Elbow Injuries in Young Athletes

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Disclosures

• None based on the content of this talk.
Learning Objectives

1. Discuss the Etiology of Elbow Injuries in Young Throwing Athletes.
2. Review Common Elbow Injuries seen in Young Throwing Athletes.
3. Discuss ways to Prevent Elbow Injuries in Young Throwing Athletes.
Growing Trends in Youth Sports

- Approximately 60 million children aged 6 to 18 years participate in some form of organized athletics.¹
- 44 million participated in more than 1 sport.¹
- An emphasis on competitive success has become widespread, resulting in increased pressure to begin high-intensity training at young ages.

Emphasis on Competitive Success

- Driven by parental goals of having their child selected for high-level travel teams, collegiate scholarships, and professional contracts.

- Trend towards a concentration on a single sport in an attempt to improve a child’s chances of elite team selection and exposure to the college recruiting process.

- Children’s sports are becoming a big business, coaches, personal trainers, club organizations, sporting goods manufactures, and tournament directors, all have a financial stake in youth sports participation.
Emphasis on Competitive Success
Overuse Injuries and Burnout in Youth Sports: A Position Statement from the American Medical Society for Sports Medicine

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EXECUTIVE SUMMARY

BACKGROUND

Youthsport participation offers many benefits including the development of self-esteem, peer socialization, and general fitness.

However, an emphasis on competitive success, often driven by goals of selection to local, regional, state, national or international teams, has become increasingly more intense.

This has resulted in increased pressure to begin high-intensity training at young ages.

Such an accelerated focus on early intensive training and competition at young ages rather than skill development can lead to overuse injury and burnout.

PURPOSE

To provide a systematic, evidence-based review that will assist clinicians in recognizing young athletes at risk for overuse injuries and burnout.

■ Identify the risk factors and injuries that are unique to the skeletally immature young athlete.

■ Describe specific high-risk overuse injuries that present unique health challenges and lead to long-term health consequences.

■ Summarize the risk factors and symptoms associated with burnout in young athletes.

■ Provide recommendations on overuse injury prevention.

METHODOLOGY

■ Medical Subject Headings (MeSH) and text words were searched on March 20, 2012, for MEDLINE, EMBASE, and PsycINFO.

■ Ninety-eight titles and abstracts were initially screened. Additional articles were found using cross-referencing. The process was repeated July 10, 2013, to review any new articles since the original search.

■ Screening by the authors yielded a total of 208 relevant sources that were used for this paper.

■ Recommendations were classified using the Strength of Recommendation Taxonomy (SORT) grading system.

DEFINITION OF OVERUSE INJURY

Overuse injuries occur due to repetitive submaximal loading of the musculoskeletal system when rest is not allowed to allow for structural adaptation to occur.

■ Injury can involve the musculoskeletal unit, bone, bony, or skeletal structures, and the tissues.

■ Overuse injuries unique to young athletes include epiphyseal injuries and physical abuse.

EPIDEMIOLOGY

It is estimated that 27 million US youth between 6 to 18 years of age participate in some sports.

The National Council of Youth Sports surveys found that 60 million children aged 6 to 18 years participate in some sports.

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Growing Trends in Youth Baseball

• Approximately 27 million children and adolescents between the age of 6 and 17 years participate regularly in team sports in the United States.²

• 2.3 million children played Little League baseball.³

Youth Elbow Injuries
4 Distinct Areas of Stress

1. Tension overload on the Medial Elbow Restraints

2. Compression overload on the Lateral Articular Surface

3. Posteriormedial shears forces on the Posterior Articular Surface

4. Extension overload on the lateral restraints.

Orthopedic Sports Medicine, Delee and Drez 3rd ed. Vol.2
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4 Distinct Areas of Stress

- **Anterior**
  - Olecranon Apophysitis
  - Avulsion Fractures
  - Osteophyte Formation

- **Lateral**
  - Osteochondrosis Capitellum
  - Osteochondritis Dissecans Capitellum

- **Posterior**
  - Medial Epicondylar Fractures
  - UCL Injuries
  - Medial Epicondyle Apophysitis

- **Medial**
  - Olecranon Apophysitis
  - Avulsion Fractures
  - Osteophyte Formation
Medial Elbow - Medial Epicondyle Apophysitis

- Medial epicondylar center is last to fuse with the humeral epiphysis (17 yo males)
- Excessive valgus stress from throwing (late cocking) can result in accelerated growth of the medial epicondylar apophysis
- Symptoms include pain with throwing and a decrease in accuracy, speed, and distance.
Medial Elbow- Medial Epicondyle Apophysitis

Thirteen-year-old baseball pitcher with Medial Right Elbow pain.

Normal Growth Plate

Widening of the Medial Epicondyle Physis
Medial Elbow- Medial Epicondyle Fractures

• If the bone does not have the opportunity to recover and heal from the repetitive valgus forces.

• Lead to separation and eventual fragmentation of the medial epicondylar physis

• Woods Type 1 and Woods Type 2.
Woods Type 1 fracture occurs in the younger child and is characterized radiographically by a large fragment, involving the entire epicondyle that is often displaced and rotated anteriorly and distally, and may even become entrapped in the joint.

Woods Type 2 fracture occurs in the adolescent and is radiographically notable for medial epicondylar fragmentation with a small fracture fragment.
Medial Elbow- Ulnar Collateral Ligament Injuries

- Becoming increasingly prevalent in adolescents as muscle mass and throwing force increase.
- Progressive discomfort and tenderness for months to years before the ligament is qualitatively injured.
- Athletes report pain during the acceleration phase of throwing.
- After rupture occurs, pain and instability is so severe that further throwing is not possible.

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Medial Elbow- Ulnar Collateral Ligament Injuries

Stephen Strasburg 2010
Medial Elbow-Ulnar Collateral Ligament Injuries

- Stress radiographs, Ultrasound, and MRI can provide additional information regarding the severity of injury.
- AP views with valgus stress at 30 degrees of flexion indicate markedly lax UCL of the right elbow in comparison to the left.
- Operative treatment is standard for a throwing athlete who desires to return to throwing sports.
• Olecranon Apophysitis
• Medial Epicondyle Apophysitis
• UCL Injuries
• Medial Epicondylar Fractures

• Osteochondrosis Capitellum
• Osteochondritis Dissecans Capitellum
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Anterior

Lateral

• Medial Epicondyle Apophysitis
• UCL Injuries
• Medial Epicondylar Fractures

Medial

Posterior
Lateral Elbow - Osteochondrosis Capitellum

- Panner’s Disease, begins as necrosis of the capitellum followed by recalcification.
- The capitellum begins to ossify at age 1 to 2 years and is completely ossified at age 14 to 17 years.
- Ages 7-12 years of age.
Lateral Elbow- Osteochondrosis Capitellum

- 11 year old pitcher with lateral elbow pain, swelling, and flexion contracture of > 15°
- Anterior posterior radiograph of the left elbow shows radiolucent lesions delineated by a peripheral rim of necrosis.
Lateral Elbow - Osteochondral Defect of Capitellum

- Affects older children, ages 13-16 years.
- Capitellar blood supply is tenuous, with end-arterioles terminating at the subchondral plate
- Compression at the radiocapitellar joint produces arterial injury at the subchondral plate resulting in bone death
- May or may not involve loose bodies
Lateral Elbow - Osteochondral Defect of Capitellum

• Early in the process, radiographs may be normal
• With time, islands of subchondral bone demarcated by a rarefied zone can be seen
• With more time, loose bodies may be generated
Anterior

Lateral
- Osteochondrosis Capitellum
- Osteochondritis Dissecans Capitellum

Posterior
- Olecranon Apophysitis
- Avulsion Fractures
- Osteophyte Formation

Medial
- Medial Epicondyle Apophysitis
- UCL Injuries
- Medial Epicondylar Fractures
Posterior Elbow- Olecranon Apophysitis

- Stresses across the posterior compartment cause a Valgus Extension Overload.
- Leads to separation of the olecranon secondary ossification center.
- Left untreated, it can result in an incompletely fused olecranon apophysis.
- Nonunion of the olecranon apophysis in adolescent throwers often require surgical fusion.
Posterior Elbow - Olecranon Apophysitis

- Physeal widening
- Sclerotic margins at the olecranon.
- Most cases are treated conservatively with rest and immobilization followed by rehabilitation.
During adolescence, the injury pattern progresses to avulsion fragments. Usually involve the Lateral and Long Heads of the Triceps.
Posterior Elbow- Olecranon Avulsion Fractures

Lateral

AP
Posterior Elbow- Osteophyte Formation

- Instead of avulsion, with age chronic apophysistis can lead to osteophyte formation
- Form at the posteromedial tip of the olecranon
- Can impinge on the trochlea in the elbow extension.
Posterior Elbow- Osteophyte Formation

- These osteophytes can fracture and produce loose bodies in the posterior elbow.
- Loose bodies will cause mechanical restrictions in extension.
- Often collect in posterior joint recess and require surgical removal.
Preventing Elbow Injuries in Young Athletes

Prevention is key to the development of elbow pathology in adolescent pitchers.

- Early Recognition and Treatment
- Limiting the cumulative effect of participation and overuse.
- Correct Biomechanics
Regular Season Pitching Rules
Little League Baseball

Pitchers league age 14 and under must adhere to the following rest requirements:
• If a player pitches 66 or more pitches in a day, four (4) calendar days of rest must be observed.
• If a player pitches 51 - 65 pitches in a day, three (3) calendar days of rest must be observed.
• If a player pitches 36 - 50 pitches in a day, two (2) calendar days of rest must be observed.
• If a player pitches 21 - 35 pitches in a day, one (1) calendar days of rest must be observed.
• If a player pitches 1-20 pitches in a day, no (0) calendar day of rest is required.

Pitchers league age 15-18 must adhere to the following rest requirements:
• If a player pitches 76 or more pitches in a day, four (4) calendar days of rest must be observed.
• If a player pitches 61 - 75 pitches in a day, three (3) calendar days of rest must be observed.
• If a player pitches 46 - 60 pitches in a day, two (2) calendar days of rest must be observed.
• If a player pitches 31 - 45 pitches in a day, one (1) calendar days of rest must be observed.
• If a player pitches 1-30 pitches in a day, no (0) calendar day of rest is required.

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<th>Age</th>
<th>Pitching Per Day</th>
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<tbody>
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<tr>
<td>13-16</td>
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<td>9-10</td>
<td>75</td>
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<td>7-8</td>
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Elbow Injuries in Young Athletes

5 fold increase in surgery on adolescents from 2000-2009

481 youth pitchers (aged 9 to 14 years) 10 year follow up study

Participants were interviewed annually.

Injury was defined as elbow surgery, shoulder surgery, or retirement due to throwing injury.

Results:

- The 10 year cumulative incidence of injury was 5%.
- Participants who pitched more than 100 innings in a year were 3.5 times more likely to be injured.
- Limiting the number of innings pitched per year may reduce the risk of injury.

Conclusion:

- Limiting the number of innings pitched per year may reduce the risk of injury.
Pitching Biomechanics

• Goal: Maximize Velocity/Lower Injury Risk
• Can’t Eliminate Inherent Stress
• Efficient Mechanics
  • Often Muscle and Mobility are laid on top faulty coordination and throwing mechanics
Foot contact creates pelvic rational speed

Core stretch creates ballistic shortening

Shortening causes upper torso acceleration

Arm goes into external rotation and loads internal rotators of the shoulder

Upper torso then decelerates, and the shoulder begins to internally rotate

Elbow moves to full extension, with maximum internal rotation speed (4,000-5,000°/sec)

Momentum is transferred from body to ball
Pitching Mechanics

- Foot contact creates pelvic rational speed
- Core stretch creates ballistic shortening, changes power in rotational speed.
- Ballistic shortening causes upper torso acceleration
- Arm goes into external rotation and loads internal rotators of the shoulder
- Upper torso then decelerates, and the shoulder begins to internally rotate
- Elbow moves to full extension, with maximum internal rotation speed (4,000-5,000°/sec)
- Momentum is transferred from body to ball

Daniel Bard
Efficient Biomechanics

- Hip Segment Rotation Speed
- Shoulder Segment Rotation Speed
- Elbow Flexion/Extension Speed
- Shoulder Internal Rotation Speed
3 Key Elements to Maximizing Velocity and Efficiency

1. Lower Body Drives the Power Process
2. The Core Changes Power into Rotational Speed
3. Arm Speed is achieved through Shoulder Internal Rotation
Lower Body Drives the Process

Stride Length as % of Leg Length = 150%

- Compromises lead leg stabilization
Lower Body Drives the Process

Stride Direction = 8° closed

- Too open
- Loose core rotation
Lower Body Drives the Process

Stride Leg Knee Flexion = 45-50°

- Stabilize through first half of acceleration
- Overflex or Overextend, break down in the chain and compensation
Wearable Biosensors

- Sensor Armor, a data-logging compression shirt that measures changes in throwing mechanics.
- Help coaches figure out when a pitcher needs to come out of the game.
Take Home Points

- Increase in Throwing injuries among the Youth.
- Early Recognition and Treatment
- Limiting the cumulative effect of participation and overuse.
- Correct Biomechanics / Lower Body Mechanics (stride length, stride direction, and stride leg knee flexion)
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