Concussion Management: The Role of Vestibular Rehabilitation

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"Restoring Quality of Life"

Concussion

• The Role of the Physical Therapist
  – Valuable member of Multidisciplinary team
  – Who is on the team?
    • MD/DD (trained in concussion evaluation/management)
    • Athletic Trainer
    • Neuropsychology
    • Neurology
    • Neuro-opthalmology/Optometry
    • Psychiatry

Concussion: Symptoms

| Cognitive          | Physical                | Emotional        | Sleep
|--------------------|-------------------------|------------------|-------------------
| Difficulty thinking clearly | Headache | Irritability | Sleeping more than usual
| Feeling slowed down | Fuzzy/blurry vision | Sadness | Sleep less than usual
| Difficulty concentrating | Sensitivity to noise or light | More emotional | Trouble falling asleep
| Difficulty remembering new information | Feeling tired, having no energy | Nervousness or anxiety | ---

Concussion Symptoms Experienced

• Headache/pressure in head (~71%)
• Balance problems or dizziness (~43-55%)
• Double/blurry vision (~49%)
• Sensitivity to light
• Sensitivity to noise
• Feeling foggy
• Concentration/memory problems
• Confusion
• Does not “feel right”
• Nausea or vomiting
  (Lovell, 2004)

Concussion

• General Recovery
  – Symptoms typically resolve within 7-10 days
    • Sport-related concussions
    • Approximately 10% of individuals continue with symptoms > 10 day (post-concussion syndrome?)
    • Symptom duration tends to be longer in children and those with prior concussions
  – Collins et al. (2006) (male HS football players; N = 137)
    • 60% better by week 2
    • 80% better by week 3
    • 90% better by week 4
    • Better = back to baseline on neuropsychological test and symptom inventory
Concussion

• Post Concussion Syndrome (Morrison et al., 2001)
  — Uncertainty of definition
  • World Health Organization (WHO): International Classification of Diseases, 10th Revision (ICD-10)
    ▪ Symptom onset within 1 month of injury
      ▪ With loss of consciousness
    ▪ Presence of three or more of the following symptoms:
      — Headache
      — Dizziness
      — Fatigue
      — Noise intolerance
      — Irritability, depression, anxiety
      — Insomnia
      — Concentration/memory difficulty
      — Reduced alcohol intolerance

Concussion Pathophysiology

• Regulatory and autoregulatory physiological dysfunction (Landy et al., 2007)
  — Concussion is a systemic injury
  — Autonomic Nervous System
    ▪ Concussion-induced heart rate (HR) variability reduction
    ▪ Increase in sympathetic activity
    ▪ Decrease in parasympathetic activity
    ▪ Relationship to altered sleep patterns
  ▪ Implications for treatment (role of mental training)
    ▪ Increase parasympathetic activity
    ▪ Increase CMR
    ▪ Improve cerebral regulations
  ▪ How much is enough rest? When should we start to exercise?

Concussion Evaluation & Concussion Management

Concussion

• General Overview
  — Immediate removal from sport
  — Medical evaluation
  — Physical and Cognitive rest
    ▪ Limit school, TV, computer, texting, music etc.
    ▪ No sports or physical exertion.
  — Return-To-Play protocol
  — School modifications
    ▪ 504 plan (part of IDEA: essentially removal of barriers)
    ▪ IEP (part of IDEA: providing educational services)
  — Medication/Supplements
  — Physical Therapy
    ▪ When is it appropriate?

Concussion

• Post Concussion Syndrome (Morrison et al., 2001)
  — Diagnostic and Statistical Manual of Mental Disorders (Fourth ed, Text Revised: DSM-IV-R)
    ▪ History of head traumas with LOC, posttraumatic amnesia and/or seizures
    ▪ Neuropsychological evidence of difficulty in attention or memory
    ▪ 3 or more symptoms lasting > 3 months
      ▪ Fatigue, disordered sleep
      ▪ Headache, dizziness
      ▪ Irritability or aggression
      ▪ Anxiety, depression
      ▪ Personality changes
      ▪ Aphthia

• Physical Therapy can be helpful for persistent symptoms:
  — Headache
  — Dizziness
  — Oculomotor dysfunction
  — Imbalance
  — Cervical pain
  — Limitation in cervical ROM/flexibility
  — Return to learn/Return to play
Post-Concussion Examination

- What is causing dizziness/headaches?
  - Peripheral vestibular
  - Central vestibular
  - Oculomotor abnormalities
  - Cervicogenic
  - Migraine
  - Multisensory

Vestibular System

Functions of Vestibular System

- Gaze stabilization
- Sensing and Perceiving motion
- Postural control
- Sensory and Motor system

Anatomy of Vestibular System

Physiology of Vestibular System
Semicircular Canal Physiology

Otoliths: Haircells and Otoconia

Sensory Systems Related to Postural Control

Post-Concussion Examination

- Physical Exam
  - Observation
  - Oculomotor
  - Vestibular
  - Balance/Gait
  - Musculoskeletal
  - Cardiovascular
  - Integumentary (?)
  - Postural Orthostatic Tachycardia Syndrome (POTS)

Observation

- Appearance of eyes
  - Strained/squinting
  - Glazing "blood shot"
- Eye position
  - Strabismus
  - Skew deviation
  - Prolonged recovery?
  - Cover/Uncover test
- Head/neck position
  - Head tilt
  - Forward head
  - Skew deviation
- Skin
  - Discoloration

http://www.seiko-opt.co.jp

Oculomotor

- Smooth pursuits/Saccades
  - 30 degrees all directions
  - 20°-24° distance from eyes
- Convergence/divergence
  - Normal < 6 cm from nose
- Gaze
  - Neutral and divergence
  - 30 degrees from center
  - 20°-24°
  - 10° holds
- Use discreet targets
- Proper speed

visionhelp.wordpress.com
Vestibular
• Vestibular-ocular reflex
  – VOR
• Vestibular Motion Sensitivity/Cancellation
  – VORcx
• Screen for BPPV (Musolino, 2002)
  – Benign Paroxysmal Positional Vertigo
  – <5% incidence in concussion
• Cervicogenic Dizziness
  – Neck Torsion Test

VOR/VORcx

Test for BPPV

Balance/Gait
• Balance Error Scoring System (BESS)
  – Reliability?
• Platform testing
  – Neurocom
  – Biodex
• Dynamic balance assessment
  – Tandem walk fwd/bwd
  – Eyes open/closed
• Impaired postural control post concussion
  (Kamm and Callaghan, 2008 & 2009, Buskirk et al., 2002)

Musculoskeletal
• Cervical ROM/passive joint mobility
  – Upper cervical spine
  – Thoracic spine consideration
• Cervical muscle strength/flexibility
  – Deep neck flexors
    • Longus colli/longus capitus

http://www.comfoundation.org/
Concussion_Balance_Testing.html
Neck Torsion Test

Cardiovascular
- Measure HR and BP
  - Resting HR may be elevated post concussion
  - Dysregulation due to increased sympathetic activity
- Treadmill Test
  - Balke Protocol
  - Address physiological dysfunction
  - When to test?

Concussion Management
- Modified Return to Play Protocol for Post-Concussion Syndrome
  - Includes
    - Vestibular rehabilitation
      - Addresses: Dizziness, balance, headache
    - Manual physical therapy
      - Addresses: Headache, neck pain, impaired strength
    - Progressive aerobic activity/exeretional training
      - Addresses: Deconditioning, decreased cerebral blood flow
    - Duration of recovery
      - Variable (see factors affecting recovery)

PT Intervention
- Vestibular Rehabilitation
  - 3 Main goals:
    - Decrease/eliminate dizziness
    - Stabilize balance
    - Improve activity levels

Vestibular Rehabilitation
- Gaze Stabilization Exercises (VOR)/(Adaptation)
  - Improves vestibular-ocular reflex
  - Reflex eye movement driven by vestibular system
  - Progress repetitions/time (how many/how long?)
  - Variable speeds
    - Initially start slow
  - Variable support surfaces
  - Variable visual backgrounds
  - Implement into task-specific training

Vestibular Rehabilitation
- Smooth pursuits and Saccadic eye movements
  - Volitional eye movements driven by cerebellum
  - Progress repetitions (how many?)
  - Variable speeds
    - Initially start slow
  - Variable support surfaces
  - Variable visual backgrounds
  - Implement into task-specific training
Vestibular Rehabilitation

- Balance retraining
  - Substitution via visual and somatosensory systems
  - As well as remaining vestibular function
  - Progress from static to dynamic situations
  - Firm support surface to unstable support surfaces
  - Task specific training
  - Simultaneous cognitive exertion

Vestibular Rehabilitation

- Habituation
  - Repeated exposure to provoking stimuli will allow the CNS to decrease the response
  - Start with least provoking first
  - Document 0 out of 10 for symptoms
  - Document duration of symptoms

Canalith Repositioning Techniques (CRT) for BPPV

- Epley maneuver

Start position of the canalith repositioning maneuver

Movement of the otoconia in the head hanging position

Slow turn while maintaining neck extension

**Vestibular Rehabilitation**

- Alsalameen et al., (2010)
  - VRT reduces dizziness and improves gait and balance function after concussion
  - Measurements included:
    - Dizziness severity
    - Activities of Balance Confidence (ABC) scale
    - Dizziness Handicap Inventory (DHI)
    - Dynamic Gait Index (DGI), gait speed
    - Sensor Organization Test (SOT)

- Alsalameen et al., (2012)
  - Exercise prescription patterns in patients treated with VRT after concussion
    - VOR: 95% of patients
      - 3x/day: 60 seconds
      - 80% of patients received on first visit
    - Static balance: 88%
      - 2x/day: 30 seconds
    - Ambulation: 76%
      - 1x/day: 20 feet/20 head turns
    - Exercise modifiers included: variable supports surfaces and variable background, dual task

**Manual Physical Therapy**

- Goals
  - Improve ROM/joint mobility
  - Decrease pain/headache
  - Increase neck strength
  - Improve somatosensory input
Aerobic Conditioning

- Progression of light aerobic activity based on symptom response
  - Treadmill, bike, elliptical
  - Monitoring heart rate
    - Initial level based on treadmill test
    - Progress to 30’; starting at 15’
- Progress to more moderate activity
  - Walk/jog routine progressing to all jog
  - Trampoline jog
  - Agility drills
- Initially perform eye exercises before aerobic activity
- Eventually perform eye exercise after aerobic activity
  - Once patient is able to perform moderate activity sx free
  - See if patient can tolerate stressing eyes after physically fatigued

Concussion Management

Finding the “Sweet Spot” (Gioia, 2012)

Thank You!

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