Postural Instability and Vestibular Deficits Associated with Concussion: Assessment and Treatment

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Concussion

• Complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.

• Assessment covers range of domains including clinical symptoms, physical signs, behavior, balance, sleep and cognition.

McCrory 2009

Post Concussion Syndrome

• Persistent physical, cognitive, emotional, and/or behavioral symptoms following mTBI
• Resolution month – years
• Prevalence at 3 month post-injury: 24-84%
• Believed to be related to pre-morbid, injury and post-morbid factors

(Ryan 2003)

Symptoms

• symptoms dizziness and balance problems are associated with measurable deficits in postural control (Broglio 2009)

• loss of consciousness, HA, nausea/vomiting, dizziness may be prognostic indicators of PCS (Zemek 2013)

Symptoms

• HA may contribute to increased balance deficits as a result of increased sensory organization challenges (Mihalik 2008)
Concussion Evaluation

Assessment across a range of domains: symptoms, physical signs, behavior, balance, sleep, cognition (McCrory 2009)

Physical Therapist:
• Objective assessment of balance
• Assessment of symptoms such as dizziness, visual disturbance

Management

• Cornerstone of concussion management: physical and cognitive rest
  – Modified by factors that require additional management
• Graded exertion program
• Return to play

(McCrory 2009)

Recovery

• symptom-free at rest
• normal neurocognitive and balance testing
• no abnormalities with return to full cognitive and physical activity

(Lovell 2004, McCrory 2009)

Multidisciplinary Team

• MD
• Neuropsychologist
• Physical Therapist
• Neuro-opthamalogist

Physical Therapist

Assessment of the Vestibular, Oculomotor and Balance Systems

Individualized and targeted intervention

For clients who suffer from dizziness and/or imbalance following concussion....

_vestibular rehabilitation is effective_

(Alsalaheen 2010)
Physical Therapy Evaluation

- History
- Systems Screen
- Oculomotor exam
- Vestibular Testing
- Positional Testing
- Balance Assessment

History

- Date of Injury
- Current Symptoms:
  - Dizziness, HA (migraine?), visual disturbance, disequilibrium, pain, auditory disturbance, fatigue, decreased concentration, memory loss etc.
- Prior Concussion

Why dizziness? Why Imbalance?

Vestibular System

1) Senses head position and acceleration - linear and angular

Vestibular Apparatus

- Labyrinth of inner ear, petrous portion of temporal bone
- Vestibulocochlear (VIII cranial) nerve
  - Superior
  - Inferior
- Vestibular nuclei, cerebellum, brainstem
- Parieto-temporal cortex

Vestibular System

2) Stabilization of gaze

3) Postural control
   - Via Vestibular reflexes: vestibulo-spinal and vestibulo-ocular

Vestibular Apparatus
Etiology

Vestibular Pathology
- Peripheral
  - Benign Paroxysmal Positional Vertigo
  - Labyrinthine Concussion
  - Perilymphatic Fistula
- Central
  - Brainstem, Cerebellar
  - Migraine
- Cervicogenic

Common causes....

Oculo-motor abnormalities

Gaze stability

Migraine

Orthostatic hypotension

PT Examination

Oculomotor Exam

Central and peripheral pathology
Assessing eye movement, nystagmus, symptoms

Common Dysfunction:
- convergence, misalignment, saccade/pursuit impairment, VOR dysfunction, gaze holding nystagmus

Spontaneous nystagmus (without fixation)
- Instruct patient to gaze straight ahead;
- ABN: nystagmus

Gaze-evoked nystagmus (without fixation) (peripheral or central)
- Instruct patient to gaze at tip of finger position 30° left, right, up, down from center,
- ABN: nystagmus (note direction changing; effects of fixation to distinguish)

Ocular ROM/Smooth Pursuit
- Instruct patient to follow tip of finger 30° (about 6 inches) left, right, up, down;
- ABN: disconjugate eye movement, restrictions in ROM

Saccades (Hor/Vert)
- Instruct pt to look back and forth between two fingers;
- ABN: disconjugate mvmt, over- or under shooting
Oculomotor Exam

Cover/Uncover; cross cover test - misalignment
- Cover then uncover eye
- ABN: movement of redress onto target

Vergence
- Use patient’s thumb, eyes follow in/out

VOR Testing (screen Cx ROM 1st)
- Patients head tilted forward 30°, patient instructed to maintain gaze of your nose, rotate patients head slowly (<2Hz) and rapidly (>2Hz);
- ABN: unable to maintain gaze/focus
- Work into head thrust tests

PT Examination

Head thrust (screen Cx ROM 1st)
- Pts head tilted forward 30°, patient instructed to maintain gaze of your nose, manually thrust/rotate (small amplitude: 5°-15°, high acceleration) patients head in an unpredictable direction;
- ABN: corrective saccade

Dynamic visual acuity (DVA)
- instruct pt to read the lowest line possible with head stationary then flex patient’s head forward 30° and manually bilaterally oscillate patient’s head at 2 Hz, instruct pt read the lowest line possible;
- ABN: drop of three or more lines of acuity (i.e. 20/20 to 20/60)
- Reliable outcome measure in clients with TBI (Gottshall 2003)

Positional Testing

- Incidence BPPV with concussion is low: <5% (Alsaleheen 2010)

As indicated:
- Dix-Hallpike
- Roll Test
Balance Assessment

- Static and Dynamic
- Gait
- Sensory Organization
- Self Report Measures

Assessment of Balance

- Static and Dynamic
  - Romberg
  - BESS – developed specifically for concussed athletes
  - Star Excursion
  - Five Time Sit to Stand
  - BESTest and miniBEST

Assessment of Balance

Gait:
- Functional Gait Index
- Dynamic Gait Index
- High Level Mobility Assessment Tool

Sensory Organization:
- Computerized Dynamic Posturography (CDP) – Sensory Organization Testing (SOT), Head Shake SOT

Sensory Organization Test

Sensory Organization Test (SOT)
- monitor body sway under 6 conditions that alter or eliminate visual and somatosensory input
- pattern of increased sway or falls indicative of sensory deficits/sensory dependence
Self-Report Measures

Dizziness Handicap Inventory (DHI)
• Reliable outcome measure TBI (Gottshall 2003)

Activity-Specific Balance Confidence Scale (ABC)

Intervention

Important Considerations:
• Monitor symptoms during each session
• Oculo-motor training as needed
• Recovery may be slow – advance slowly
• Limit exertion according to symptoms
• Multi-disciplinary team approach

Intervention

Rehab plan is individualized specific to exam findings

Post-concussion, clients with lingering dizziness, imbalance receiving vestibular rehab are most commonly prescribed:
• Eye–head coordination
• standing static balance exercises
• ambulation exercises
(Alahasheen 2012)

Oculomotor Training

Gaze Stabilization Exercises:
• Dynamic vestibular dysfunction
• Visual blurring, disequilibrium/gt ataxia, limited trunk/head rotation due to decreased VOR gain
• plasticity – ability of vestibular system to make changes in neuronal response to input
• Goal - regain gaze stability and postural control

Oculomotor Training

Gaze Stabilization: VOR1 - VOR2
• 1 min – 2 min
• Seated – standing – foam – unilateral – walking
• Blank background – full field
• Add mental task
• Perform with eyes closed or in dark

Note: Business card should be positioned at eye level.
Oculomotor Training

Brock String:
- Vergence insufficiency, binocular vision
- 10ft white string, 3 beads different colors

Oculomotor Training

Pencil Push-ups:
- Convergence insufficiency

Balance and Gait

Specific and targeted balance and gait program:
- Include sensory organization challenges
- Include task and environmental challenges
- Include mental challenges
- Dual task training

Monitor symptoms and limit exertion – especially early on

Case Study

References


References


