Knock Knock:
Opening the Door to Youth Sports Concussion Services In Your Practice
NAN 2004

Presenters
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Management of Sports Concussion: A Focus on Youth Sports
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Consultant, NFL and NHL Neuropsychology Programs
Consultant, NASCAR, IRL and CHAMP Racing

Field, Collins, Lovell et al.
Comparing recovery from concussion in High School and college athletes

Incidence of Concussion
- 75 to 85% of all head injuries
- 1.0 to 1.5 million cases per year in US
- 300,000 from sports (an underestimate?)
- Most cases go unreported

Concussion: Definition
- A complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.
- Common features
  - Direct blow to the head or body
  - Rapid onset of short lived impairment (usually)
  - Acute symptoms a result of functional rather than structural injury
  - Normal structural neuroimaging studies

CIBS, Vienna, 2001
High School/University Athletes within 3 days of injury

1. Headache (71%)
2. Feeling slowed down (58%)
3. Difficulty concentrating (57%)
4. Dizziness (55%)
5. "Fogginess" (53%)
6. Fatigue (50%)
7. Visual Blurring or double vision (49%)
8. Light sensitivity (47%)
9. Memory dysfunction (43%)
10. Balance problems (43%)

Symptoms
- Headache
- Difficulty remembering
- Difficulty concentrating
- Feeling like "in a fog"
- Feeling slowed down
- Sleep disturbance
- Fatigue
- Difficulty falling asleep
- Dizziness
- Balance problems
- Sensitivity to light
- Drowsiness
- Sleeping more than usual
- Trouble falling asleep
- Fatigue

Commonly Reported Symptoms
High School/University Athletes within 3 days of injury

POST-CONCUSSION SCALE

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>SEVERITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Difficulty remembering</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Fatigue</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Difficulty falling asleep</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Sleeping more than usual</td>
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<td>0 1 2 3</td>
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<tr>
<td>Light sensitivity</td>
<td>4 5 6</td>
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<tr>
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<td>0 1 2 3</td>
</tr>
<tr>
<td>Nervousness</td>
<td>4 5 6</td>
</tr>
<tr>
<td>Sensitivity to noise</td>
<td>0 1 2 3</td>
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NEW MANAGEMENT STRATEGIES

- Removal of symptomatic athletes from play
- Graduated return to play
- Neuropsychological testing recommended
  "One of the Cornerstones of Management"

Summary of What We Have Learned From Traditional Testing Projects

- Testing yields useful information
- Testing difficult because...
  - Difficult to evaluate large numbers of athletes
  - Sensitivity of tests to cognitive speed
**COMPUTER BASED TESTING**

Currently Available Programs

- CogSport
- Headminders (CRI)
- ANAM
- ImPACT

**COMPUTER-BASED TESTING**

Advantages

- Promotes Group Testing
- Accurate Evaluation of Reaction Time
- More Cost-Effective
- Minimizes Practice Effects (randomization)
- Automatic Scoring and Display of Results
- Transmission of Test Results Via E-Mail

**COMPUTER-BASED TESTING**

Disadvantages?

- Difficulty in Presentation of Some Tests
- Presentation of Instructions Requires Reading
- Less Direct Interaction with Examiner?

**Current Large-Scale Programs**

Neuropsychological Testing

- 20 NFL Teams
- IRL, F1, CHAMP Car
- NASCAR
- USA Olympic Hockey
- USA Hockey
- 400+ High Schools in US
- 60 Sports Medicine Clinics in US
- Pro Boxing in California
- USA Ski Team
- USA Soccer Juniors

- Ontario Hockey League
- New Zealand Rugby
- S. African Rugby
- World Cup Soccer
- 150+ Universities in US
- Many Neuropsychology Clinics in US
- Major League Baseball
- Major League Baseball Umpires

**WHY USE NEUROPSYCHOLOGICAL TESTING?**

Unique Contribution To The Diagnostic Puzzle

- Testing Provides Unique Information
- Concussed Athletes Often Deny Symptoms
- Athletes May Lack Awareness of Symptoms

**UNIQUE CONTRIBUTION OF NEUROPSYCHOLOGICAL TESTING TO CONCUSSION MANAGEMENT**

Testing reveals cognitive deficits in asymptomatic athletes within 4 days post-injury

N=215, MANOVA p<.000000
**UNIQUE CONTRIBUTION OF NEUROPSYCHOLOGICAL TESTING TO CONCUSSION MANAGEMENT**

- MANOVA $p < 0.000000$ (ImPACT Test Battery)

**VALUE ADDED OF NEUROPSYCHOLOGICAL TESTING**

NP testing increases Diagnostic yield to 88%

**WHY USE NEUROPSYCHOLOGICAL TESTING?**

Mild or “Ding” Injuries May be Significant

- Cannot gauge severity of injury based on initial symptoms
- Acute recovery may not be a linear process

Concussion and Memory Dysfunction

- 64 high school athletes with Grade 1 concussion
- 24 Non-injured control subjects
- All athletes diagnosed with “ding”
  - Confusion, amnesia, signs/symptoms cleared within 15 minutes
  - No athlete in sample sustained LOC
- No athlete returned to contest
- ImPACT evaluation obtained at baseline, 36 hours, 4 days and 7 days post-concussion


**Memory Impairment Following “Mild Concussion”**

- Current research supports the use of neuropsychological testing following concussion
- Relying on symptoms alone may be dangerous
- Attentional processes, memory, and cognitive speed are key elements of testing
- Younger athletes deserve particular attention

Summary

Cerebral Concussion

- Mild traumatic brain injury
- Alteration in consciousness due to a blow to the head or acceleration/deceleration/rotational force
- Does NOT imply/require loss of consciousness.
- Usually temporary changes in mental status, temporary changes in somatic functioning
- May produce a wide range of symptoms

Post Concussion Symptoms

- Pressure in head
- Headache
- Balance troubles
- Visual Disturbance
- Numbness
- Tingling
- Feeling slow
- Sensitivity to light/noise
- Feeling like in a “fog”
- Difficulty concentrating
- Difficulty remembering
- Irritability
- Sadness
- Nervousness

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- Irritability
- Sadness
- Nervousness

Physiological Changes

- Shearing or strain injury of axons
- Diffuse microscopic changes to axons
- Microscopic tearing of small blood vessels
- Metabolic cascade resulting in imbalance between glucose demands and regional CBF supply (vulnerable to SIS)

Giza & Hovda, JAT, 36(3), 228-35
Epidemiology

- High School
  - 20% or 250,000 per year in football (Gerberich, et al. 1985)
  - 25,520 per season (Powell, 1995)
  - NATA High School Study
    - 57,716 occurrences of mTBI per year
    - 5.3% of football injuries
    - 4.4% of wrestling injuries
    - 3.4% boys soccer
    - 2.6% girls soccer
    - 2.3% girls basketball

- College: NCAA Injury Surveillance System
  - 1.6 to 6.4% of all injuries
  - Ice Hockey - 4.5% of all injuries (.56 per 1,000 AE)
  - Football .43 per 1,000 AE
  - Wrestling .49 per 1,000 AE
  - Soccer (Men = .33/Women = .62)
  - Basketball (Men = .16/Women = .29)

Epidemiology: Gender

<table>
<thead>
<tr>
<th>Study</th>
<th>Sport</th>
<th>Males (% of All Injuries)</th>
<th>Females (% of All Injuries)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hillary, Mann, Schatz, 2002</td>
<td>Soccer</td>
<td>3.9%</td>
<td>4.3%</td>
</tr>
<tr>
<td>Powell, Barber-Foss</td>
<td>Basketball</td>
<td>2.6%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Powell, Barber-Foss</td>
<td>Baseball/Softball</td>
<td>1.7%</td>
<td>2.7%</td>
</tr>
<tr>
<td>Powell, Barber-Foss</td>
<td>Wrestling</td>
<td>4.1%</td>
<td>4.4%</td>
</tr>
<tr>
<td>NCAA</td>
<td>Soccer</td>
<td>4.7%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>3.23%</td>
<td>3.75%</td>
</tr>
</tbody>
</table>

Understanding Base Rates

- History of Previous Concussion: 10-80%
- Recent Trend Upwards:
  - % with 1+ Previous Concussion
    - Kunsblt (2001) 77%
    - Moser & Schatz (2001) 97%

Understanding Base Rates

- Sensitivity and Specificity of Test Measures varies as a function of Base Rate (LaBarge, et al, 2003, ACN, 18)
- Sample Data:
  - Test + Concussed: 60  Control: 6
  - Test - Concussed: 16  Control: 65

Sample: Data from

http://www.ccbm.utoronto.ca/practise/ca/statscalc/index.html
Importance of Baseline Assessment

“Nobody in football should be called a genius. A genius is a guy like Norman Einstein.”

-- Football commentator and former player Moser & Schatz (2001): High School

- Youth Athletes
- College-prep boarding school
- Mandatory participation in sports
- Multiple sports over 5-10 years
- No concussion program in place
- Attempt to understand/replicate previous findings

Moser & Schatz (2001): Study Design

Youth athlete volunteers from a Private Boarding School, divided into independent groups on the basis of concussion history.

- Zero or One Previous Concussion: 8 healthy volunteers with either no history of concussion, or had sustained one previous concussion (not within the past six months).
- Two+ Previous Concussions: 13 youth athletes who had sustained two or more previous concussions (not within the past six months).
- Recent Concussion: 13 youth athletes who had sustained a recent concussion, with no identified medical or neuropsychological difficulties related to concussion within one week after testing.

Moser & Schatz (2001): Results

<table>
<thead>
<tr>
<th>Concussion Group</th>
<th>RBANS Mean Raw Scores</th>
<th>Total</th>
<th>Control</th>
<th>Attention</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1 Previous</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>252.53</td>
<td>62.18</td>
<td>72.28</td>
<td></td>
</tr>
<tr>
<td>Zero</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>248.54</td>
<td>55.92</td>
<td>60.09</td>
<td></td>
</tr>
<tr>
<td>Two+ Previous</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>235.37</td>
<td>53.13</td>
<td>60.38</td>
<td></td>
</tr>
<tr>
<td>Recent</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>132.32</td>
<td>34.11</td>
<td>92.00</td>
<td></td>
</tr>
</tbody>
</table>

Follow-up Study

238 youth athlete volunteers ... divided into four independent groups on the basis of concussion history:

- No Concussion: 82 healthy volunteers with no history of concussions.
- One Previous Concussion: 56 youth athletes who had sustained one previous concussion (not within the past six months).
- Two+ Previous Concussions: 51 youth athletes who had sustained two or more previous concussions (not within the past six months).
- Recent Concussion: 49 youth athletes who had sustained a recent concussion, with no identified medical or neuropsychological difficulties related to concussion within one week after testing.

Dependent Measure: RBANS

Subtests measure multiple neurocognitive domains

- Immediate Memory
- Visuospatial/Construction
- Language
- Attention
- Delayed Memory

Note: Higher Mean Scores = Stronger Cognitive Functioning.

Analyses are two-tailed. Effect size denoted by “r”.

Moser & Schatz (In Review)

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**Study Results-GPA**

<table>
<thead>
<tr>
<th>GPA by Concussion Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Concussion: 3.54</td>
</tr>
<tr>
<td>One Previous: 3.35</td>
</tr>
<tr>
<td>Two+ Previous: 3.23</td>
</tr>
<tr>
<td>Recent: 3.26</td>
</tr>
</tbody>
</table>

**Study Results-RBANS**

<table>
<thead>
<tr>
<th>RBANS Subtest by Concussion Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Concussion: 240.3</td>
</tr>
<tr>
<td>One Previous: 244.8</td>
</tr>
<tr>
<td>Two+ Previous: 235.9</td>
</tr>
<tr>
<td>Recent: 231.7</td>
</tr>
</tbody>
</table>

**Study Results-MANOVA**

- Multivariate Analysis of Variance (MANOVA) revealed a significant overall effect of concussion history on cognition \([F(21,672)=1.8; p=.015]\).
- Univariate F-tests revealed significant main effects of concussion history on **Attention** \([F(3,228)=4.72; p=.003]\) and **GPA** \([F(3,228)=5.76; p=.001]\). Means and standard deviations are presented in next slide.

**Moser & Schatz: Group Means**

<table>
<thead>
<tr>
<th>Effects of Previous Concussion on RBANS and GPA scores.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concussion Group</td>
</tr>
<tr>
<td>------------------</td>
</tr>
<tr>
<td>No Concussion: 82</td>
</tr>
<tr>
<td>One Previous: 56</td>
</tr>
<tr>
<td>Two+ Previous: 51</td>
</tr>
<tr>
<td>Recent: 49</td>
</tr>
</tbody>
</table>

**What we know:**

- Health non-concussed youth athletes with a history of concussion often show subtle deficits in attention and concentration at baseline assessment.
- These enduring effects of previous cerebral concussions can be detected using traditional and computer-based measures.
- Concussions occur in female athletes at a greater rate/frequency.

**What we think we know:**

Contributing to these findings:

A more vulnerable and susceptible youth brain

Participation in multiple sports over a large period of years.
Future Directions:

- Baseline screenings for all athletes, but especially in vulnerable youth athletes.
  - Documenting pre-concussion status,
  - Pre and post concussion comparisons
  - Multiple “sliding” baseline.
- Involvement/awareness of pediatricians and family practices – Neuropsychology

PRACTICE GUIDE

CHECKLIST
Are you ready to start a Youth Sports Concussion Practice?

Establish & Document Knowledge & Expertise

1. Formal coursework
2. Read Journals, Books
3. Consultation
4. Research/Publications
5. Interest in the Sport
6. Knowledge base of working with/testing kids.

DART

- Diagnosis:
  - Symptom Severity Value (LOC, headache, amnesia)
  - Grading System
- Assessment:
  - Test tools, alternate forms, how often?
- Return to Play:
  - Maintenance & Maintenance Consultation, Limitations, Documentation
- Treatment:
  - REST! EDUCATE! SUPPORT.
  - HEADACHE MANAGEMENT
  - REFERRAL (Pediatric Neurologist in place?)

OFFICE SET UP

- Baselines not covered by insurance.
- Sometimes schools offer to pay for post-concussion services.
- Use Post Concussion Diagnosis. Avoid general dx like “encephalopathy” or “Unspecified”
- Billing: 90115-initial exam and first (computerized) testing
  96117-followup/retesting

Identify Your Market Share

Need to inform school contacts & parents of costs up front.
- Releases/Record Forms
- Scheduling/Accessibility
- Office Environment
### Identify Your Market Share

- **Target populations:**
  - public/private schools, community/rec leagues, minor league teams
- **Target referral sources:**
  - ERs, pediatricians, neurologists, athletic trainers, school nurses

### Propose Baseline Programs

- Develop a plan.
- Market to local public/private schools.
- Consider cost: data collection, bartering.
- Get your foot in the door as the school concussion consultant.

### Bartering

- Follow APA guidelines
- Formal agreements/contracts
- Inform your accountant
- Items to consider:
  - Use of private school’s gym, library, golf course; Tickets to games. Opportunities to be listed as supporters in programs, school activities; tables at events.

### Execute Marketing Strategies

- Website: www.rsmppsychology.com
- Brochure.
- Educational Materials.
- Mailings.
- Talks to schools, teams, hospitals, associations.
- Meet with local referral sources.
- Write articles for local venues.
- Partner in philanthropic activities.
- Place ads, Signage, PA Announcements

### Sample PA Announcement

- Ever feel like you’ve been cross-checked from behind into the boards?
- Is life an endless series of bad blue line calls?
- Do most of the people in your life belong in the penalty box?
- Let RSM Psychology Center conveniently located in Lawrenceville help you.
- Win the critical faceoffs
- Score on the power play and
- Make that game winning goal in overtime.
- Look for RSM Psychology Center in tonight’s program.

### Ethical/Legal Considerations

- **Competence**
- **Informed Consent:** data collection, limitations of screening, insurance.
- **Parental consent in divorce.**
- **Confidentiality**
- **Dual relationships (school payment)**
- **Consultation without seeing patient**
- **HIPAA**
- **Bartering**
CASE: 17 yo Female
Honors Senior Student Field Hockey Player

- Stick to face. Fractured nose.
- Initial sx: nausea, vomiting, headache.
- ER cleared. Return to school. No play.
- Persistent sx. Poor school work. Referred for neuro psych by AT.
- ImPACT screen. REST from school. Consult with school. Referral to neuropsych for MRI.
- ImPACT retest. Continued sx. Low scores, little improvement. MORE REST from school. CANCEL ACT.
  - Headache stopped. Returned to school half day, then full day. Work with teachers to reduce workload and modify expectations.
  - Monitor by phone consults with student, parent, school, MD. Out the rest of the season.
- Scheduled for follow up visit and testing.

REALITIES

- You’ve got to spend money to make money.
- It takes a while to develop and groom a sports concussion practice.
- Become a part of the sports culture.
- It helps to be outgoing, gregarious.
- It helps to be business-oriented.

Pain is temporary...
Quitting lasts forever.
Lance Armstrong