Current Trends in Youth Sports, Injuries, and Sport Related Concussions  
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Objectives

• Discuss the overview of injury patterns in pediatric athletes over the last 10 years
• Identify early sports specialization and its relationship to injuries in our young athletes.
• Discuss new interventions and practices for the management of sport related concussion

Why so many injuries?

• 27 million US youth between 6 to 18 yrs of age participate in team sports
• 60 million children aged 6 to 18 years in organized athletics
• 44 million participating in more than 1 sport.
Participation is starting at younger ages
Upward trend in year-round participation
Overall Slowdown in most popular sports?

Current Landscape in Sports
• Agency sponsored
• Club sports
• Recreational sports
• Intramural sports
• Interscholastic sports
Not all Kids are Destined to be these guys!

Early Sports Specialization

The theory of **sport specialization** is based on an interpretation of a study done by Ericsson. How many hours of practice were thought to be required to reach mastery level of a skill?

1. 100
2. 1,000
3. 10,000
4. 100,000
10,000 hrs?

- Ericsson 1993
- Malcolm Gladwell
- High volumes of practice at a **young age**
- Strongest predictor of becoming an **expert performer**
- Sports?

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Early Sports Specialization

- “Professional Pie”
- 6% NCAA
- **0.2 to 0.5%** percent of High School athletes go PRO
  - Higher risk of **overuse**
  - Higher risk of **burnout**
  - **Isolation?**
- Parents/coaches

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Practice, Practice, Practice... Success??
Rhythmic Gymnastics

- 2 studies (118)
  - Elite athletes were more likely to initiate intense training in early and middle childhood
- Peak performance occurs before full maturation

German Olympians 1558 athletes

- Elite athletes began intense training and competition in their sport later than near-elites (11.4 vs 10.2 years and 13.1 vs 12.0 years)
- Elites participated in > 1 sport from age 11 years than near-elites (64% vs 50%)

Do Genetics Play a Role?

- Very limited data
- Over 200 autosomal gene variants and loci associated with physical performance
- Preferable genotypes are uncommon AND combinations are even more rare
- Chances of a “perfect” sports genotype are 1 in 20 million
Final Words on Sports Specialization

• Few Make it Pro
• Early Specialization
  – Success limited
  – Likely detrimental?
• Encourage other Sports
• Early success does not mean later success

Overuse Injuries Definition

• Repetitive submaximal loading of the MSK system
• Rest not adequate to allow for structural adaptation
• Common during peak growth velocity

AMMSM

<table>
<thead>
<tr>
<th></th>
<th>Trained</th>
<th>Disexplored</th>
<th>Injured</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant No.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Race, %</td>
<td>92.3</td>
<td>90.0</td>
<td>90.0</td>
<td>.59</td>
</tr>
<tr>
<td>Sex</td>
<td>M</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age (years)</td>
<td>16.7 ± 1.3</td>
<td>15.2 ± 0.6</td>
<td>14.1 ± 1.1</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Height, m</td>
<td>1.65 ± 0.13</td>
<td>1.62 ± 0.08</td>
<td>1.57 ± 0.10</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>58.6 ± 57.0</td>
<td>56.2 ± 48.4</td>
<td>50.7 ± 36.0</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Body mass index, kg/m²</td>
<td>20.7 ± 4.9</td>
<td>19.4 ± 4.2</td>
<td>20.1 ± 3.6</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Creatinine kinase, U/L</td>
<td>43.1 ± 44.4</td>
<td>4.4 ± 2.2</td>
<td>4.9 ± 6.6</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Old sport-activity level</td>
<td>16.1 ± 9.3</td>
<td>16.1 ± 9.2</td>
<td>16.1 ± 9.2</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Number of reported sports, year</td>
<td>8.1 ± 5.3</td>
<td>7.8 ± 3.3</td>
<td>9.0 ± 3.4</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>New sport specialisation score</td>
<td>1.96 ± 1.041</td>
<td>1.55 ± 0.728</td>
<td>1.97 ± 0.901</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>% Trained</td>
<td>98.9</td>
<td>83.0</td>
<td>58.4</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>% Disexplored</td>
<td>98.1</td>
<td>76.0</td>
<td>67.1</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>% Injured</td>
<td>98.1</td>
<td>29.0</td>
<td>20.0</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Required sport activity participation ratio</td>
<td>0.16</td>
<td>0.16</td>
<td>0.16</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>% plays per sport</td>
<td>1.4</td>
<td>3.5</td>
<td>2.9</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>% plays per activity level</td>
<td>30.6</td>
<td>34.0</td>
<td>19.4</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>
### Overuse Injuries

<table>
<thead>
<tr>
<th>Degree of Specialization</th>
<th>Risk of Injury</th>
<th>Risk of Serious Overuse Injury</th>
<th>Risk of Acute Injury</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low specialization (0 or 1 of the following): Year-round training (&gt;8 months per year) Chooses a single main sport Quit all sports to focus on 1 sport</td>
<td>Low</td>
<td>Low</td>
<td>Moderate</td>
</tr>
<tr>
<td>Moderately specialization (2 of the following): Year-round training (&gt;8 months per year) Chooses a single main sport Quit all sports to focus on 1 sport</td>
<td>Moderate</td>
<td>Moderate</td>
<td>Low</td>
</tr>
<tr>
<td>Highly specialization (3/3 of the following): Year-round training (&gt;8 months per year) Chooses a single main sport Quit all sports to focus on 1 sport</td>
<td>High</td>
<td>High</td>
<td>Low</td>
</tr>
</tbody>
</table>

### Key Historical Points and Factors

- Playing on more than 1 team
- One sport or multiple
- Extra Coaching
- Additional training
- Days of rest
- Type of footwear
- Previous injuries and treatment

### Intrinsic Risk Factors

- Growth
- Anatomy
- Flexibility
- Strength
- Biomechanics
- Energy availability
Poor Biomechanics

• Growth
• Decreased Proprioception

Symptom guided grading of overuse injury

<table>
<thead>
<tr>
<th>Injury Severity</th>
<th>Symptom Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>Symptoms occur at the end of the activity, or only at initiation, then diminish</td>
</tr>
<tr>
<td>Grade 2</td>
<td>Symptoms develop during activity, late onset, diminish after activity is completed</td>
</tr>
<tr>
<td>Grade 3</td>
<td>Symptoms develop during activity, early onset and persist during remainder of activity, diminishing after activity has ended</td>
</tr>
<tr>
<td>Grade 4</td>
<td>Symptoms develop during activity and limit training frequency, intensity, or duration</td>
</tr>
<tr>
<td>Grade 5</td>
<td>Symptoms prevent training</td>
</tr>
</tbody>
</table>

Traction Apophysitis

Sinding Larsen Johansson
ISELIN DISEASE

High Risk Overuse Injuries
- Stress fractures
- Osteochondritis Dissecans
- Recalcitrant or Complicated Apophyseal Injuries

Spondylolysis/Spondylolisthesis
• Medial Tibial Stress Syndrome
  — Shin Splints
• Tibial Stress Fracture

Osteochondritis Dissecans

Current Trends in Youth Baseball
• Around 5 million children ages 6-17yo participate in organized youth baseball leagues in the US
• Since 1990s Club/Select teams
• Some concerns for decreased participation
Current Trends in Youth Baseball

- Talent recognition for pitchers occurs in the latter years of high school
- UCL surgeries are commonly performed on youth or high school pitchers
- 15-19 year olds accounted for 56.7 percent of UCL surgeries performed between 2007-2011

Overuse Injuries Throwers

- Shoulder
  - Little League Shoulder
  - Impingement
  - Instability
  - SLAP
- Elbow
  - Medial epicondylar apophysitis/avulsion fractures
  - Ulnar collateral ligament sprain
  - Osteochondrosis and osteochondritis of the capitellum
All Signs Point To….Overthrowing?

- Age guidelines regarding the number of pitches daily
- Rest requirements between pitching
- Season and yearly total pitch limits
- **PROPER BIOMECHANICS**

Current Trends in Concussions

- Baseline Testing
- How we are managing Concussions in CCMC
• 1.6 million to 3.8 million suffer sport related concussions annually

Baseline Testing

• Baseline testing
  – Performed in mass (usually)
  – Unsure of reliability
  – Methodology
  – Limited domain

Baseline Testing CCMC

• ImPACT Baseline
  – Neurocognitive Domain
• Neurologic
  Evaluation/Balance Error Scoring System (BESS)
  – Balance/Vestibular
• King-Devick Test
  – Ocular Dysfunction
• Neck Examination
Neurocognitive Domain

- 13 yrs and older
- Symptom Score
- Widely used and growing data
- Does not substitute full neuropsychological testing
- Methodology
  - Office
  - No distractions

Full Neurological Exam and BESS

- 3 stances
  - Double leg
  - Single leg (non dominant)
  - Tandem stance
- 20 seconds
- Eyes closed
- Foam and hard surfaces

King Devick Test

- 2 minute rapid number naming assessment
- Individual reads numbers aloud quickly
  - Test cards
  - Computer/Tablet
- Less than 60 seconds
Ocular Dysfunction and K-D Test

- Dysfunction of pathways travel from the eyes to the visual cortex
- Requires eye movement
  - Saccades
  - Convergence
  - Accommodation
- Attention and language function

Bottom Line is....

- Get as much information as possible on each individual

Neck Examination

- Girls and concussions
  - Decreased head neck mass segment
  - Greater angular acceleration of head
- Rehabilitation
  - Strengthening
  - Posture
- PREVENTION
New Trends in Management of Concussion

- The earlier...the better
- OK to encourage and push
- MULTIDISCIPLINARY APPROACH

First and Foremost...Getting back to Regular Lifestyle

- Prolonged rest
  - Detrimental
  - Depression
  - Deconditioning
- Early reintroduction to validating life activities
  - School-kids job
  - Social
  - Nutrition
  - Sleep

Early Return to Exercise

- Reintroduction to exercise
  - Symptom threshold
  - Graduated
- Controlled Aerobic Rehabilitation
  - HR/BP/VO2
  - Treadmill
  - Symptom scores
Exercise Intolerance?

• Ongoing Predictor of recovery
• Biomarker?
• Long Term information
  — School
• Rehabilitation
  — Symptoms

Role of Physical Therapy

Neuropsychology

• Comprehensive testing
• Identify additional conditions
  — Psychiatric disorders
  — Learning disabilities
• Sequelae/CTE
• Accommodations
Conclusions

• Increased youth sports involvement over the last 10 years
  — Possible slowdown in team sports?
• Early Sports Specializing
  — Overuse injuries?
  — Better Athlete?
• Concussion Update
  — Full evaluation if possible
  — Earlier exercise and rehab beneficial