

Concussion



PHYSICAL THERAPY EVALUATION FOLLOWING CONCUSSION

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Objectives

The learner will be able to:

- Describe the pathophysiology of concussion
- List the various components of concussion assessment
- Incorporate appropriate examination techniques when examining individuals post concussion
- Recognize the importance of a team approach in the management of individuals post concussion
- Describe typical examination findings post concussion

Concussion

“Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces.”

Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012

Mechanism of Injury

- Mechanical trauma to the brain as a result of acceleration/deceleration forces
 - Direct blow to the head, face or neck
 - Direct blow elsewhere on the body with an impulsive force transmitted to the head
 - Blast Injury



Pathophysiology of Mechanical Trauma

- Acceleration/Deceleration forces cause axonal stretching and deformation of the cell membrane
- May or may not involve LOC (4-10%)
- Rapid onset of short-lived impairment of neurological function that resolves spontaneously
- Symptoms due to a functional disturbance, not structural
- Normal imaging



Pathophysiology

Axonal stretching causes:

- Influx of Ca⁺⁺/Efflux of K⁺ causing vasoconstriction and ↓ blood supply
- Na⁺/K⁺ pump works overtime to restore neuronal membrane potential increasing the demand for adenosine triphosphate (ATP)
- Increased ATP demand triggers an increase in glucose metabolism
- Increased demand for glucose in setting of reduced blood supply creates a supply and demand disparity

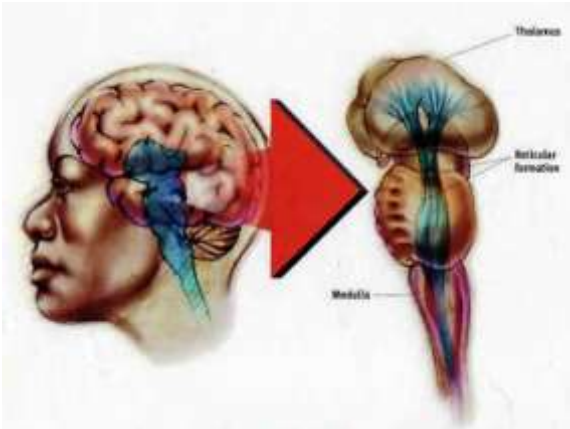
METABOLIC CRISIS

Giza & Hovda, 2001, J Ath Trng

Symptoms Post - Concussion

- ▶ Headache
- ▶ Nausea
- ▶ Vomiting
- ▶ Balance Problems
- ▶ Dizziness
- ▶ Fatigue
- ▶ Trouble falling asleep
- ▶ Sleeping more than usual
- ▶ Sleeping less than usual
- ▶ Drowsiness
- ▶ Sensitivity to light
- ▶ Sensitivity to noise
- ▶ Irritability
- ▶ Sadness
- ▶ Nervousness
- ▶ Feeling more emotional
- ▶ Numbness or tingling
- ▶ Feeling slowed down
- ▶ Feeling mentally foggy
- ▶ Difficulty concentrating
- ▶ Difficulty remembering

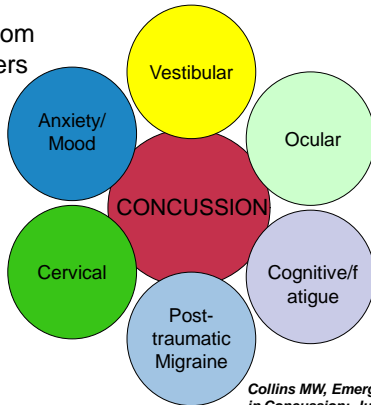
Post Concussion Symptom Scale, Lovell, Collins 1998



Reticular Formation

- Arousal
 - Attention
 - Wake-sleep cycles
 - Sensory integration
 - Posture
 - Equilibrium
 - Autonomic Function
 - Control of Gaze
 - Eye Movements
- } **ASCENDING**
} **DESCENDING**
} **LOCAL BRAINSTEM CIRCUITS**

Symptom Clusters



Collins MW, Emerging Frontiers in Concussion; June 2013

Multidisciplinary Team

- CORE TEAM
 - Neuropsychology
 - MD (w/ training in mTBI)
 - Physical Therapy (Vestibular, Orthopedic and/or Exertional)
- ADDITIONAL MEMEBERS
 - Neuro-Otology
 - Neuro-Ophthalmology
 - Neuro-Optometry
 - Psychology/Psychiatry
 - Cognitive Therapy

In cases of young athletes:


- Athletic Trainer/Coach
- School



Examination

- Medical Work-Up / Diagnostic Tests
- Patient / Client History
- Systems Review
- Tests and Measures

Medical Work-up/Diagnostic Tests

- MRI/CT
 - X-rays
- 
Typically Normal
- Neurocognitive Assessments
 - ImPact - Immediate Post - Concussion Assessment and Cognitive Testing
<http://www.impacttest.com>

Physical Therapy

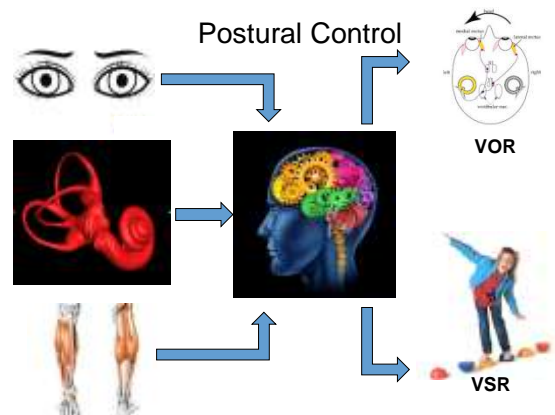
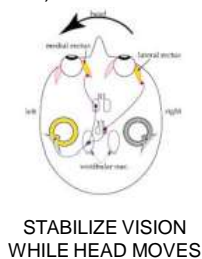
- Vestibular Therapist
 - Oculomotor Control
 - Vestibular Function
 - Postural Control
- Orthopedic/CVP/Sports Therapist
 - Cervical Spine
 - Activity tolerance/Exertional Training

Vestibular System

- Peripheral Vestibular System
 - Semicircular Canals
 - Otoliths: Utricle and Saccule
 - Vestibular Ganglia
 - Vestibular Nerve
- Central Vestibular Projections
 - Vestibular Nuclei
 - Cerebellum
 - Autonomic Nervous System
 - Thalamus
 - Cerebral Cortex

Function of the Vestibular System

- Vestibulo Ocular Reflex (VOR)
- Vestibulo Spinal Reflex (VSR)



Dizziness and Concussion

- Dizziness
- Imbalance
- Blurry Vision, difficulty focusing
- Motion discomfort
- Difficulty in busy environments

Physical Therapy Examination

- Patient History
 - Mechanism of injury
 - Anticipated
 - Unanticipated
 - LOC (duration)
 - Amnesia
 - Retrograde
 - Post Traumatic
 - Removed from/Continued play
 - Symptoms
 - "On-field"
 - Current
 - Medications

Concussion Grading Scale

Lovell, Maroon, Collins

Physical Therapy Examination

- Patient History
 - Migraines
 - Personal history
 - Family history
 - Prior Concussions
 - Length of recovery, ? Complete recovery
 - Mood Disorders
 - Learning Disabilities
 - Oculomotor Problems
 - "Lazy eye", strabismus, amblyopia



Ocular Motor Exam

- Pursuits
- Saccades
- Gaze Holding
- Convergence
- Alignment

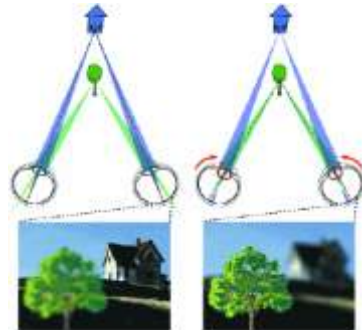


Watch for symptom provocation!

Oculomotor Control



Vergence: Adjusts eyes for different viewing distances



Convergence

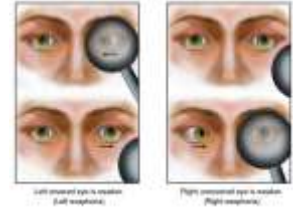
- Near Point of Convergence
 - Point at which target doubles as it moves closer to the individual
 - Point at which eyes stop converging
 - 6-10 cm



Ocular Misalignment

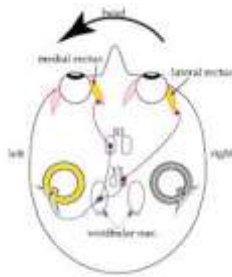
Abnormal eye deviation

- Tropia
 - Always present
- Phorias
 - Not always there
- Test
 - Cover – Uncover
 - Cross-Cover



Vestibular Ocular Reflex (VOR)

- Ability to maintain focus on stationary object while moving head without blurriness or dizziness?
- ***“Do you get dizzy or do things get blurry when you move quickly?”***



Assessing VOR Function

- Head Thrust Test
 - Tests are typically normal unless the peripheral receptor is damaged
 - May provoke symptoms
- Dynamic Visual Acuity Test
 - Typically abnormal with regard to tolerance for repetitive head movement and ability to stabilize gaze

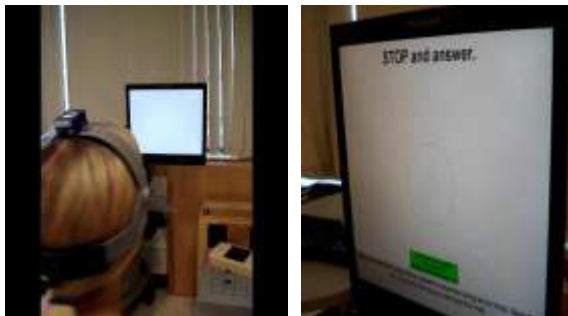
Head Thrust

- Flex the patient's neck 30°
- Have the patient look at your nose
- Turn the head quickly to each side ~30°
- Make thrusts unpredictable

Head Thrust



Computerized DVA

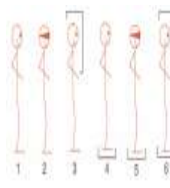


Sensory Organization

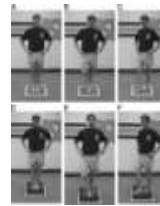
Computerized
Dynamic
Posturography
Nashner 1982



Clinical Test for
Sensory Interaction
in Balance
Shumway-Cook, Horak
1986



Balance Error
Scoring System
BESS
Guskiewicz K, UNC



ABNORMAL FINDINGS IN CONCUSSION

Oculomotor Problems & Concussion

- Ocular issues following traumatic brain injury are common
 - convergence insufficiency
 - ocular misalignments
 - end range nystagmus
- Decompensation of pre-existing problem
- Presence of ocular issues have a negative impact on vestibular rehab

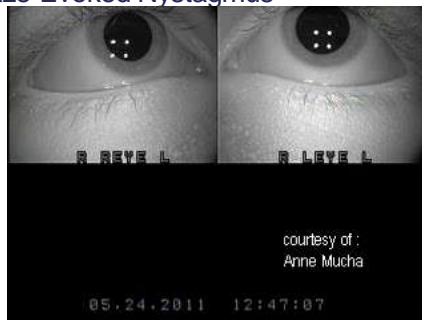
***Eye movement coordination impairments
impact eye-head coordination***

Oculomotor Disturbances

- Blurred vision
- Double vision
- Jumping images (oscillopsia)
- Eye strain

Intervention is often helpful!

Abnormal Findings Gaze-Evoked Nystagmus



Abnormal Findings Ocular Misalignment



Convergence Insufficiency

- A patient with normal convergence should be able to converge to at least 10 cm (4 inches) from their nose.

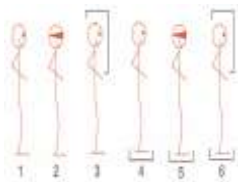


Patient converging to near target properly

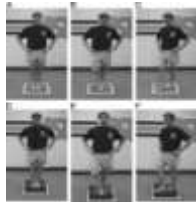
Patient now unable to converge with right eye turned out (induced by off-center target)

Patient converged to target, but right eye is a bit more converged than the left eye.

Balance: Impaired Sensory Organization



Symptom provocation when vision or somatosensation are manipulated



Increased sway/loss of balance in more challenging postures

Space and Motion Discomfort

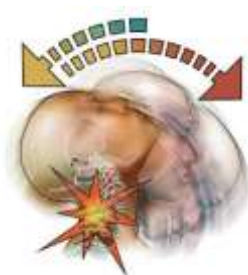
- Uneasiness created by situational stimuli
 - Moving crowds, supermarkets, busy patterns, etc
 - Heightened awareness of normal motion

Jacob et al, 1993



- Exam
 - Oculomotor Exam
 - CTSIB

Whiplash



Acceleration / Deceleration

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Activity Tolerance

- Assess response to:
 - Cognitive stress
 - School
 - Work
 - Emotional Stress
 - Anxiety
 - Depression
 - Physical exertion



Summary

- Symptoms are many and varied
- Central processing of sensory information is dysfunctional
- Requires careful evaluation by a coordinated team

