VIRTUAL REALITY IN THE TREATMENT OF UPPER EXTREMITY FUNCTION IN ACUTE TBI REHABILITATION

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OBJECTIVES

• Identify the standard of occupational therapy in TBI rehabilitation.
• Outline potential benefits of immersive virtual reality (VR) in TBI rehabilitation.
• Provide lessons learned and observations obtained to date of VR use in TBI rehabilitation.
VR INTRO

• Video

**Soundboxing** (Maxint LLC) – Player punches orbs that line up with the beat of a song.
CASE STUDY #1
OT looks at the “job of living” - whatever the person wants or needs to do in a day

- Self-care tasks, chores or yardwork, childcare
- Work or volunteer
- Hobbies and social activities

Health changes can also impact mood, sleep, energy, and cognition which also affects daily functioning.
TRAUMATIC BRAIN INJURY DEMOGRAPHICS
(EDWARDS 2014; US DEPT OF VA/DOD 2016; SALISBURY, 2016; SIMMONS, 2016)

• US
  • 1.7 – 2.2 million incidence per year
  • Risk factors include cardiovascular disease, falls which increase with aging population

• Military/ Veterans
  • Between 2000-2012 over 4% of service members sustained a documented TBI
OCCUPATIONAL THERAPY FOR TBI ADDRESSES
(WHEELER, 2016; WHEELER, 2017)

• Arousal, motor function, cognition, visual perception
• Psychosocial and emotional factors
• Social participation
• Occupational participation: ADL, IADL, work, community
OT FOR TBI CAN INCLUDE
(SIMMONS, 2014; WHEELER, 2017; NEISTADT, 1994; YUNGER, 2012)

• Exercise programs
• Computer-based tools/Assistive Technology
• Postural and dynamic balance
• Multidisciplinary rehabilitation programs
• Constraint induced movement therapy (CIMT)
• Functional and table top activities
• Biofeedback
• Motor imagery, mirror therapy, mental rehearsal
Return to Work

Driving
- Visual processing
- Divided attention; Executive processing

Computer Tasks
- UE Function
- Sustained Focus

Social Interaction
- Emotional Regulation

BOTTOM UP AND TOP DOWN STRATEGIES

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VIRTUAL REALITY AS A REHAB TOOL FOR TBI

• Fairly well tolerated and potentially effective tool to add to conventional care to address cognition, ADLs, driving, fitness to return to military duty

• Benefits
  • Improved individualization and grading
  • Application to real-world, meaningful tasks
    • Optimizes neuroplasticity
    • May increase motivation and focused attention to increase repetition
  • Can serve as an effective distraction from pain

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2-DIMENSIONAL VS HEAD MOUNTED DISPLAY
(MUMFORD, 2012; LEVIN, 2015; HIGHLAND, 2015; EDWARDS, 2014)

• Benefits of HMD
  • More immersive
  • Reduced external distraction
  • Embodiment

• Benefits of 2D
  • Cost and accessibility
  • More research completed

• Unknowns
  • Do they have the same potential side-effects/ tolerance e.g. “simulator sickness”
IMPLEMENTING VR FOR TBI: WHO, WHAT, WHEN, AND HOW

• Wide range of use across
  • Age, gender, and cultural factors
  • Physical function (e.g. option to adapt with straps or alternate sensors)
  • Cognitive factors (e.g. able to follow 2 step directive)

• Potential Contraindications
  • Occurrence of seizure
  • Unstable mental health condition
  • Visual impairments prohibiting use
  • Communicable diseases preventing sharing of device
  • Impulsivity preventing safe use
IMPLEMENTING VR FOR TBI: WHO WHAT WHERE WHEN AND HOW

• 2-D options
  • Commercial devices such as Nintendo Wii, Microsoft Kinect
  • Rehab devices that interface with 2D VR platforms

• Head Mounted
  • Commercial devices such as HTC, Oculus, Windows Mixed Reality, Smartphone-based
  • New devices being released regularly
  • Rehab-specific and commercial software
IMPLEMENTING VR FOR TBI: WHO WHAT WHERE WHEN AND HOW

• Inpatient Rehab
• Outpatient Rehab
• Home/ Community
IMPLEMENTING VR FOR TBI: WHO WHAT WHERE WHEN AND HOW (SALISBURY, 2016; KENNEDY, 1993; PARK, 2017)

- Part of coordinated care plan, in addition to rather than substitute for other evidence-based treatments
- Dosing is person dependent and tapered
  - Start with introduction and check tolerance
  - Slowly build up duration and intensity
- Tolerance
  - Simulator Sickness Questionnaire:
    - 16 items; rate symptoms as none, slight, moderate, or severe
    - mSSQ: headache, sweating, nausea, blurred vision, and dizziness with eyes open
- Other factors: patient satisfaction, changing health status, identified treatment priorities
IMPLEMENTING VR FOR TBI: WHO WHAT WHERE WHEN AND HOW

• Safety
  - Coordinate with your facility e.g. Infection control for HMD
  - Start seated and progress to standing as indicated/ tolerated (BERG, mSSQ)

• Equipment
  - Identify existing or feasible to obtain equipment
  - Start by exploring with:
    - Staff
    - Optimal candidates
    - Increasing complexity
IMPLEMENTING VR FOR TBI: WHO WHAT WHERE WHEN AND HOW

• Select Games by Considering:
  • Physical demands: UE, LE, endurance
  • Cognitive demands: divided attention, processing
  • Sensory processing demands: vision, hearing
  • Ability to adjust and adapt to meet patient needs and treatment priorities
  • Patient preferences
EXAMPLES OF GAMES FOR TBI AND UE

**Soundboxing** (Maxint LLC) —
Player punches orbs that line up with the beat of a song.

**VR Diner Duo** (WhirlyBird Games) —
Player combines ingredients to match a customer’s hamburger order.

**Fruit Ninja VR** (HalfBrick Studios PTY LTD) — Fruit comes at player from all angles and needs to be sliced with swords before hitting the ground.
CASE STUDY #2
UPCOMING RESEARCH: AN IDEA WAS BORN

• PICO, OT department evidence based practice workgroup
• Connected with facility resources: AT, MADE, leadership
• Learned of and applied for grant through MN Spinal Cord Injury and Traumatic Brain Injury Annual Research Grant Program
UPCOMING RESEARCH: THE PLAN

• Compare the outcomes when HMD VR is used as a tool during OT sessions for inpatients with acute TBI to conventional OT

• Measure Outcomes Using
  • Action Research Arm Test (ARAT)
  • Measures of UE/hand function e.g. strength, coordination
  • Self-care performance
  • Patient satisfaction and impressions
UPCOMING RESEARCH: THE FUTURE

• Use knowledge gained to identify clearer pathway to the use of VR
  • Across the TBI continuum of care
  • In home and tele-rehab settings
  • To address other treatment components such as cognition, emotional regulation, pain
  • Connected to multi-modal sensory experiences, biofeedback, and haptic feedback
  • Simulated outings, home evals, work tasks, etc
  • Assessments more applicable to real-life challenges
VR RESOURCES

• VRHealth.Institute – provides exercise equivalents, assigns games ratings based on observed MET score (a standard measure of exertion)

• VirtualMedicine.health

• UploadVR.com, RoadToVR.com – for information on VR products and software
REFERENCES


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