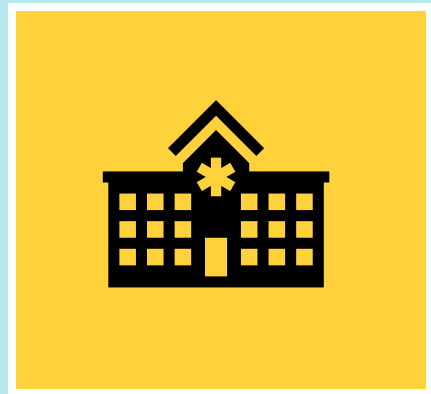


FACILITATING OCCUPATIONAL PARTICIPATION USING TECHNOLOGY FOR NEUROREHABILITATION



Dr. Joahnes Gatdula, OTD, OTR/L, CPAM,
ITOT, CNS

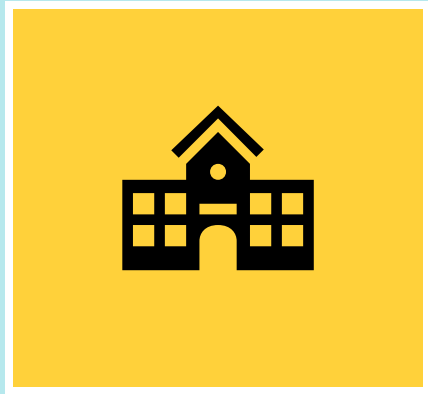
Dr. Allen Espelita, OTD, OTR/L, C/NDT, CLT,
CEAS I, CPAM



- Hamad Medical Corporation
- Blessing Hospital/ SRA-LAB
- Veterans Affairs Greater Los Angeles Healthcare System



▶ Dr. Joahnes Gatdula, OTD,
OTR/L, CPAM, ITOT, CNS

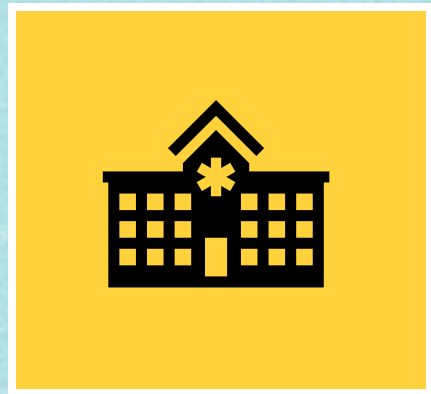


- MSOT Instructor - Irvine California
- OTD Capstone Mentor – Waco, Texas
- Kids picture book author - disability inclusion



▶ Dr. Joahnes Gatdula, OTD,
OTR/L, CPAM, ITOT, CNS





- Hamad Medical Corporation
- University Medical Center of Southern Nevada

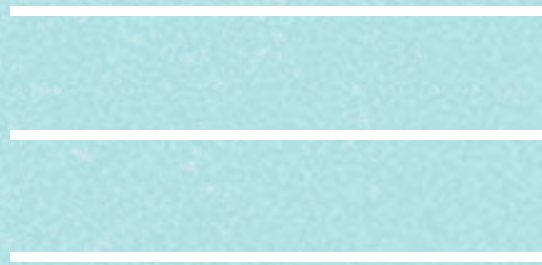
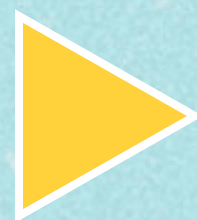


▶ Dr. Allen Espelita, OTD, OTR/L,
C/NDT, CLT, CEAS I, CPAM

Disclaimer



- Not official VA or UMC presentation.
- No commercial endorsement.
- Education purpose only.
- Patients provided consent for video/
photo



Objectives

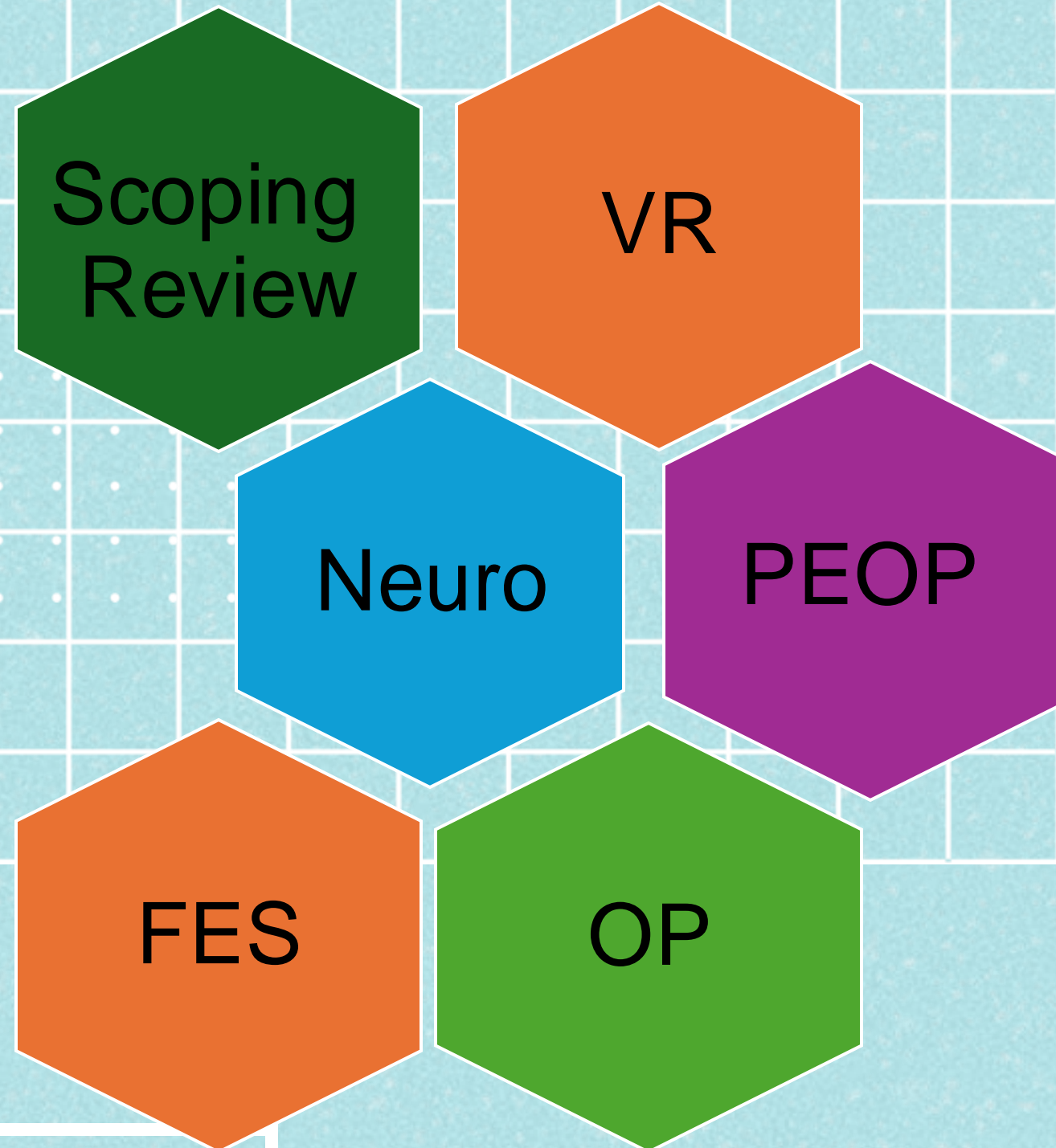
- Define VR and FES stimulation devices.
- Discuss thematic analysis of occupational participation, evaluation, and functional interventions using different technology.
- Analyze appropriate standardized evaluation based on motor, perceptual and vestibular deficits.
- Provide case discussion of patients utilizing technology toward meaningful roles, occupational engagement, and quality of life.



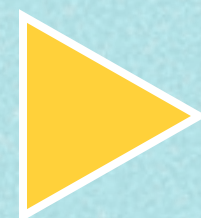
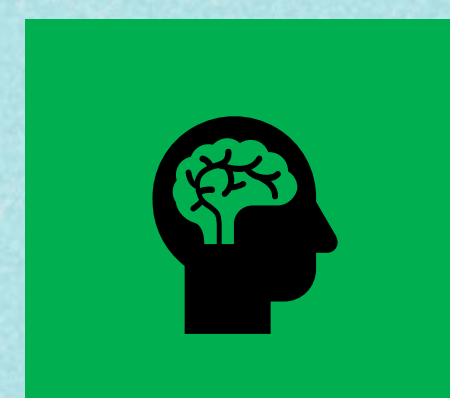
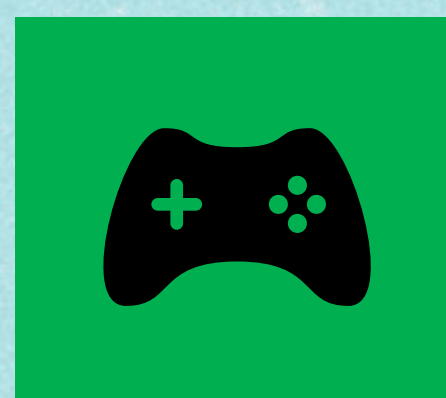
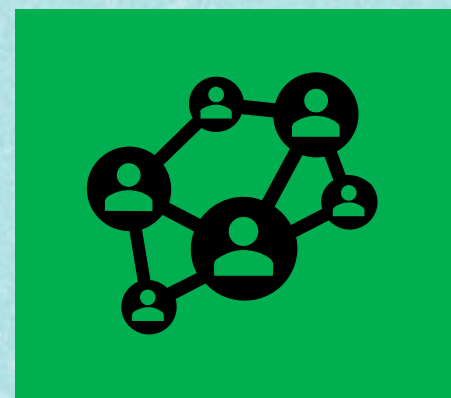
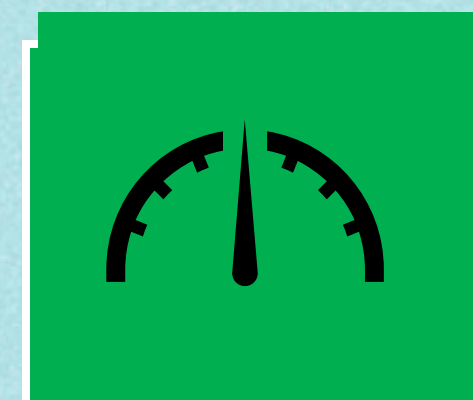
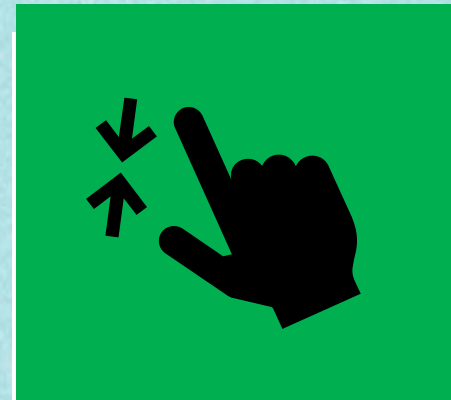
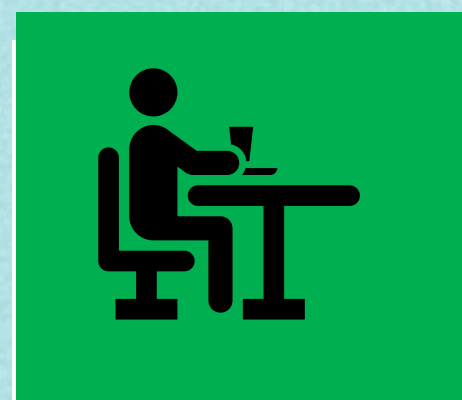
“For people without disabilities, technology makes things easier. For people with disabilities, technology makes things possible.”

IBM, 1991

METHODOLOGY

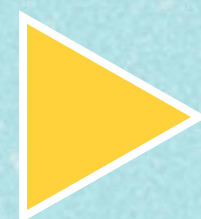
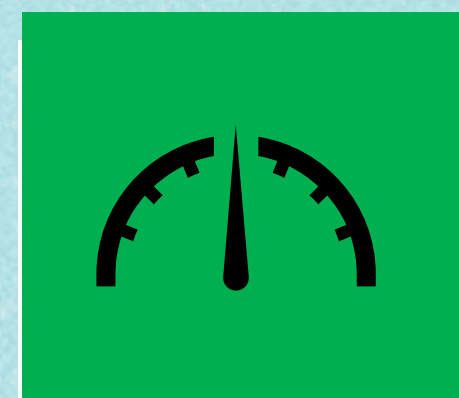
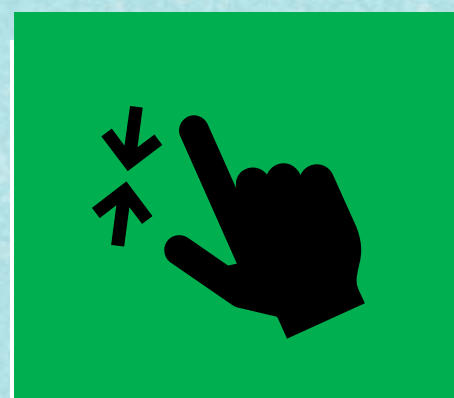
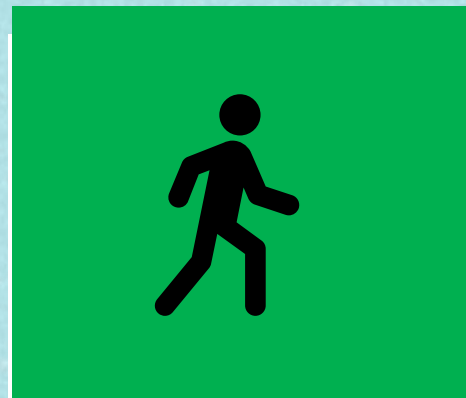


RESULTS: VR



Adlakha, et al., 2020; Demeco et al., 2023; Ettenhofer et al., 2019; Teasell et al., 2020; VA Immersive, 2024

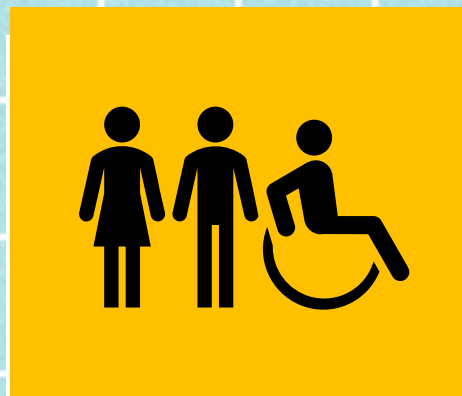
RESULTS: FES



OCCUPATIONAL PARTICIPATION



Integration of occupational performance in meaningful task. Performing personally meaningful and socially valued activities and roles.



Enabled better understanding of one's abilities and limitations, assisted in occupational adaptation, and held unique meaning for participants

VIRTUAL REALITY

a range of computing technologies that present artificially generated sensory information in a form that people perceive as similar to real-world objects or events

Saldana et al., 2020

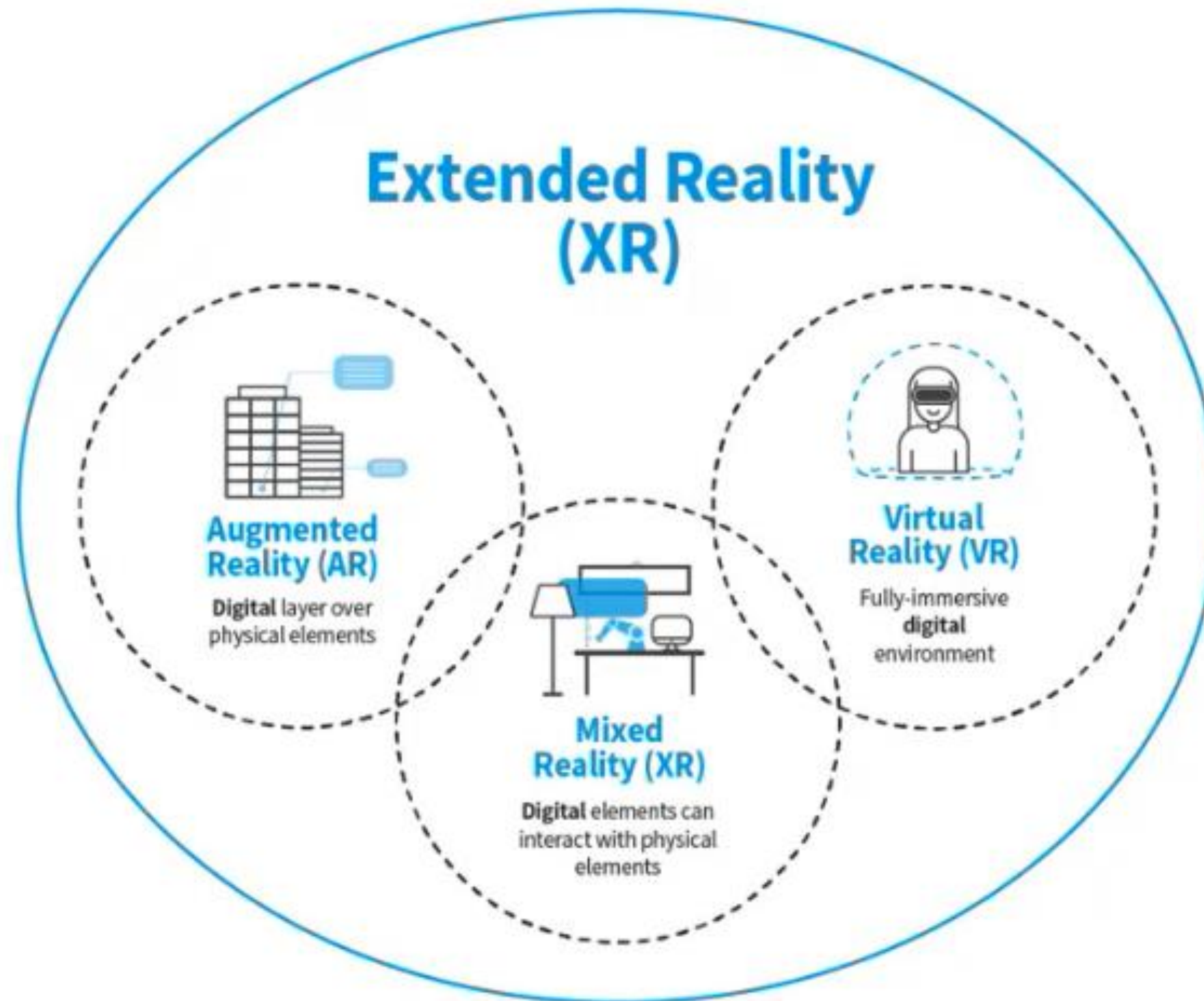


Microsoft PowerPoint images



Extended Reality (XR)

Umbrella term that encompasses any sort of technology that alters reality by adding digital elements to the physical or real-world environment by any extent.



Interaction Design Foundation
interaction-design.org

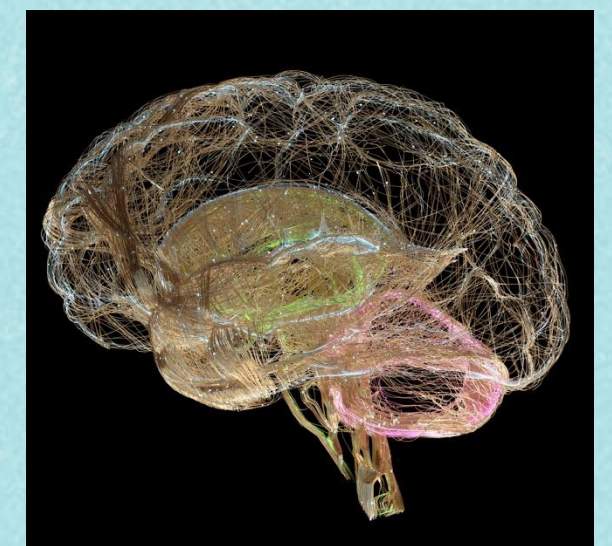
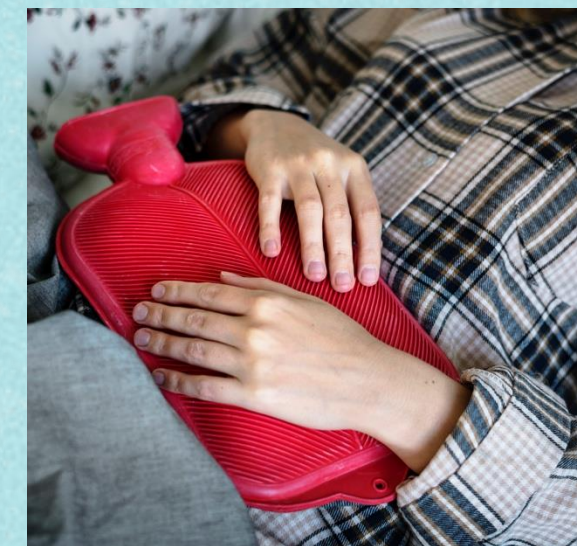


VA Immersive, 2023



VR INDICATIONS

- PTSD
- Creative arts
- Amputation
- Rehabilitation patients
- Mental health units
- Pain management
- Cognitive impairment

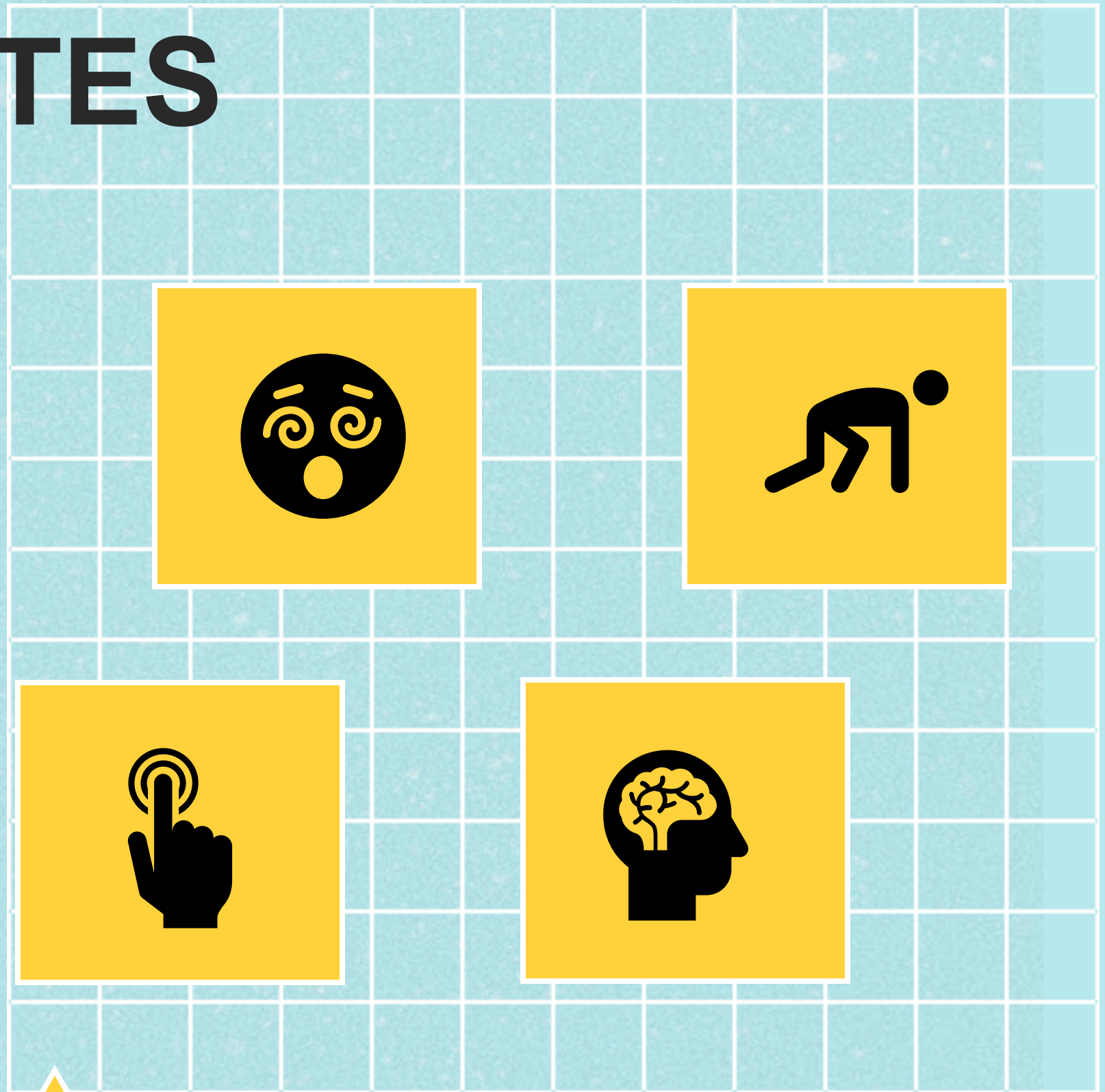


Microsoft PowerPoint images

Adlakha et al., 2020; VA Immersive, 2023


VR SAFETY NOTES

- Fall risk precautions
- Close supervision
- Seizure warning
- Disorientation
- Dissociation
- May elicit vertigo






Research and Evidence Supporting VR








ELSEVIER




Chaos, Solitons & Fractals
Volume 140, November 2020, 110192





Effectiveness of gamification for the rehabilitation of neurodegenerative disorders

Shagun Adlakha^a, Deepak Chhabra^b  , Pratyosh Shukla^c  

Show more 

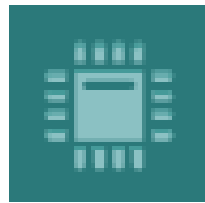
 Add to Mendeley  Share  Cite

<https://doi.org/10.1016/j.chaos.2020.110192> 

[Get rights and content](#) 

Adlakha et al., 2020

Research and Evidence Supporting VR



sensors



Review

Immersive Virtual Reality in Post-Stroke Rehabilitation: A Systematic Review

Andrea Demeco ¹ , Laura Zola ¹, Antonio Frizziero ¹ , Chiara Martini ², Arrigo Palumbo ³, Ruben Foresti ¹ ,
Giovanni Buccino ^{4,*} and Cosimo Costantino ¹ 

¹ Department of Medicine and Surgery, University of Parma, 43126 Parma, Italy

² Department of Diagnostic, Parma University Hospital, 43126 Parma, Italy

³ Department of Medical and Surgical Sciences, University of Catanzaro "Magna Graecia",
88100 Catanzaro, Italy

⁴ Division of Neuroscience, IRCCS San Raffaele, University Vita-Salute San Raffaele, 20132 Milan, Italy

* Correspondence: buccino.giovanni@hsr.it



Research and Evidence Supporting VR

Biochemistry Research International

[Biomed Res Int.](#) 2019; 2019: 7106951.

Published online 2019 Nov 13. doi: [10.1155/2019/7106951](https://doi.org/10.1155/2019/7106951)

PMCID: [PMC6885151](#)

PMID: [31828120](#)

Efficacy of Virtual Reality Rehabilitation after Spinal Cord Injury: A Systematic Review

[Amanda Vitória Lacerda de Araújo](#),¹ [Jaqueline Freitas de Oliveira Neiva](#),^{1,2} [Carlos Bandeira de Mello Monteiro](#),^{1,3} and [Fernando Henrique Magalhães](#)^{✉ 1}

▶ [Author information](#) ▶ [Article notes](#) ▶ [Copyright and License information](#) [PMC Disclaimer](#)

Journal Article

De Araujo et al., 2019



Meta Quest 3



Medvis AR



FireFly VR



Applied
VR



XR Health



Neuro
Rehab VR

VA Immersive, 2023



REAL SYSTEM Y-SERIES



Penumbra., 2022

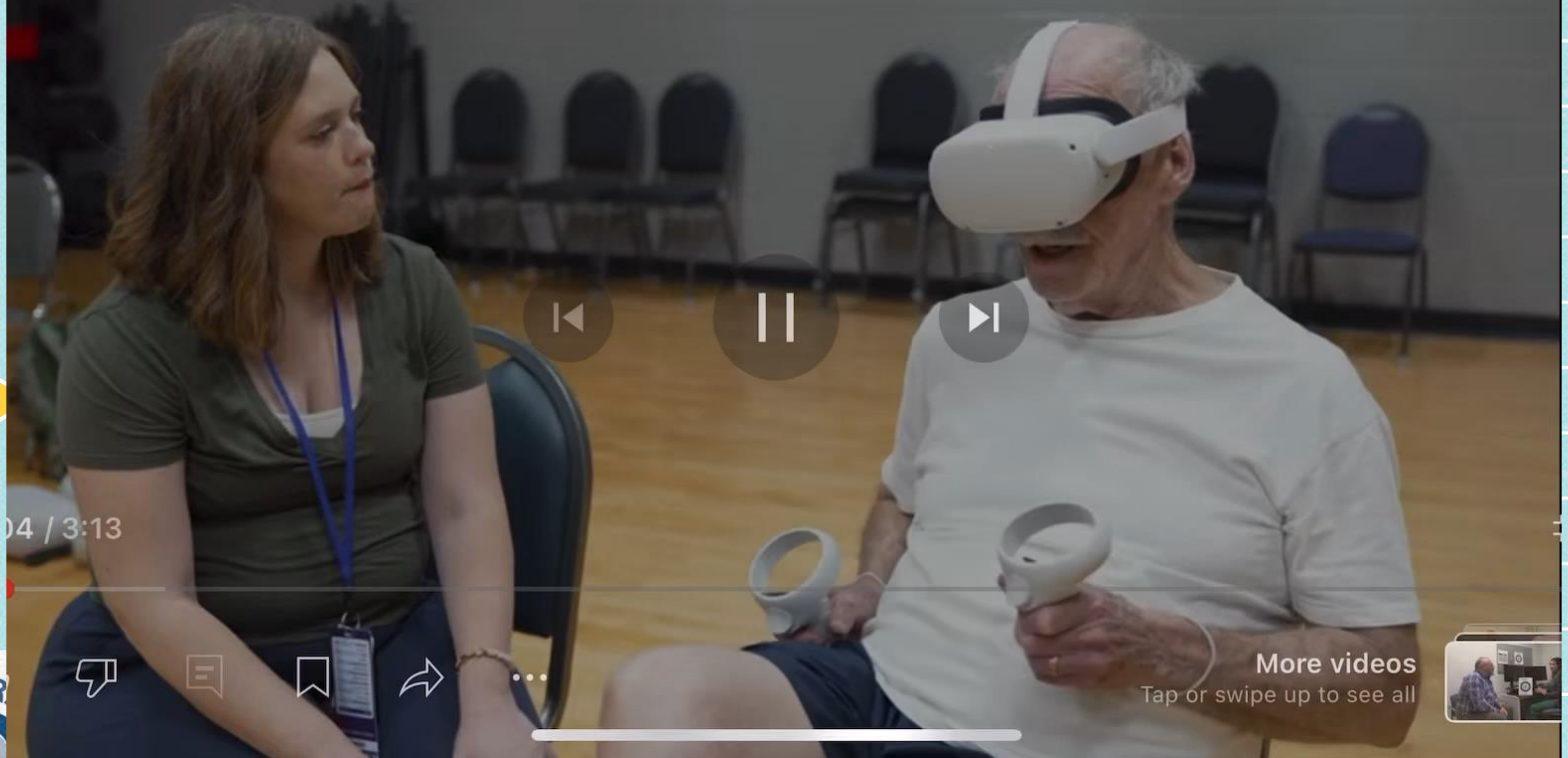


IMMERSIVE REHABILITATION



Immersive: VR Group Therapy Testimonial >

Veterans Health Administration



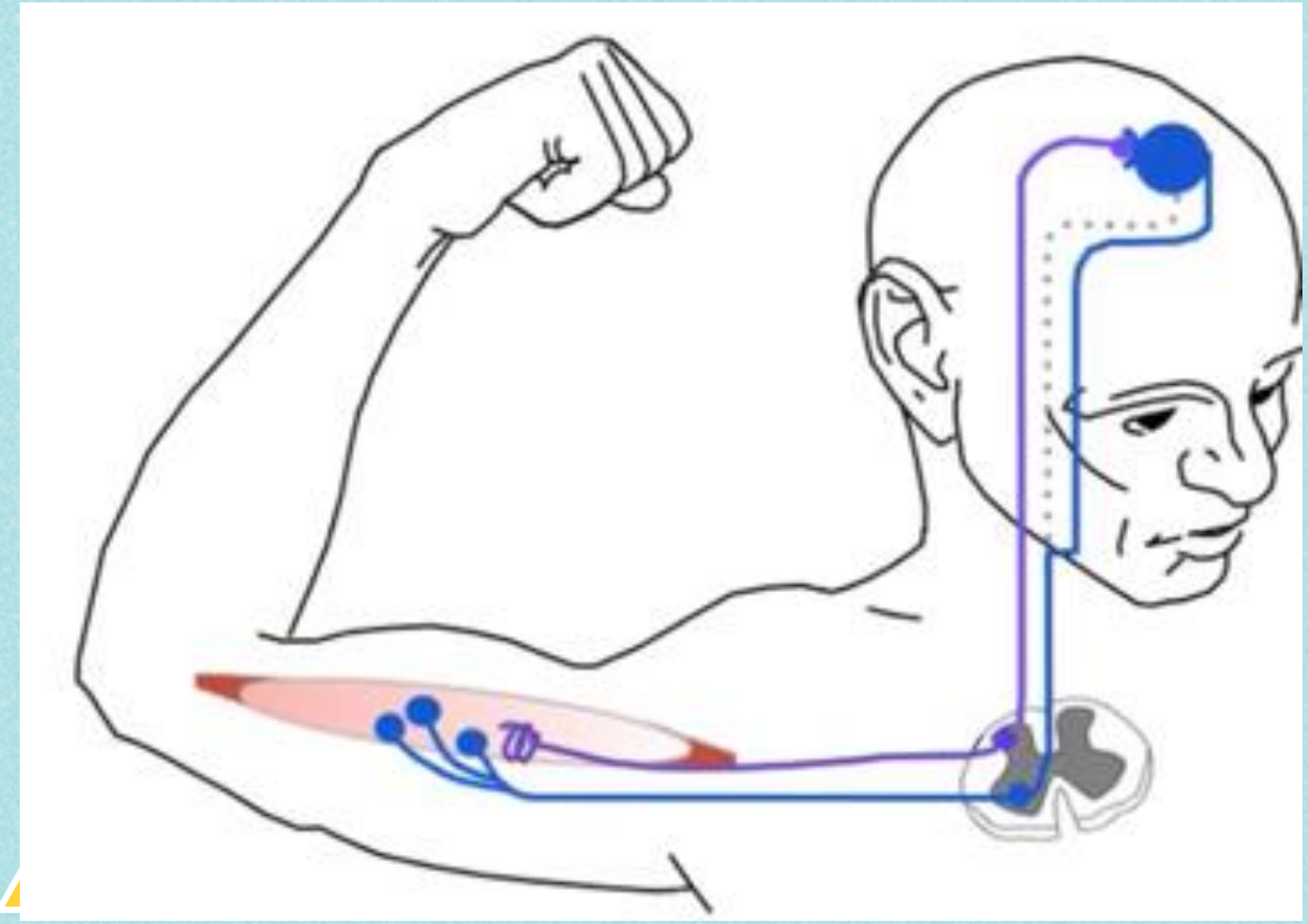
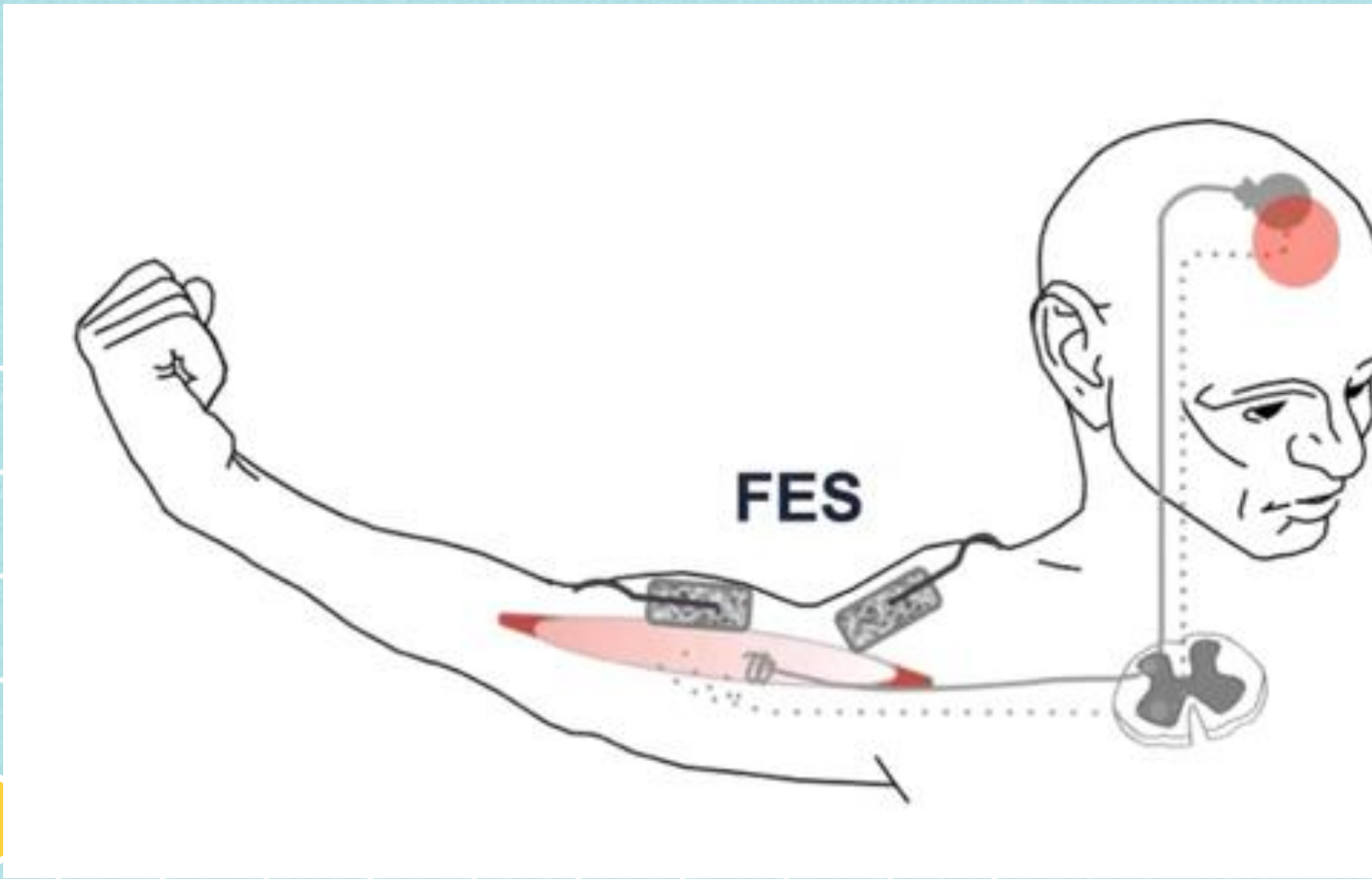
04 / 3:13



More videos
Tap or swipe up to see all



VA Immersive, 2023



How FES therapy works?

Patient
actively
attempts the
desired
movement

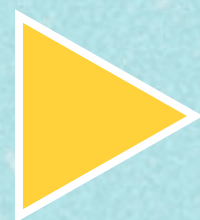
FES actively
generates the
desired
movement

Therapist
guides the
timing &
quality of
movement

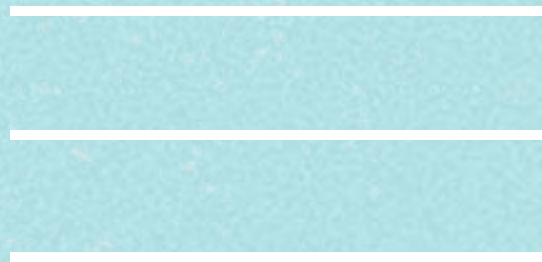


FES INDICATIONS

- Spinal cord injury
- Stroke
- Multiple sclerosis
- TBI
- Cerebral palsy
- Weakness following brain/ spine surgery
- Brachial plexus injury

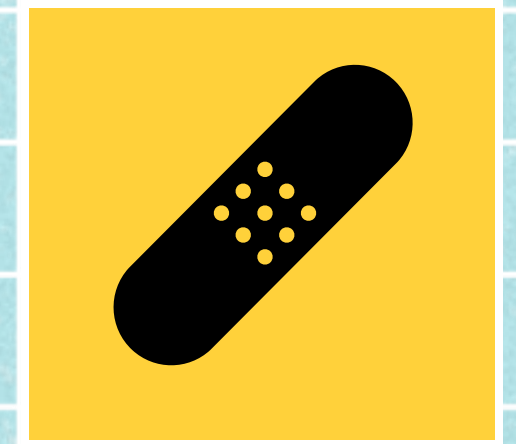


Kapadia et al., 2020; Saikaley et al., 2022; Teasell et al., 2020



FES CONTRAINDICATIONS

- Metal implants
- Pacemaker
- Seizure
- Open wound
- Autonomic dysreflexia
- Active cancer
- Fracture/ dislocation





Research and Evidence Supporting FES

Hindawi Publishing Corporation
BioMed Research International
Volume 2015, Article ID 729768, 14 pages
<http://dx.doi.org/10.1155/2015/729768>

Review Article

Effectiveness of Functional Electrical Stimulation in Improving Clinical Outcomes in the Upper Arm following Stroke: A Systematic Review and Meta-Analysis

Amir K. Vafadar,¹ Julie N. Côté,² and Philippe S. Archambault¹

¹*School of Physical and Occupational Therapy, McGill University and Interdisciplinary Research Center in Rehabilitation (CRIR), 3654 Promenade Sir William Osler, Montreal, QC, Canada H3G 1Y5*

²*Department of Kinesiology and Physical Education, McGill University and Interdisciplinary Research Center in Rehabilitation (CRIR), 475 Pine Avenue West, Montreal, QC, Canada H2W 1S4*

Correspondence should be addressed to Amir K. Vafadar; amir.vafadar@mail.mcgill.ca

Received 16 June 2014; Revised 17 August 2014; Accepted 9 October 2014



Research and Evidence Supporting FES

Cerebrovascular
Diseases

Systematic Review

Cerebrovasc Dis
DOI: 10.1159/000535470

Received: September 15, 2023
Accepted: November 17, 2023
Published online: December 28, 2023

Meta-Analysis of Functional Electrical Stimulation Combined with Occupational Therapy on Post-Stroke Limb Functional Recovery and Quality of Life

Mei Sun^b Che Jiang^c Jianbo Zhang^c Kuihong Cheng^{a,c} Wei Zheng^b
Xiwu Zhang^c Xiaona Wu^c Zhuang Chen^c Gaoquan Luo^c Gang Zhao^{a,c}

^aFirst Clinical School of Medicine, Southern Medical University, Guangzhou, China; ^bDepartment of Anesthesiology, PLA General Hospital of Southern Theater Command of PLA, Guangzhou, China; ^cDepartment of Neurosurgery, General Hospital of Southern Theater Command of PLA, Guangzhou, China

Sun et al., 2023

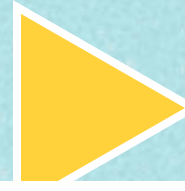
MYNDMOVE



MyndMove Therapy, 2022



MYNDMOVE



Jenny
1000014
Feb 1990

SESSION DETAILS
REPORTS
SESSION HISTORY













Jun 27, 2014
Jun 24, 2014
Jun 24, 2014
Jun 24, 2014
Jun 24, 2014
Jun 24, 2014
Jun 20, 2014
Jun 20, 2014
Jun 20, 2014
Jun 20, 2014

END SESSION
HELP


LOGIN | PATIENT | SETUP | TREATMENT | NOTES

Patient

Available Protocols

 S01: Hand-Mouth	 S02: Opposite Shoulder
 S03: Side Reach	 S04: Forward Reach
 S05: Opposite Shoulder + Lateral Reach	 S06: Opposite Knee Reach
 S07: Side Reach + Lumbricals	 S08: Side Reach + Ext. Digi.
 S09: Forward Reach + Lumbricals	 S10: Forward Reach + Ext. Dig.
 S11: Palmar Grasp	 S12: Lateral Pinch

S01: Hand-Mouth



BEGIN TREATMENT

Protocol Sequence:

1. Elbow Flexion & Shoulder Flexion
2. Elbow Extension & Shoulder Extension
3. Arm Relaxation

Equipment Needed:

- Cables: Red, Blue, and Green
- Splitters: None
- Electrodes: 6 - 5x5
- Switches: 1 (left switch or right switch)

MORE DETAILS



Research and Evidence Supporting FES

 **frontiers** | Frontiers in **Rehabilitation Sciences**

TYPE Original Research
PUBLISHED 09 September 2022
DOI 10.3389/frehab.2022.995244

 Check for updates

OPEN ACCESS

EDITED BY
Ashraf S. Gorgey,
Hunter Holmes McGuire VA Medical Center,
United States

REVIEWED BY
Eric Turner Harness,
Neuro Ex, Inc, United States
Feilong Zhu,
Beijing Normal University, China

*CORRESPONDENCE
Kim D. Anderson
kxa304@case.edu

SPECIALTY SECTION
This article was submitted to Interventions for
Rehabilitation, a section of the journal Frontiers

Multi-center, single-blind randomized controlled trial comparing functional electrical stimulation therapy to conventional therapy in incomplete tetraplegia

Kim D. Anderson^{1,2*}, Radha Korupolu^{3,4}, Kristin E. Musselman^{5,6},
Jacqueline Pierce⁷, James R. Wilson^{1,2}, Nuray Yozbatiran^{3,4},
Naaz Desai⁸, Milos R. Popovic^{5,9,10} and Lehana Thabane^{11,12,13}

REGRASP



REGRASP







Bioness H200 Wireless

Dr. Allen Espelita,

OTD, OTR/L, C/NDT, CLT, CEAS I, CPAM

What is the Bioness H200 Wireless?

Wireless hand rehabilitation system.

Utilizes Functional Electrical Stimulation (FES) to improve hand function.

Designed for neuro patients with upper limb impairments (e.g., stroke, TBI, SCI).



Clinical Benefits of Bioness H200 Wireless

Key Benefits:

- Improves hand strength and dexterity.
- Enhances motor control and range of motion.
- Reduces spasticity and improves muscle re-education.
- Promotes functional use of the hand in daily activities.
- Increase in local blood circulation.

Key Features of the H200 Wireless

- **Wireless Convenience:**
 - Portable and easy to use at home or in clinics.
- **Three Pre-Programmed Modes:**
 - Customizable stimulation patterns for different needs.
- **Comfort and Fit:**
 - Lightweight and ergonomically designed for patient comfort.
- **User-Friendly Interface:**
 - Patients can control their therapy easily via the handheld remote.

Key Features of the H200 Wireless



Clinical Application and Protocols

- In the Clinic:
 - Often used alongside traditional therapy methods (e.g., OT).
 - Can be incorporated into goal-directed, task-specific training.
- At Home:
 - Enables patients to continue therapy at home with supervision from clinicians.
- Duration of Use:
 - Typically used 45–60 min sessions were delivered 3–5 days a week.



Research and Evidence Supporting FES



Embedded PDF

Functional Electrical Stimulation Therapy for Retraining Reaching and Grasping After Spinal Cord Injury and Stroke

Naaz Kapadia^{1,2,3,4}, Bastien Moineau^{1,5,6} and Milos R. Popovic^{2,3,4,5}*

¹ Rehabilitation Engineering Laboratory, The KITE Research Institute, Toronto Rehabilitation Institute-University Health Network, Toronto, ON, Canada, ² Rehabilitation Sciences Institute, University of Toronto, Toronto, ON, Canada, ³ CRANIA, University Health Network and University of Toronto, Toronto, ON, Canada, ⁴ The KITE Research Institute, Toronto Rehabilitation Institute-University Health Network, Toronto, ON, Canada, ⁵ Institute of Biomaterials and Biomedical Engineering, University of Toronto, Toronto, ON, Canada, ⁶ Myant Inc., Toronto, ON, Canada

Kapadia et al., 2020



Research and Evidence Supporting FES

Cureus

Open Access Case
Report

DOI: 10.7759/cureus.52447

Clinical Outcomes of “Paralyzed” Nerve Transfer for Treating Spinal Cord Injury: A Proof of Concept in a Human Model

Review began 12/22/2023

Review ended 01/05/2024

Published 01/17/2024

© Copyright 2024

Chepla et al. This is an open access article distributed under the terms of the Creative Commons Attribution License CC-BY 4.0., which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Kyle J. Chepla ¹, Blake Perkins ², Anne M. Bryden ², Michael W. Keith ³

1. Surgery, MetroHealth Medical Center, Cleveland, USA 2. Physical Medicine and Rehabilitation, MetroHealth Medical Center, Cleveland, USA 3. Orthopaedic Surgery, MetroHealth Medical Center, Cleveland, USA

Corresponding author: Kyle J. Chepla, kyle.chepla@gmail.com

Chepla et al., 2024



Research and Evidence Supporting FES



Article

STIMGRASP: A Home-Based Functional Electrical Stimulator for Grasp Restoration in Daily Activities

Renato G. Barelli, Valter F. Avelino  and Maria Claudia F. Castro * 

Electrical Engineering Department, Centro Universitário FEI, São Bernardo do Campo 09850-901, SP, Brazil

* Correspondence: mclaudia@fei.edu.br

Barelli, et al., 2023

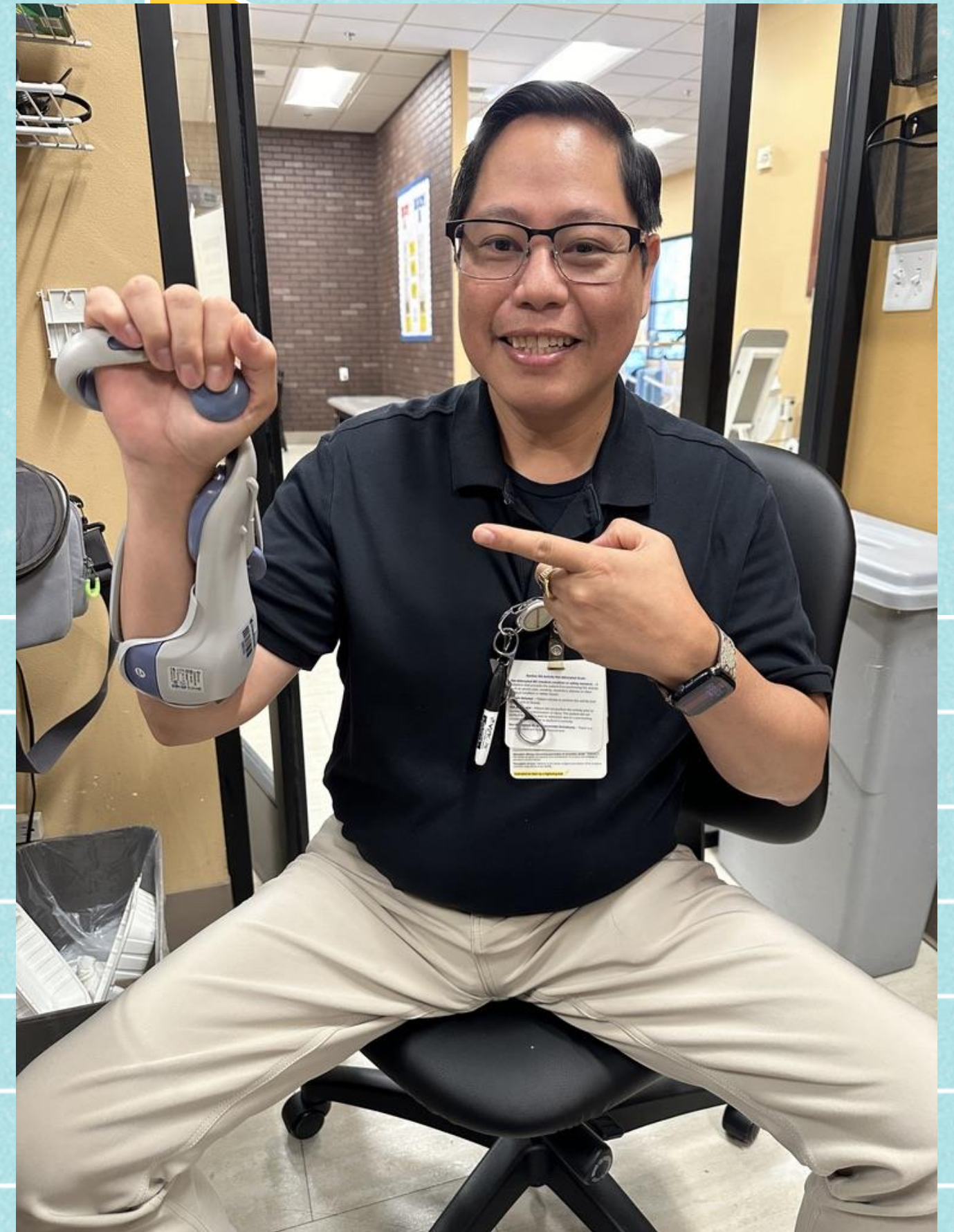
Limitations and Considerations

- Challenges:
 - Initial cost of the device.
 - Requires patient motivation and consistent use.
 - May not be suitable for patients with severe sensory impairments.
- Considerations:
 - Custom fitting is required for optimal performance.
 - Regular follow-ups for adjustments and progression.

Summary

Recap of Key Points:

- The Bioness H200 Wireless is an innovative tool for neurorehabilitation.
- Benefits include improved motor function and greater independence.
- It is a versatile tool that can be used in both clinical and home settings.



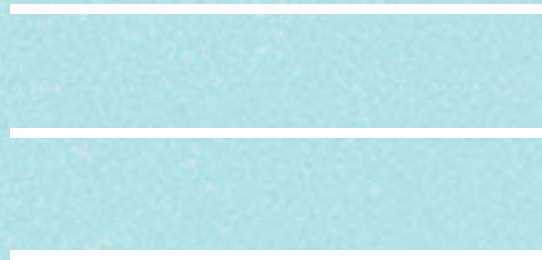
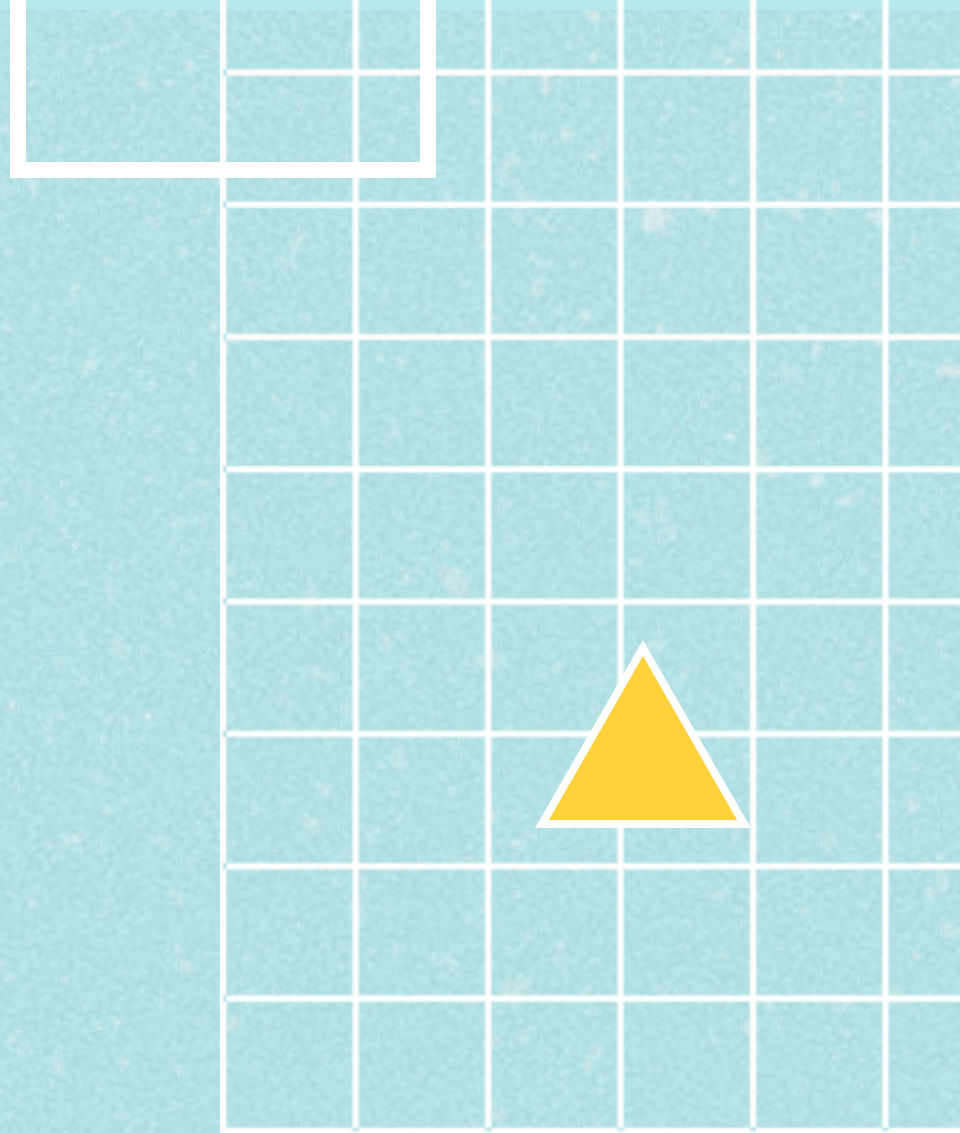
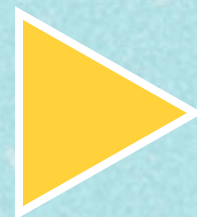
Future Directions

- Looking Ahead:
- Advancements in neurorehabilitation technology.
 - Expanding access to affordable, home-based rehab solutions.





OT VIDEO



REFERENCES

Adlakha, S., Chhabra, D., & Shukla, P. (2020). Effectiveness of gamification for the rehabilitation of neurodegenerative disorders. *Chaos Solitons & Fractals*, 140, 110192. <https://doi.org/10.1016/j.chaos.2020.110192>

Anderson, K. D., Korupolu, R., Musselman, K. E., Pierce, J., Wilson, J. R., Yozbatiran, N., Desai, N., Popovic, M. R., & Thabane, L. (2022). Multi-center, single-blind randomized controlled trial comparing functional electrical stimulation therapy to conventional therapy in incomplete tetraplegia. *Frontiers in Rehabilitation Sciences*, 3. <https://doi.org/10.3389/fresc.2022.995244>

Barelli, R. G., Avelino, V. F., & Castro, M. C. F. (2023). STIMGRASP: A home-based functional electrical stimulator for grasp restoration in daily activities. *Sensors*, 23(1), 10. doi:<https://doi.org/10.3390/s23010010>

Bioness. (2024). Bioness.com.

<https://www.bioness.com/Documents/H200Consumer/MP612-00964-001%20Rev.%20B%20>



REFERENCES

- Bioventus . (2020). *H200 User Guide Wireless Bioness*. Bioventus.
<https://bionessrehab.com/wp-content/uploads/2023/05/MP612-00964-001-Rev.-D-efile.pdf>
- Chepla, K. J., Perkins, B., Bryden, A. M., & Keith, M. W. (2024). Clinical outcomes of “Paralyzed” nerve transfer for treating spinal cord injury: A proof of concept in a human model. *Cureus, 16*(1)
doi:<https://doi.org/10.7759/cureus.52447>
- De Araújo, A. V. L., De Oliveira Neiva, J. F., De Mello Monteiro, C. B., & Magalhães, F. H. (2019). Efficacy of Virtual Reality Rehabilitation after Spinal Cord Injury: A Systematic Review. *BioMed Research International, 2019*, 1–15.
<https://doi.org/10.1155/2019/7106951>
- Demeco, A., Zola, L., Frizziero, A., Martini, C., Palumbo, A., Foresti, R., Buccino, G., & Costantino, C. (2023). Immersive Virtual Reality in Post-Stroke Rehabilitation: A Systematic review. *Sensors, 23*(3), 1712.
<https://doi.org/10.3390/s23031712>

REFERENCES

- Ettenhofer, M. L., Guise, B., Brandler, B., Bittner, K., Gimbel, S. I., Cordero, E., Schmitt, S. N., Williams, K., Cox, D., Roy, M. J., & Chan, L. (2019). Neurocognitive Driving Rehabilitation in Virtual Environments (NeuroDRIVE): A pilot clinical trial for chronic traumatic brain injury. *Neurorehabilitation, 44*(4), 531–544. <https://doi.org/10.3233/nre-192718>
- Hassett, L., Van Den Berg, M., Lindley, R. I., Crotty, M., McCluskey, A., Van Der Ploeg, H. P., Smith, S. T., Schurr, K., Howard, K., Hackett, M. L., Killington, M., Bongers, B., Togher, L., Treacy, D., Dorsch, S., Wong, S., Scrivener, K., Chagpar, S., Weber, H., . . . Sherrington, C. (2020). Digitally enabled aged care and neurological rehabilitation to enhance outcomes with Activity and MObility Using Technology (AMOUNT) in Australia: A randomised controlled trial. *PLoS Medicine, 17*(2), e1003029. <https://doi.org/10.1371/journal.pmed.1003029>.
- Kapadia, N., Moineau, B., & Popovic, M. R. (2020). Functional electrical stimulation therapy for retraining reaching and grasping after spinal cord injury and stroke. *Frontiers in Neuroscience, 14*. <https://doi.org/10.3389/fnins.2020.00718>



REFERENCES

- Klepo, I., Sangster Jokić, C., & Tršinski, D. (2022). The role of occupational participation for people with traumatic brain injury: a systematic review of the literature. *Disability and rehabilitation*, 44(13), 2988–3001. <https://doi.org/10.1080/09638288.2020.1858351>
- Lew, S.V. (2020). <https://doi.org/10.1080/09638288.2020.1858351>
- Kim, W. S., Cho, S., Ku, J., Kim, Y., Lee, K., Hwang, H. J., & Paik, N. J. (2020). Clinical Application of virtual reality for upper limb motor rehabilitation in Stroke: Review of technologies and clinical evidence. *Journal of Clinical Medicine*, 9(10), 3369. <https://doi.org/10.3390/jcm9103369>
- Levin, M. F., & Demers, M. (2020). Motor learning in neurological rehabilitation. *Disability and Rehabilitation*, 43(24), 3445–3453. <https://doi.org/10.1080/09638288.2020.1752317>
- MyndMove Therapy - MyndTec Inc. (2022, January 18). MyndTec Inc. <https://myndtec.com/clinicians/myndmove-therapy/>
- Penumbra. (2022). *The REAL® System, virtual Reality rehabilitation tool*. REAL System: VR Rehabilitation. <https://www.realsystem.com/>



REFERENCES

Popovic, M. (2022). *Myndmove* [Slide show].

<https://www.sralab.org/academy/online-learning/c-star-myndmove-how-functional-electrical-stimulation-therapy-reaching-and-grasping-can-be-used>

Proulx, C. E., Beaulac, M., David, M., Deguire, C., Haché, C., Klug, F., Kupnik, M., Higgins, J., & Gagnon, D. H. (2020). Review of the effects of soft robotic gloves for activity-based rehabilitation in individuals with reduced hand function and manual dexterity following a neurological event. *Journal of Rehabilitation and Assistive Technologies Engineering*, 7, 205566832091813.

<https://doi.org/10.1177/2055668320918130>

Rehabtronics. (2022). *ReGrASp Clinician System - Rehabtronics*.

<https://rehabtronics.com/product/regrasp-clinician-system/>

Saldana, D., Neureither, M., Schmiesing, A., Jahng, E., Kysh, L., Roll, S. C., & Liew, S. (2020). Applications of Head-Mounted Displays for Virtual Reality in Adult Physical Rehabilitation: A scoping review. *the American Journal of Occupational Therapy*, 74(5), 7405205060p1-7405205060p15.

<https://doi.org/10.5014/ajot.2020.041442>



REFERENCES

Saikaley, M., Pauli, G., Iruthayarajah, J., Mirkowski, M., Iliescu, A., Caughlin, S., Fragis, N., Alam, R., Harris, J., Dukelow, S., Chae, J., Knutson, J., Miller, T., & Teasell, R. (2022). *Upper extremity motor rehabilitation interventions* [Book-chapter]. EBRSR.

http://ebrsr.com/sites/default/files/Ch.%2010%20Upper%20Extremity%20Motor%20Interventions_v20.pdf

Sun, M., Jiang, C., Zhang, J., Cheng, K., Zheng, W., Zhang, X., Wu, X., Chen, Z., Luo, G., & Zhao, G. (2023). Meta-Analysis of Functional Electrical Stimulation Combined with Occupational Therapy on Post-Stroke Limb Functional Recovery and Quality of Life. *Cerebrovascular Diseases*, 1–10.

<https://doi.org/10.1159/000535470>

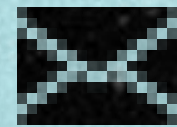
Teasell, R., Hussein, N., Mirkowski, M., Vanderlaan, D., Saikaley, M., Longval, M., & Iruthayarajah, J. (2020). *Stroke Rehabilitation Clinician Handbook* (pp. 1–60).

http://www.ebrsr.com/sites/default/files/EBRSR%20Handbook%20Chapter%2004_Upper%20Extremity%20Post%20Stroke_ML.pdf

REFERENCES

- Vafadar, A. K., Côté, J. N., & Archambault, P. S. (2015). Effectiveness of Functional Electrical Stimulation in Improving Clinical Outcomes in the Upper Arm following Stroke: A Systematic Review and Meta-Analysis. *BioMed Research International*, 2015, 1–14. <https://doi.org/10.1155/2015/729768>
- VA Immersive. (2023). *Introductory Guide to Immersive Technology*.
INTRODUCTORY GUIDE TO IMMERSIVE TECHNOLOGY.
<https://www.innovation.va.gov/hil/assets/documents/va-immersive-introduction-guide-summer-2023-public.pdf>
- VA Immersive. (2024). *Immersive virtual reality in health care literature compendium*. <https://www.innovation.va.gov/hil/assets/documents/va-immersive-lit-review-2024.pdf>

Thank you!



Joahnes.Gatdula@va.gov
Arespelita@gmail.com



**FACILITATING OCCUPATIONAL PARTICIPATION
USING TECHNOLOGY FOR NEUROREHABILITATION**

