Early Results of Optical and Vestibular Reflex Testing in Concussions

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Introduction

• Presenting early results of testing using optico-vestibular reflex testing in the setting of concussion
  – Does this battery of tests show abnormalities in athletes who have suffered concussions?
Introduction

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  – Does this battery of tests show abnormalities in athletes who have suffered concussions?
Current Study

• 144 adolescent athletes and 31 adults with no history of head injuries were baselined
  – Provided two data sets
    • Normative data
    • Baseline data for in season testing
Current Study

• 7 clinically diagnosed Concussions
  – 1 from baseline group
  – 6 from clinical and athletic practice
    • 3 rugby players
    • 1 wrestler
    • 2 Football players
• “Bell rung”
  – 3 patients
Materials and Methods

- Testing done with VNG machine
Testing protocol

- Spontaneous nystagmus/Gaze
- Random and predicted horizontal and vertical saccade
- Antisaccade
- Smooth pursuit horizontal and vertical
- Subjective visual horizontal and vertical
- Optokinetic test
- Random saccade and visuomotor respond
- Audible stimuli and motor respond
Material and Methods

- **Baseline testing**
  - Mean and standard deviation obtained
    - Normative data

- **Concussion testing**
  - Abnormal result
    - Defined at 2 SD below baseline mean
# Clinically Diagnosed Concussions

<table>
<thead>
<tr>
<th>Test</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Time From Injury</strong></td>
<td>48h</td>
<td>72h</td>
<td>&lt;24h</td>
<td>72h</td>
<td>&lt;48h</td>
<td>4 days</td>
<td>2.5 Weeks</td>
</tr>
<tr>
<td>Saccade horizontal, random</td>
<td>*</td>
<td>*</td>
<td>N</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>N</td>
</tr>
<tr>
<td>Saccade H predictive</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>N</td>
<td>*</td>
</tr>
<tr>
<td>Smooth Pursuit Horizontal</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Optokinetics</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>N</td>
</tr>
<tr>
<td>Gaze/Nystagmus</td>
<td>N</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>N</td>
</tr>
<tr>
<td>SVV/SVH</td>
<td>N</td>
<td>*</td>
<td>N</td>
<td>*</td>
<td>*</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Reaction time (visual stimulus only)</td>
<td>*</td>
<td>NP</td>
<td>*</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
<tr>
<td>Saccade and motor reaction time</td>
<td>*</td>
<td>NP</td>
<td>*</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
<td>NP</td>
</tr>
</tbody>
</table>

* N: Not tested
## “Bell Rung” Episodes

<table>
<thead>
<tr>
<th>Test</th>
<th>S1</th>
<th>S2</th>
<th>S3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time From injury</td>
<td>3 weeks</td>
<td>3 weeks</td>
<td>3 weeks</td>
</tr>
<tr>
<td>Saccade horizontal, random</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Saccade H predictive</td>
<td>N</td>
<td>*</td>
<td>N</td>
</tr>
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<td>N</td>
<td>*</td>
<td>N</td>
</tr>
<tr>
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<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Gaze/Nystagmus</td>
<td>N</td>
<td>*</td>
<td>N</td>
</tr>
<tr>
<td>SVV/SVH</td>
<td>N</td>
<td>N</td>
<td>*</td>
</tr>
</tbody>
</table>
Case Study

• 17 year old lacrosse player
  – Baseline obtained prior to season
  – Concussion during season
  – Re-tested <72 hours from time of injury
  – Re-tested 10 days later
<table>
<thead>
<tr>
<th>Test</th>
<th>BASELINE</th>
<th>72h from concussion</th>
<th>10 d from injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saccade horizontal, random</td>
<td>N</td>
<td>*</td>
<td>N</td>
</tr>
<tr>
<td>Saccade H predictive</td>
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<td>*</td>
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Results Summary

• Concussion patients
  – All athletes seen within 72 h of concussion
    • 5/8 tests in battery (+)
      – 2 SD below normative data
    – As time from injury increases, test normalizes

• “Bell Rung” patients
  – Even three weeks from injury
    • Residual abnormalities remained
Results Summary

• Baseline comparison (1 case)
  – Abnormalities from a baseline were definitely seen
    • Normalized within 10 days of injury
  – Correlated with symptoms
    • Athlete returned to play 1 day prior to 2\textsuperscript{nd} test.
Discussion

• Promising results
  – Basis of testing seems valid
    • **In cases of concussion**
      – Detectable abnormality seen with battery of tests
      – Abnormalities normalize
        » correlated with symptom scores
    • **In case of “bell rung”**
      – May be causing more damage than initially thought.
Discussion

• Benefits of testing
  – Objective test
    • Cannot be faked
  – May have immediate diagnostic capabilities
    • If technology can be miniaturized
      – May be used on the sideline
      – May be used by EMS/ER
Current Studies

• 200 football players baselined prior to 2010 season
  – Follow for current football season

• 25 professional soccer players baselined
  – End of season testing
    • Effect of headers
Future Studies

1. Can this testing detect acute (within minutes) concussion?
2. Can it determine return-to-play criteria?
3. Long term cumulative effect of concussions?
4. Can we assess effectiveness of a concussion treatment program?
Thank You