Advanced Techniques in Concussion Identification and Remediation

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Objectives

- Understand basic components and techniques utilized in a concussion exam
- Learn how to incorporate rehabilitation techniques into your athletic training room
- Learn basic vestibular and vision exercises
- Learn how to work in conjunction with physical and occupational therapy.
Athletic Trainer’s Concussion Cycle

Pre-season Baseline Testing:
- Cognitive
- VOMS
- Balance

On-field injury evaluation

Injury occurs

Treatment
- HEP with athletes

Physician Referral

Return to Play
Components of a Concussion

- Cervicogenic
- Ocular
- Vestibular
- Sleep
- Psychiatric / Psychological
- Cognitive
**Vestibular System**
How the eyes, brain and body all work together in space

Common Sign and Symptoms:
- dizziness
- difficulty Focusing
- balance
- functioning in busy environment
  Aka cafeteria

Treatment with Physical Therapist
- Balance
- Minimal vision therapy
- Exertional therapy - rehabs the vestibular system and helps gauge patient’s progress
  - Cardio, dynamic circuit (lunges/squats) and functional circuit (agilities)

Goal: Asymptomatic with 25 minutes of full exertion, dizziness resolved and balance returned to normal.

**Oculomotor Dysfunction**
Characterized by deficiency in one or more of the following visual skills:
- fixation maintenance
- saccadic eye movement
- pursuit eye movements

Common Sign and Symptoms:
- reading a passage more than once
- skipping words or lines
- words look 3D
- blurry vision

Evaluation is needed by a trained neuro-optometrist

Treatment: Vision Therapy
- Specialized computer programs
- Optical devices

Goal: enhance the brain’s ability to control eye alignment, teaming, movement, as well as focusing abilities and visual processing.
Functions of Vestibular System

- **Vestibular Ocular Reflex (VOR)**
  - Allows gaze stabilization with head/body movement
  - VOR test on exam
    - Gaze instability/oculomotor deficits
      » blurry vision, HA, dizziness, motion sensitivity, visual motion sensitivity

- **Vestibulocollic Reflex (VCR)**
  - Initiates righting reaction for head on neck
  - VORC helps to differentiate
    - Cervical Instability
      » HA, neck pain, dizziness with head movement

- **Vestibulospinal Reflex (VSR)**
  - Provides balance/stability with movement of the trunk
  - BESS testing or Sway
    - Balance
      » Imbalance, “clumsy”, falls
Vestibular Therapy

• True Vestibular Rehabilitation
  – Improves
    • mild convergence and eye teaming abilities
    • accommodative ability
    • mild visual tracking skills
    • Balance
    • Cardiovascular

• Intra-office with Physical therapist trained in vestibular therapy
Vestibular Therapy

• 5 Categories of Exercise
  – Eye-Head Coordination
  – Sitting Balance
  – Standing Static Balance
  – Standing Dynamic Balance
  – Ambulation
Head Eye Coordination
Sitting Balance
Standing Dynamic Balance

STANDING STATIC - 19
Single Leg (Varied Surfaces)

Holding on to support, lift right leg up while maintaining balance over single leg. Progress to removing hands from support surface for longer periods of time.

*Add uneven surface once exercise becomes too easy
EXERTION THERAPY

We know too much activity can prolong recovery, but too little may not be beneficial either.
<table>
<thead>
<tr>
<th>Stage of Rehabilitation</th>
<th>Physical Therapy Program: Autonomic Dysfunction</th>
<th>Physical Therapy Program: Vestibular Dysfunction</th>
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<tbody>
<tr>
<td><strong>STAGE 1</strong></td>
<td>Target Heart Rate: 30-40% of maximum exertion</td>
<td>• Stationary aerobic conditioning: bike, UBE</td>
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<tr>
<td>Recommendations: Exercise in quiet area, no impact activities, balance and vestibular treatment by specialist (PM); limit head movement/position change; limit concentration activities</td>
<td>*(Max HR-Rest. HR x 30) + Rest. HR</td>
<td>• Static balance activities</td>
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<td>• Exercises that limit head movements (weight machines, squats/lunges with focusing)</td>
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<td><strong>STAGE 2</strong></td>
<td>Target Heart Rate: 40-60% of maximum exertion</td>
<td>• More progressive dynamic aerobic conditioning: elliptical, treadmill walking, progress to treadmill jogging</td>
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<tr>
<td>Recommendations: Exercise in gym areas recommended; use various exercise equipment; allow some positional changes and head movement; low level concentration activities (counting repetitions)</td>
<td>*(Max HR-Rest. HR x 40) + Rest. HR</td>
<td>• Balance activities with head movements</td>
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<td>• Resistance exercises with head movements (example: lateral squats with head movement)</td>
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<td><strong>STAGE 3</strong></td>
<td>Target Heart Rate: 60-80% of maximum exertion</td>
<td>• Moderately aggressive aerobic exercise (intervals, pyramids, stair running)</td>
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<td>Recommendations: Any environment OK for exercise (indoor, outdoor); integrate strength, conditioning, and balance/proprioceptive exercise; can incorporate concentration challenges (counting exercises, visual games)</td>
<td>*(Max HR-Rest. HR x 60) + Rest. HR</td>
<td>• All forms of strength exercises</td>
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<td>• Dynamic warm-ups</td>
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<td><strong>STAGE 4</strong></td>
<td>Target Heart Rate: 80% of maximum exertion</td>
<td>• Impact activities (running, plyometrics)</td>
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<td>Recommendations: Continue to avoid contact activity, but resume aggressive training in all environments</td>
<td>*(Max HR-Rest. HR x 80) + Rest. HR</td>
<td>• 60% max exertion sport-specific activities avoiding contact</td>
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<td><strong>STAGE 5</strong></td>
<td>Target Heart Rate: 100% of maximum exertion</td>
<td>• Full physical training activities with contact</td>
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<td>Recommendations: Initiate contact activities as appropriate to sport activity; full exertion activities for sport activities</td>
<td>*(Max HR-Rest. HR x 1) + Rest. HR</td>
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</tbody>
</table>
Exertion Therapy

- Physical activity while symptoms are still present
- Monitor if symptoms increase during activity or maintain
- Important to know what other deficits are present
Its not about
Neuro- Visual Processing

• 70% of sensory processing for the entire body is directly affected by information coming from two eyes

• 1,000,000 nerve fibers per eye provide pathways for the visual information process

• Dysfunction could be caused by:
  – Structural Damage
    • Moderate to Severe TBI’s
  – Impairment btw vision and sensorimotor information
    • mTBI’s
      – Deficits in visual function, executive function, visual attention and visual memory
Convergence Insufficiency

Binocular problem at near “eye teaming”
Accommodative Dysfunction

Reduction of the ability to focus

FOCUSING PROBLEMS CAN MAKE IT HARD TO KEEP THE PRINT CLEAR WHICH CAUSES YOU TO WORK MORE AND MORE LEADING TO INCREASED LEVELS OF VISUAL STRESS AND FATIGUE

Reduction of the ability to focus
1. **Fixation** - Maintaining focusing on a target without distraction.

2. **Smooth Pursuits** - Following a moving target.

3. **Saccades** - eye “jumps” from point “A” to point “B”.

Oculomotor/Visual- Motor Dysfunction

Jefferson Comprehensive Concussion Center
Optometric Treatment

• True Optometric Rehabilitation
  – Improve
    • convergence and eye teaming abilities
    • accommodative ability
    • visual tracking skills
    • Short term visual memory

• Intra-office with Vision Therapist or Home Computer Program

• Low level ocular exercise can be done during vestibular therapy
Pencil Push-ups

- Arm's length
- Closed Up
Brock String

Tip: Whatever bead you are looking at there should be one
3-Dot Card

Barrel Card/ 3-dot Card

**Fig:** Patient working with Barrel Card  
**Fig:** Patient working with Albee 3-Dot Card
Saccades and Smooth Pursuits

Be careful to not let your athlete become too symptomatic

Also there should be NO head movement, just movement with the eyes
Marsden Ball
Conclusion

• Identify your Sports Concussion Team
  • Sports Concussion Specialist, Vestibular Therapist, Neuro-Optometrist

• Work closely with PT, have athletes do HEP in ATR
  – Helps athletes feel like they are still part of the team

• Continuing learning advanced concussion treatments
techniques
References