (Chen et al., 2022; Doucet & Mettler, 2018; Hung et al., 2019; Lee et al., 2021; Villafañe et al., 2018; Yurkewich et al., 2020).
- Robotic-assistive technology can be a valuable tool to increase upper extremity function for the neuromuscular population.

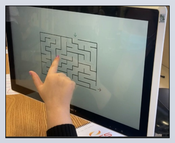
PURPOSE

The purpose of this capstone is for the student to become proficient in a variety of robotic assisted technology devices for the neuromuscular population across diverse populations.

Diego in use at TGH bilaterally with incomplete SCI patient (Collins, 2022).



Motus Nova Hand (Rosenstein et al., 2008).



BITS in use for maze, device analyzed patient accuracy (Collins, 2022).

SITE DESCRIPTION

- Tampa General Hospital Outpatient Clinic is based in Tampa, FL and serves both the pediatric and adult populations.
- The clinic has a variety of technological and robotic-assisted devices for its patients including Tyromotion Diego, Bioness H200, Motus Nova, Bioness Integrated Therapy System (BITS), Motomed with e-stim, and Interactive Metronome (IM).
- This capstone explored the use of robotic-assisted devices for the neuromuscular conditions across populations.
- The OTD student explored evidence-based uses of available devices, create clinician resources, and work toward certifications to use devices in the clinic.

TGH Tampa General Hospital

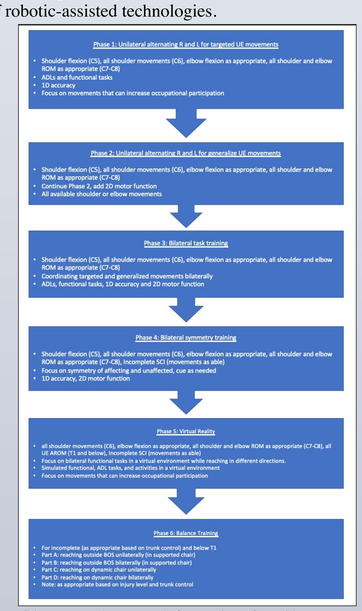
TGH logo (Tampa General Hospital, 2022).

LITERATURE REVIEW SUMMARY

- Research suggests the use of a robotic-devices that use repetitive task-oriented and occupation-based training can increase the user's AROM, strength, motor planning skills, and decrease compensatory strategies (Amano et al., 2020; Lee et al., 2021)
- There are many devices (ArmeoSpring therapy, Gloreha, BITS, and Tyromotion Diego) that use repetitive task-oriented game-based modalities to increase use of the affected arm from a variety of neuromuscular conditions (Wuennemann et al., 2019).
- Current innovations are good tools to use when available based on cost-effectiveness and therapeutic opportunities (Wuennemann et al., 2019; Chen et al., 2022).
- While this is a great tool to use during intervention, it should always be conducted in conjunction with other skilled occupational therapy services and cannot replace the expertise of rehabilitation professionals (Villafañe et al., 2018).
- Research for this population is heavily adult based but has the potential to be a tool for the pediatric therapist working with children with neuromuscular upper extremity deficits (Rahman et al, 2012).
- Both task oriented and repetitive training using robotic assisted technology are found as options to yield functional results that can increase an individual's ability to use their affected upper extremity more effectively (Chen et al., 2022).

CAPSTONE PROJECT DESCRIPTION

- This capstone project explored how the use of robotic assistive technology can be used to increase participation in occupations across diverse populations including stroke and cerebral palsy. Protocols, patient education, clinician resources, and measurability standards were explored and created to implement within the clinic.
- The research shows that robotic-assistive technology can be valuable in the rehabilitation of upper extremity deficits for diagnoses include CVA, SCI, CP and other neuromuscular disorders (Jayasree-Krishnan et al., 2021; Krebs et al, 2009; Singh et al., 2018; Yozbatiran & Francisco, 2019).
- While working directly with OTs both on the pediatric and the adult side of the outpatient setting the student explored the effectiveness and measurability of the use of robotic-assisted technologies.

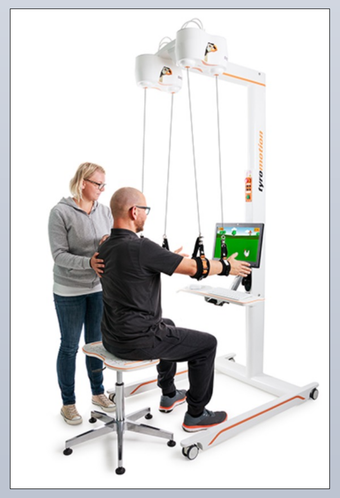


Diego protocols were made for a variety of conditions. Above is a protocol for SCI based on level and functional ability (Collins, 2022).

Student created BITS and diego user manual for easy use within the clinic (Collins, 2022).

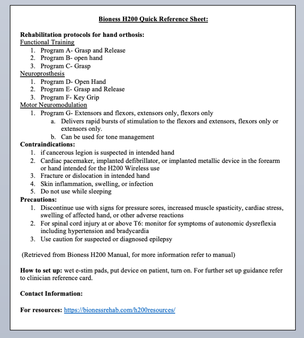
Patient handouts created for each device (Collins, 2022).

Bioness H200 device (Bioness, 2022).



Diego device in use with BUE (Tyromotion, 2022).

69yo M with incomplete C4 quadriplegia BUE AROM initial versus currently with use of Tyromotion Diego and BITS (Collins 2022).



Bioness H200 Quick Reference Sheet:

Rehabilitation protocols for hand orthosis:
Functional Training
1. Program A- Grasp and Release
2. Program B- open hand
3. Program C- Grasp

Neuroprosthesis
1. Program D- Open Hand
2. Program E- Grasp and Release
3. Program F- Key Grip

Motor Neuromodulation
1. Program G- Extensors and flexors, extensors only, flexors only
   a. Delivers rapid bursts of stimulation to the flexors and extensors, flexors only or extensors only.
   b. Can be used for tone management

Contraindications:
1. if cancerous legion is suspected in intended hand
2. Cardiac pacemaker, implanted defibrillator, or implanted metallic device in the forearm or hand intended for the H200 Wireless use
3. Fracture or dislocation in intended hand
4. Skin inflammation, swelling, or infection
5. Do not use while sleeping

Precautions:
1. Discontinue use with signs for pressure sores, increased muscle spasticity, cardiac stress, swelling of affected hand, or other adverse reactions
2. For spinal cord injury at or above T6: monitor for symptoms of autonomic dysreflexia including hypertension and bradycardia
3. Use caution for suspected or diagnosed epilepsy

(Retrieved from Bioness H200 Manual, for more information refer to manual)

How to set up: wet e-stim pads, put device on patient, turn on. For further set up guidance refer to clinician reference card.

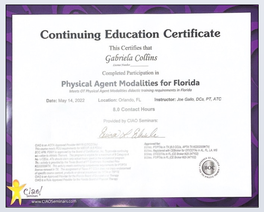
Contact Information:

For resources: https://bionesrehab.com/h200resources/

Quick reference sheets were created for Diego, Bioness H200, BITS, and Motus Nova. Above is a Quick Reference Sheet for Bioness H200.

LEARNING OBJECTIVES ACHIEVED

- Explored currently available robotic-assisted technology within the scope of occupational therapy.
- Increased clinical practice skills for the use of robotic-assisted technology for the neuromuscular population.
- Explored the benefits of robotic-assisted devices for the neuromuscular pediatric population.
- Explored measurability standards to quantify patient progress.
- Created clinician education resources for the use of robotic-assisted technology available at the site.
- Physical Agent Modalities (PAMs) certification course.
- Interactive Metronome Certification (IM) Certification.



IM certification (left), PAMs certification (right).

SUMMARY OF NEEDS ASSESSMENT

- Robotic-assisted technology is an up-and-coming therapeutic technique that is becoming more accessible and commonly used for clients in a variety of settings and populations.
- For the outpatient setting, these techniques have the potential to not only allow patients to increase their ability to use their upper extremities but have carry over into their daily occupations.
- A resource was created for clinicians at the site allowing confidence of evidence-based practice. This would provide a guide to implementation of the devices in a way that is backed by current research.
- Streamlined consistent measurability standards across clinics to create consistency when tracking patient progress.

IMPLICATIONS FOR OT PRACTICE

- Implementation of this capstone project has provided Tampa General Hospital with evidence on the effectiveness of the use of robotic-assisted technology for upper-extremity function, increased ability to quantify progress, and a clinician guide to further incorporate this technology into patient treatment plans.
- A gap was discovered for the use of these devices for the neuromuscular pediatric population. The current research suggests the need to evaluate the potential for this population.
- There is the opportunity for future students to continue and enhance the use of robotic-assisted devices at Tampa General Hospital and within other settings working with individuals with neuromuscular conditions.

REFERENCES & ACKNOWLEDGMENTS

References Available Upon Request

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