Keeping Your Eye on the Ball

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Vision’s role in baseball (catching/throwing/swinging)
Concussions in baseball
Concussions in baseball
Vision’s role in baseball

Static Visual Acuity: ability to see stationary targets clearly
Kinetic Visual Acuity: ability to see moving targets clearly
Eye Tracking: ability to follow the ball with their eyes
Eye Focusing: ability to change focus quickly and clearly
Peripheral awareness: ability to see objects from the side while looking straight ahead
Depth Perception: ability to quickly and accurately judge the distance and speed of the ball
Eye-Hand Coordination: ability of their eyes to effectively direct the movements of their hands and body
Vision and the brainstem

50% of the cranial nerves impact visual function

Direct:

CN II, III, IV, and VI

Indirect

CN V and VII
Vision and the cortex

All 4 cortical lobes are involved in visual function

Frontal
Parietal
Temporal
Occipital
Concussions Impact Vision
Occurrence of oculomotor dysfunctions in acquired brain injury: a retrospective analysis

METHODS:

Medical records of 220 individuals with either TBI (n = 160) or CVA (n = 60) were reviewed retrospectively. This was determined by a computer-based query spanning the years 2000 through 2003, for the frequency of occurrence of oculomotor dysfunctions including accommodation, version, vergence, strabismus, and cranial nerve (CN) palsy.

RESULTS:

The majority of individuals with either TBI (90%) or CVA (86.7%) manifested an oculomotor dysfunction. Accommodative and vergence deficits were most common in the TBI subgroup, whereas strabismus and CN palsy were most common in the CVA subgroup. The frequency of occurrence of versional deficits was similar in each diagnostic subgroup.

CONCLUSION:

These new findings should alert the clinician to the higher frequency of occurrence of oculomotor dysfunctions in these populations and the associated therapeutic, rehabilitative, and quality-of-life implications.

Occurrence of oculomotor dysfunctions in acquired brain injury: a retrospective analysis

41.1% Accommodation
  ◦ Accommodative insufficiency

51.3% Versional
  ◦ Saccades

56.3% Vergence
  ◦ Convergence insufficiency

25.6% Strabismus
  ◦ Strabismus at near

6.9% CN palsy
  ◦ CN III

### Additional Studies on Occurrence

<table>
<thead>
<tr>
<th>Dysfunction (%)</th>
<th>Reading</th>
<th>Convergence</th>
<th>Accommodation</th>
<th>Strabismus</th>
<th>Pursuit/Saccades</th>
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</thead>
<tbody>
<tr>
<td>Goodrich et al., 2007 [39]</td>
<td>61</td>
<td>30</td>
<td>22</td>
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<td>20</td>
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<tr>
<td>Brahm et al., 2009 [10]*</td>
<td>87</td>
<td>48</td>
<td>49</td>
<td>7</td>
<td>23</td>
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<td>Ciuffreda et al., 2007 [12]</td>
<td>—</td>
<td>42</td>
<td>41</td>
<td>25</td>
<td>39</td>
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<td>Capó-Aponte et al., 2012 [40]</td>
<td>65</td>
<td>55</td>
<td>65</td>
<td>0</td>
<td>60</td>
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Role of Optometry in Concussion

**Diagnose** and/or treat *compromises to the visual system*
- Optically and/or Vision Rehabilitation

**Optimize Visual Function**
- Assist in maximizing overall rehabilitation
- ADL’s Activities of Daily Living
- QOL Quality of Life

*find an optometrist that specializes in neuro-optometric rehabilitation*
Development of a mild traumatic brain injury-specific vision screening protocol

Polled 16 experts (FT VA Medical Center and/or Army employees with experience in TBI assessments and rehabilitation):
- case history questions
- testing procedures

High Yield Case History Questions for Vision

Have you noticed a change in your vision since your injury?
Are you more sensitive to light, either indoors or outdoors, since your injury?
Have you had any double vision since your injury?
Have you noticed any changes in your peripheral vision since your injury?
Is your vision blurry at distance or near since your injury?
Have you noticed a change in your ability to read since your injury?
Do you lose your place while reading more now than before your injury?
How long can you read continuously before you need to stop?
Do you get headaches during/after reading more now than before your injury?
Do you have more difficulty remembering what you have read now than before your injury?

High Yield Vision Screening Protocol

Case History

Movement
- Fixation, Pursuits, Saccades

Focusing
- Accommodation

Alignment
- Distance and Near Phoria

Teaming
- Near point of convergence (performed mid way through and again at the end of the exam to assess fatigue)

Versional Testing: Fixation / Pursuits / Saccades
## Versional Testing: ReadAlyzer

<table>
<thead>
<tr>
<th></th>
<th>Recorded</th>
<th>Grade Aver.</th>
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<tbody>
<tr>
<td>Fixations/100 words</td>
<td>213</td>
<td>155</td>
</tr>
<tr>
<td>Regressions/100 words</td>
<td>38</td>
<td>35</td>
</tr>
<tr>
<td>Fixation Duration (sec)</td>
<td>0.44</td>
<td>0.28</td>
</tr>
<tr>
<td>Reading Rate (words/min)</td>
<td>64</td>
<td>138</td>
</tr>
<tr>
<td>Grade Level Equivalent</td>
<td>1.0</td>
<td>3</td>
</tr>
<tr>
<td>Regression/Fixation Ratio</td>
<td>18%</td>
<td>23%</td>
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</table>

<table>
<thead>
<tr>
<th>Anomalies (Fix/Regr/Both)</th>
<th>2/5/8</th>
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</thead>
<tbody>
<tr>
<td>Cross Correlation</td>
<td>0.261</td>
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<tr>
<td>Correct Comp. Answers</td>
<td>50%</td>
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<tr>
<td>Analysis Reliability</td>
<td>63%</td>
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</tbody>
</table>

| Grade Level of Text Read   | 2      |
| Lines to analyze in text   | 8      |
| Lines found by analysis    | 6      |
| Saccades in Return Sweeps  | 1.2    |
Versional Testing: King-Devick
Accommodative Testing: Total Focusing Power and Facility
Vergence Testing:
Phoria, Vergence Ranges
Vergence Testing: Near Point of Convergence
Role of Optometry in Concussion

Diagnose and/or **treat compromises to the visual system**
- **Optically** and/or **Vision Rehabilitation**

Optimize Visual Function
- Assist in maximizing overall rehabilitation
- ADL’s Activities of Daily Living
- QOL Quality of Life

*find an optometrist that specializes in neuro-optometric rehabilitation*
Effects of individualized prismatic spectacle lenses in the treatment of post concussive symptoms

A subset of TBI patients who were initially evaluated by a single physiatrist and who received standard treatments and medications yet had persistent post concussive symptoms. These patients were then assessed by a single optometrist, and those found to have vertical heterophoria were treated with individualized prismatic spectacle lenses. A total of 83 patients were referred for testing; 77 were positive for vertical heterophoria on screening, of which 43 had complete data sets and were included for analysis.

All patients were treated with individualized prismatic spectacle lenses to correct for vertical heterophoria.

Outcomes were measured by the difference in score before and after intervention of an objective, self-administered vertical heterophoria symptom burden instrument and by subjective improvement in symptoms as expressed by the patient at the end of intervention.

Vertical heterophoria was identified in a group of TBI patients with postconcussive symptoms and treatment of the vertical heterophoria with individualized prismatic spectacle lenses resulted in a 71.8% decrease in subjective symptom burden and a relative reduction in VHS-Q score of 48.1%.

Versional eye tracking in mild traumatic brain injury: effects of OMT

Twelve individuals with mTBI (mean age = 29 ± 3 years) having oculomotor-based near-vision symptoms participated in the study

Clinical Measures, Laboratory Measures, Visual Attention Test, Symptoms

12 weeks of vision therapy 2x per week 45 mins per session

The versional-based OMT had a significant, positive effect on most aspects of versional tracking. These findings are suggestive of improved rhythmicity, accuracy and sequencing of saccades following OMT in mTBI as a result of oculomotor learning.

Versional Treatment
Twelve adult subjects (8 females, 4 males) between the ages of 23 and 33 yr (mean ± standard deviation [SD]: 29 ± 3 yr) with documented mTBI, having an injury onset of >1 yr (1–10 yr post injury) to avoid possible contamination from the natural recovery process

Clinical Measures, Laboratory Measures, Visual Attention Test, Symptoms

12 wks of vision therapy 2x per week 45 mins per session

Oculomotor rehabilitation was effective in individuals with mTBI who reported near work-related symptoms of an oculomotor basis. An overall improvement in nearly all of the critical, abnormal parameters of accommodation was observed both objectively and subjectively following OMT. Improved oculomotor behavior was attributed to effective oculomotor learning effects in these individuals.

Accommodative Treatment
Effect of oculomotor rehabilitation on vergence responsivity in mild traumatic brain injury.

Twelve subjects (8 females and 4 males) between the ages of 23 and 33 yr (mean ± standard deviation: 29 ± 3 yr) participated in the study.

Clinical Measures, Laboratory Measures, Visual Attention Test, Symptoms

12 wks of vision therapy 2x per week 45 mins per session

Vergence-based OR was effective in individuals with mTBI who reported near work-related symptoms. **Overall improvement** in nearly all of the critical, abnormal measures of vergence was observed both **objectively and clinically**. Improved vergence motor control was attributed to residual neural visual system plasticity and oculomotor learning effects in these individuals. Concurrently, **near work-related symptoms reduced, and visual attention improved**.

Vergence Treatment
Maximize Concussion Rehabilitation

Concussions are complex
◦ Develop a Comprehensive Rehabilitative Team

Concussion Impacts Vision
◦ Versional Eye Movements
◦ Accommodation
◦ Vergence Eye Movements

Vision Impacts Performance
◦ On and off the field