Vestibular Impairment with Concussion

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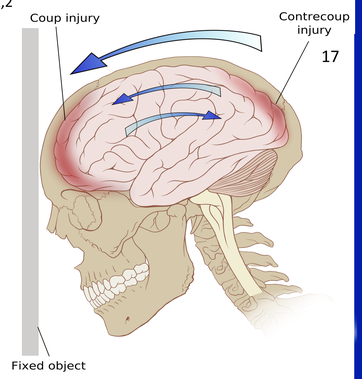
INTRODUCTION

A short-lasting disturbance of neural function typically induced by a sudden acceleration of the head, usually without skull fracture.[1,2]



1.6-3.8 million in US per year[3]

Common Symptoms[4,5]:
- **Vertigo** (BPPV)
- **Visual Instability**
- **Dizziness**
- **Balance**
- Others

What parts of the vestibular system can be damaged with concussion? Is there a better way to assess the vestibular system after a concussion?

CONCUSSION EVALUATION TOOLS[5,6,7]

- Sideline Assessment of Concussion (SAC)
- Sport Concussion Assessment Tool – 3 (SCAT-3)
- Balance Error Scoring System (BESS)
- Sensory Organization Test (SOT)

VESTIBULAR ANATOMY

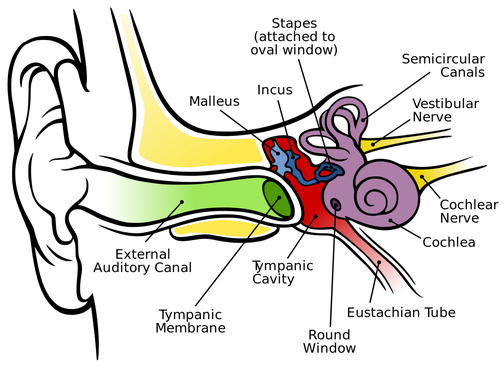


Figure 1. Anatomy of the human ear.[8]

3 Main functions (Equilibrial Triad)[9]:

1. Sensory ability (detects head movement)
2. Central nervous system processing (feed back on body and head orientation
3. Motor output to our body (to correct eye, head and bodily positions)

VESTIBULO-SPINAL REFLEX (VSR)

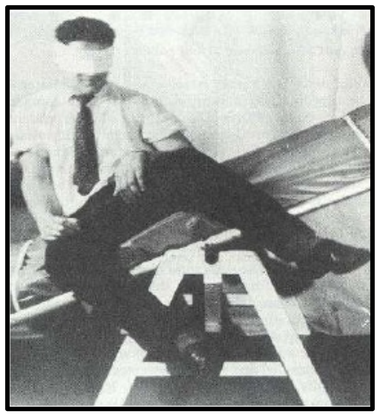


Figure 2. Man exhibiting the Vestibulo-spinal reflex[10]

Function[4]

- Stabilizes the body to maintain posture, keeping the center of mass over the base of support.
- Upper and Lower Limb Response:

1. Extends the limbs ipsilateral to the direction of acceleration
2. Contracts the limbs contralateral to the direction of acceleration

With Concussion

Vestibulo-spinal system dysfunction commonly results in disrupted balance.[12]

What To Assess

- Challenge Balance (Eyes closed, tandem gait, single leg, foam surface, combinations)

VESTIBULO-OCULAR REFLEX (VOR)

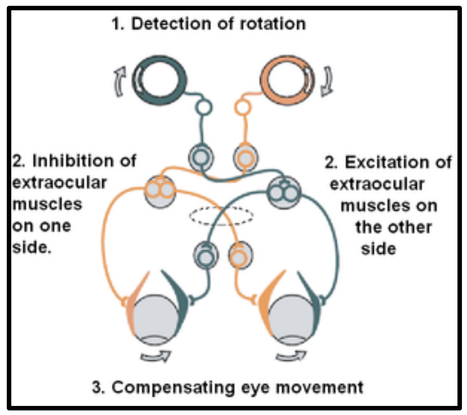


Figure 3. Vestibulo-ocular reflex[11]

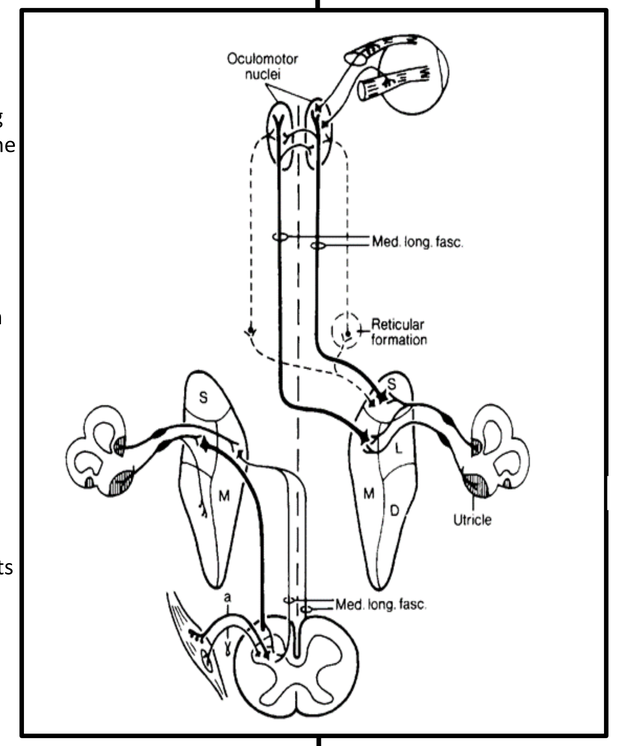


Figure 3. The VOR and VSR reflex arcs. S, L, M, and D indicate the superior, lateral, medial, and descending vestibular nuclei, respectively.[13]

Both systems have different neural circuitry, Therefore can be independently impaired

Function

- Maintains stable vision during movement of the head[4]
- Regulated by the semicircular canals (angular VOR) and otilithic organs (linear VOR)[9].

With Concussion

Impairments in the vestibulo-ocular system commonly manifest as symptoms of dizziness and visual instability.[5]

What To Assess[4]

- Saccadic eye movement
- Attention and processing speed
- Convergence
- Pursuit
- Accommodation
- Dynamic Visual Acuity

CURRENT LIMITATIONS OF ASSESSMENTS

- SAC, SCAT-3,BESS, and SOT do not properly assess vestibulo-ocular and ocular motor function[5].
- The King-Devick measures saccadic eye movement, attention and processing speed, but not pursuit, convergence, or accommodation, which are important indicators of dysfunction.[14,15]
- A brief (5-10 min) Vestibular/Ocular Motor Screening (VOMS) Assessment for concussion was recently developed but has yet to gain much traction.[5,16]

TREATMENTS[4]

- Counseling
- Medication
- Vestibular rehabilitation therapy (VRT)
- Canalith repositioning maneuvers (CRM) for positional BPPV
- Various home-based exercise programs

CONCLUSION

Concussions may cause balance impairments through damage to the vestibular and/or ocular motor systems.

Currently, assessments focus primarily on the VSR and do not properly asses the VOR.

Assessing both reflexes separately may address latent balance and vestibular dysfunctions that should be treated before return to play.

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