



# Preadolescent Sports Participation & Injury

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# Overview of the Preparticipation Physical Evaluation

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# 1° Objectives of the PPE

- To identify medical problems with risks of life-threatening complications during participation
- To identify conditions that require a treatment plan before or during participation
- To identify and rehabilitate old musculoskeletal injuries

# 1° Objectives of the PPE

- To identify and treat conditions that interfere with performance
- To remove unnecessary restrictions on participation
- To advise athletes regarding appropriate sports in which to participate.

# 2° Objectives of the PPE

- Determine general health
- Serve as entry point into the health care system
- Provide opportunity for discussion on health & lifestyle issues
- Meet administrative requirements

# Timing of evaluation

- **Ideally, 4-6 weeks prior to beginning of sport season**
  - **Gives time to identify and rehabilitate injuries beforehand**
  - **Not so early as to miss later injuries/illnesses**

# Frequency of Evaluation

- **AHA: Both history and physical every 2 years, with interim history yearly**
- **Sports medicine docs: with each new level of participation, plus yearly updates of hx and problem-focused exams**
- **AISD: requires yearly physical exam**

# Determining Clearance

- Does the problem place the athlete or another participant at increased risk of injury?
- Can the athlete safely participate with treatment (such as medication, rehabilitation, bracing, or padding)?
- Can limited participation be allowed while treatment is being completed?
- If clearance is denied only for certain sports or sport categories, in what activities can the athlete safely participate?
- When do I refer to a specialist??!

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# References

- Hergenroeder, A. The preparticipation sports examination in children and adolescents UpToDate Online, version 16.1. Accessed 5/12/08.
- Preparticipation Physical Evaluation, 3rd Edition The physician and sportsmedicine, McGraw-Hill 2005



# Preparticipation Evaluation - The Pulmonary Perspective

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# Outline

- The Preparticipation Evaluation
- Differential Diagnosis of Exercise Induced Dyspnea
- Managing the Athlete with Asthma

# The Preparticipation Exam

- Goals
  - Identify those with undiagnosed conditions
  - Manage appropriately those with known conditions
    - Allow for safe participation
    - Enhance participation by maximizing pulmonary function



# The Preparticipation Exam

- The history (The bad news)
  - Symptoms alone can lead to both overdiagnosis and underdiagnosis of exercise induced asthma!
  - Symptoms alone are not a good indicator of which patients to refer for additional testing!
- The physical exam (The worse news)
  - Probably the least useful part of asthma screening in athletes!



# The Preparticipation Exam History

- Typical for EIA
  - Previous history of asthma or allergic rhinitis
  - Cough, wheeze, chest tightness, dyspnea occurs after at least 6 to 8 minutes of vigorous exercise
  - Symptoms do not resolve quickly with rest or without treatment
- Not Typical for EIA
  - No previous atopic history
  - Symptoms that occur rapidly with exercise and resolve rapidly with rest
  - Stridor, syncope or near syncope, palpitations, cyanosis, headaches, muscle aches, cramping

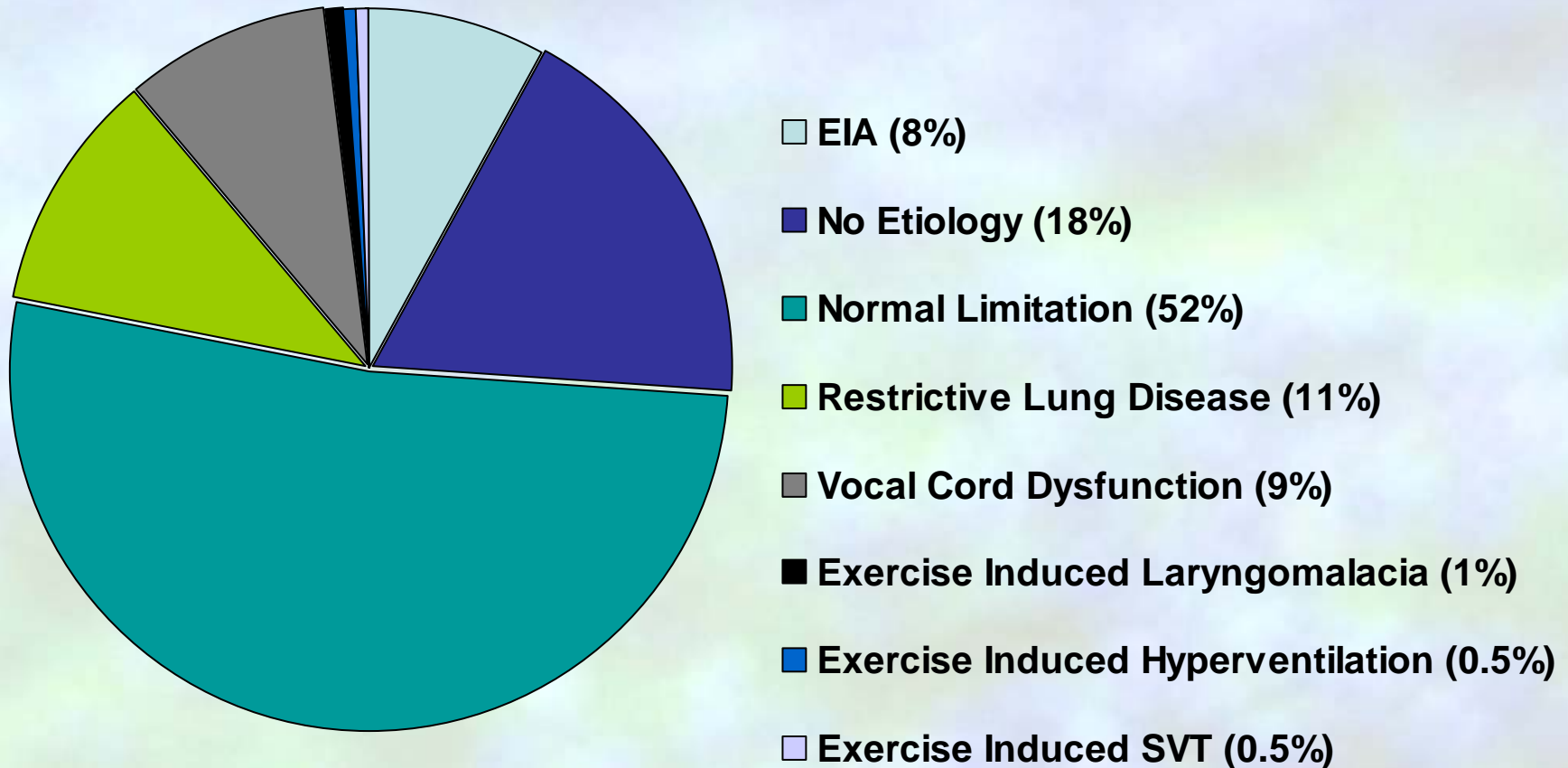


# The Preparticipation Exam

## Physical Exam

- Lungs are usually clear unless there is ongoing exacerbation
- Look for other signs of atopy – allergic conjunctivitis, rhinitis, atopic dermatitis, allergic shiners, allergic salute, cobblestoning etc.
- Look for chest wall deformities, clubbing

# Causes of Exercise Induced Dyspnea



Abu-Hasan, M et al. Annals of Allergy, Asthma and Immunology. 2005;94: 366-371

# Managing the Athlete with Asthma



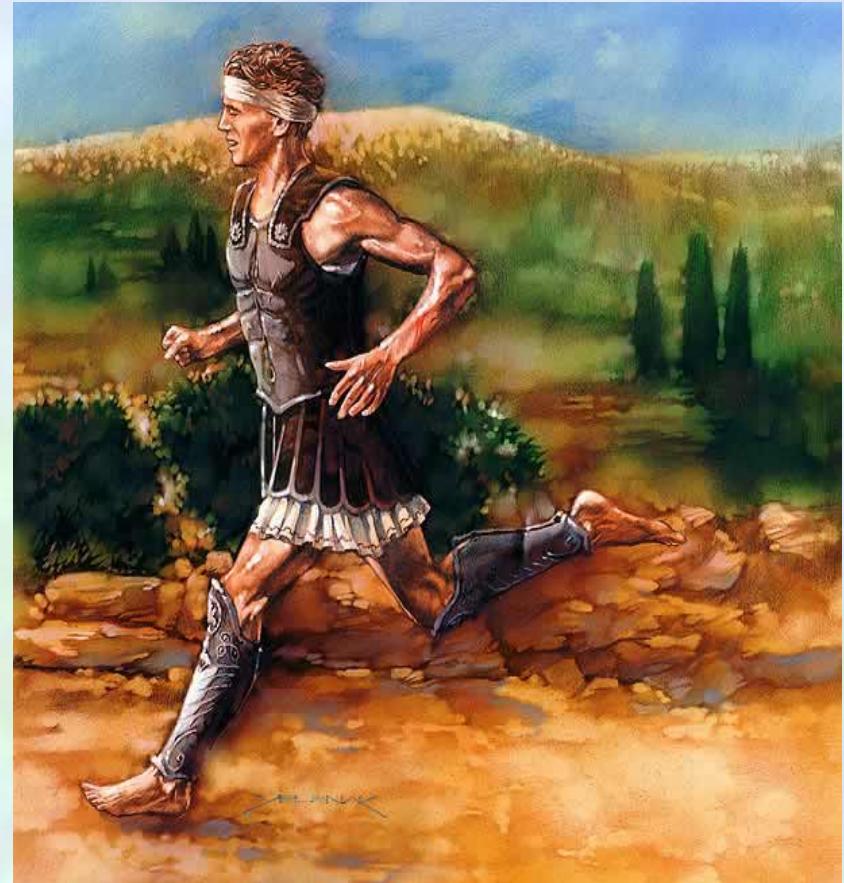
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# Managing the Athlete with Asthma

- Clearance
  - “With proper medication and education, only athletes with the most severe asthma will need to modify their participation”

Pediatrics 2001;107;1205-1209





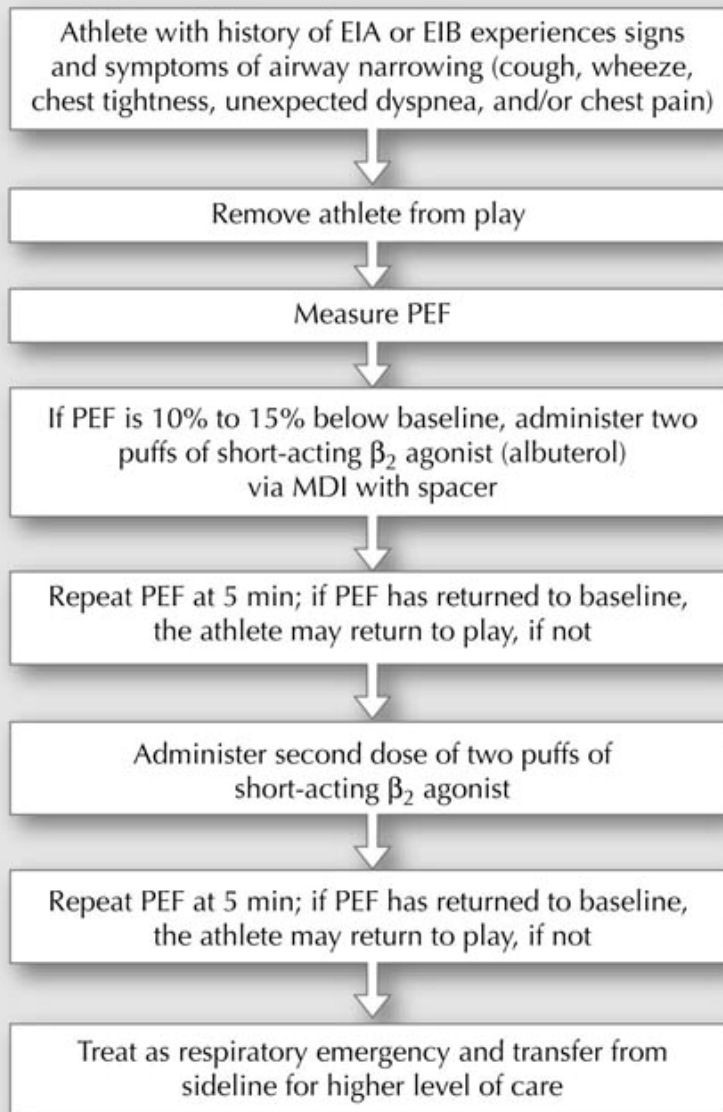
# Managing the Athlete with Asthma

- Management
  - Obtain adequate asthma control
  - Warm up – Short warm up at 80% maximum workload 15 minutes before competition
  - Pretreatment
    - B-agonists
    - Mast cell stabilizers
    - Anticholinergics
  - Remember to use a spacer or use a breath actuated device!!!!



# Managing the Athlete with Asthma

- Return to Play
  - Coaches and athletic trainers must be able to recognize signs of EIA
  - Player should be removed from activity
  - Measure sideline PEF and compare to baseline PEF  
If decreased by  $>15\%$  give short acting B-agonist.  
Repeat PEF in 5 minutes and repeat B-agonist if needed
  - Consider having a sideline asthma toolbox
    - Peak flow meter
    - Fast acting B-agonist
    - Spacer



If at anytime during the initial evaluation and therapy, the signs or symptoms worsen, treat as impending emergency and transfer to acute care facility immediately.

Allen TW. Current Sports Medicine Reports 2005, 4:301-304

# Additional Testing

- Methods of Testing
  - Sideline testing with PEF
  - Treadmill Exercise Testing
  - Methacholine Testing
  - Eucapnic Voluntary Hyperventilation
- Who to refer?
  - Athlete with severe symptoms
  - Competitive athlete unhappy with his/her performance
  - Athlete with no history of asthma and poor response to pretreatment

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# ACL Injury: Epidemiology and Prevention

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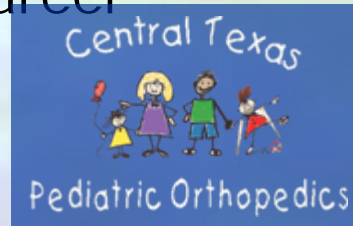
# Outline:

- **Epidemiologic Studies**
- **The Problem – Female Knee / ACL Injury Epidemic**
- **Increasing incidence of Injuries?**
- **Is this epidemic from an underlying neuromuscular 'disease'?**
- **Training Programs to reduce injuries**
- **Future direction**



# Epidemiology of Knee Injuries

- NCAA Athletes – Arendt et al:
  - ▶ Soccer and Basketball – higher risk sports for male and female athletes
  - ▶ Most are Non-Contact
  - ▶ Females → 3 to 8 times higher incidence of Knee Injury
  - ▶ Female Knee Injury :
    - 100,000 female athletes in NCAA
    - Greater than 10,000 knee injuries annually
    - Female ACL Tear: greater than 2000 annually
    - 8-10% Risk of ACL Tear over 4-year career



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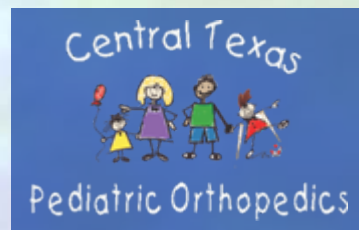
# High School Athletes

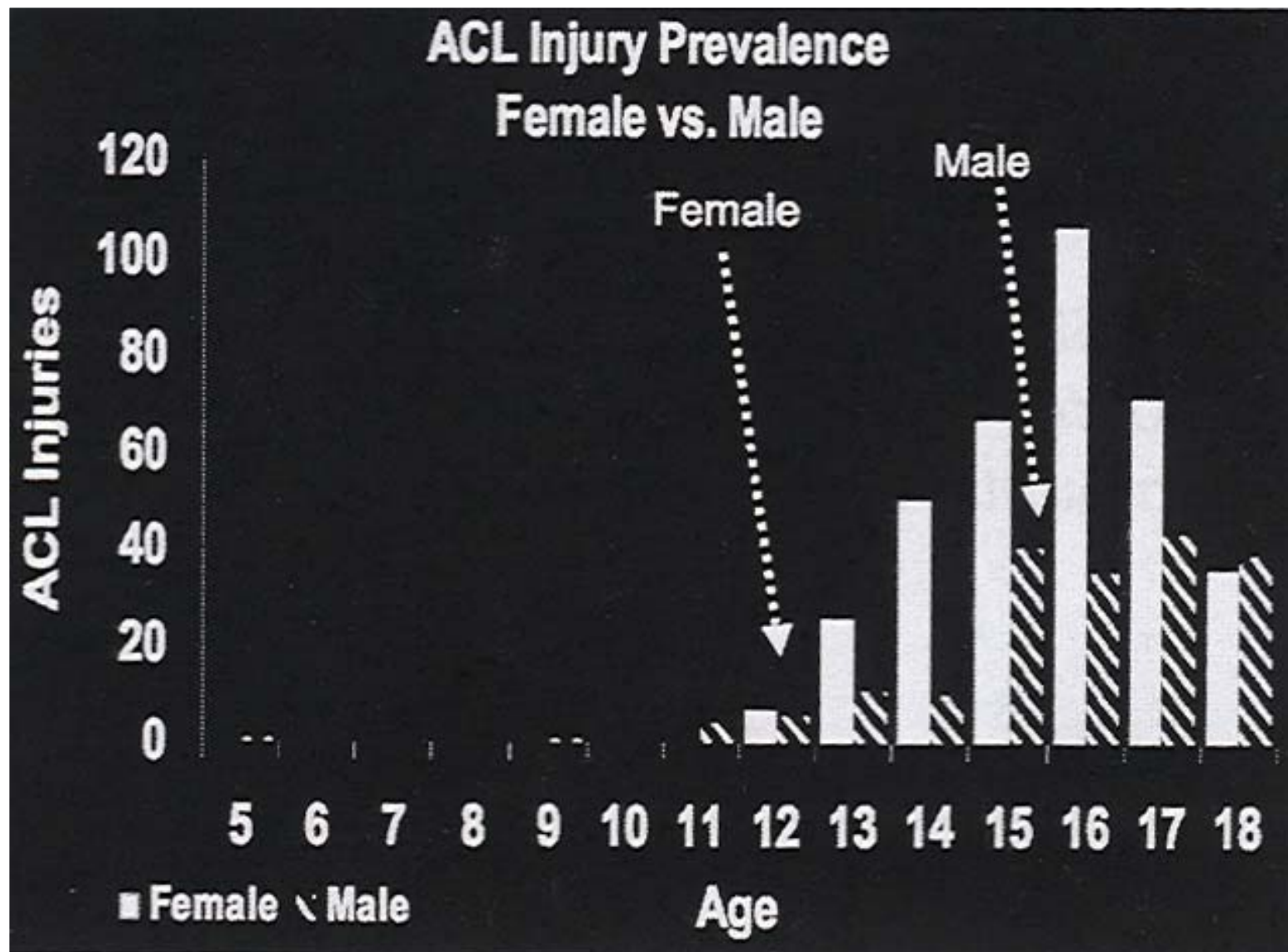
- Powell et al. High School Sports
  - ▶ 14 – 18
  - ▶ Highest Risk: football, wrestling, women's soccer/basketball
  - ▶ Injuries requiring surgery: 60% knee
  - ▶ Women in Basketball and Soccer have significantly higher injury rates than men



# Knee Injury in Pediatric/Adolescent Athletes

- Pediatric/Adolescent Soccer Athletes
- Insurance Data: Shea et al (2004)
  - ▶ Increased Risk in Pediatric/Adolescent Female Athletes
  - ▶ Age of Increased Risk of ACL Injury:
    - Females age 12-13
    - Males age 15-16





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# Is the Incidence of Knee Injury Increasing in Young Athletes?

- Real Increase?
- Detection Bias?
  - Sports Medicine Training
  - MRI
  - Public Awareness
- In the absence of accurate recording systems, what evidence do we have of increased incidence of knee injuries?



# Increasing Incidence of Knee Injury

- High School
  - Title Nine Legislation
  - Male HS Athletes
    - Since 1971, 3% Increase
    - 3.7 to 3.8 Million
  - Female HS Athletes
    - Since 1971, 900% Increase
    - 0.3 to 2.9 Million
- More Female Athletes, with 4-6 times higher risk of Knee/ACL Injury



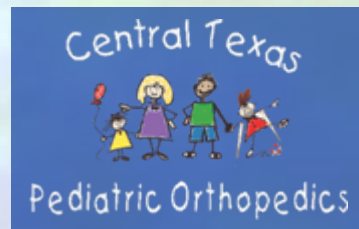
# Female ACL Injury Epidemic

- Most ACL Tears 15-25
- 38,000 – 100,000 Females Annually
- Directional Change Sports: Basketball, Soccer, Team Handball, Volleyball, Skiing
- Majority are Non-Contact!
- Are these injuries preventable?



# Female ACL Injury Epidemic: Risk Factors

- Epidemic
- Secondary to a Disease
- Cause(s)?
- Female ACL Injury may be a Neuromuscular disease



# Female ACL Injury Epidemic: Risk Factors

- Intrinsic
  - Anatomic, Genetic, Neuromuscular, Hormonal, Joint Laxity
    - Most of these are difficult to change!
- Extrinsic
  - Environment, Neuromuscular/Training



# Female ACL Injury Epidemic: Jump Landing Mechanics

- Jump Landing Tasks
  - Adolescent Females vs. Males (Ford et al 2003)
    - Females - landing with greater knee valgus
  - Pre-adolescents Female vs. Males (Sabick et al)
    - Males – greater hip abduction, knee varus



# Female ACL Injury Epidemic:

- Jump Landing/Directional Change Mechanics: Differences between Males and Female
  - Video Analysis of Injuries
  - Women: Different Knee Positions
    - Hip and Knee Extension
    - Hip Adduction
    - Hip Inward Rotation
    - One Leg Landing
    - Ligament Dominant vs. Muscle Dominant



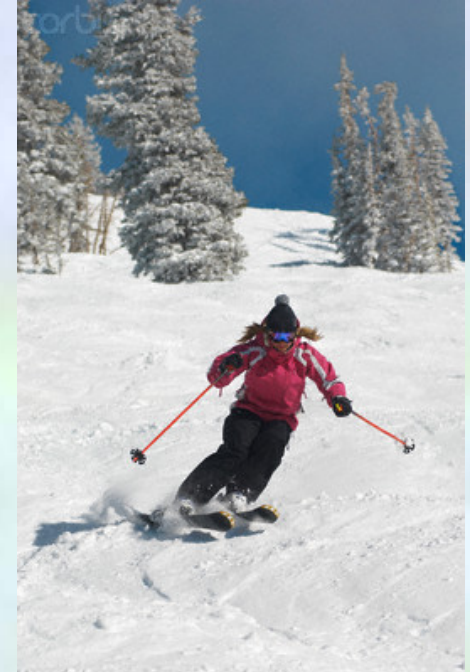
# 'Pathological' Landing Mechanics and ACL Injury

- Hewett, 2006
  - Prospective Study
  - Pre-sport Exercise Testing
  - 9 Females with ACL Tears Next Year
  - All demonstrated poor landing mechanics, with 'Dynamic Valgus Collapse'
  - **Knee Collapse, Hip Adduction, Hip Inward Rotation – 'KCHAIR' Position**



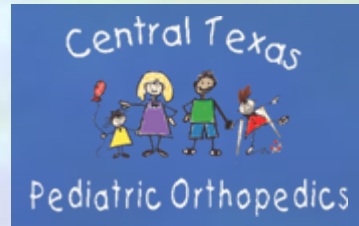
# 'Pathological' Landing Mechanics and ACL Injury

- Prevention of Skier ACL Injuries
  - Stay out of the back CHAIR on your skis
- Emphasis upon strength, endurance, proper landing mechanics
- Female athletes in Direction Change Sports
  - **Knee Collapse, Hip Adduction, Hip Inward Rotation – 'KCHAIR' Position**



# Can we prevent ACL injury?

- If many ACL tears are related to weakness and/or 'bad mechanics', can we train athletes to prevent or reduce the incidence of these injuries?
- Can we identify those athletes at risk?



# Neuromuscular Training Programs to Prevent Injury: Levels of Evidence

- Level 3 and 4 Evidence
  - 5/5 studies demonstrate a lower risk of lower extremity and ACL injury
  - Most studies on injury prevention programs suffer from significant study flaws:
    - Randomization, control groups
    - Identification of Injury
    - Historical controls
    - Compliance measures

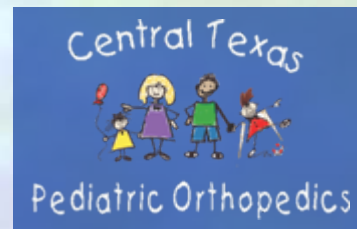


# Neuromuscular Training Programs to Prevent Injury: Levels of Evidence

- No Level 1 Evidence
- Level 2 Evidence:
  - Only 2 Level 2 Studies – non-randomized risk of knee injury in intervention group (Hewett et al AJSM 1999)
  - One study showed no difference in ACL injury in the intervention and control groups (Pfeiffer, Shea 2006 JBJS)

# Challenges for Implementation of Training Programs

- Coaching
  - Limited practice time
  - Limited field/gym access
  - Education for Coaches/Parents



# Challenges for Implementation of Training Programs

- High Schools
  - Athletic Departments
  - Medical Leadership
  - Develop close working relationship with athletic director, coaches
  - Athletic trainers / training room



# Challenges for Implementation of Training Programs

- Education for Medical Professionals
  - NPs, PAs
  - ATC's
  - Primary Care Physicians



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# Implementation of Training Programs

- Hewett: DNA, Dynamic Neuromuscular, Analysis
- PEP Program: Mandelbaum
- Don't just focus upon the knee / lower extremity
- Core Strengthening: Ireland, Zazulak, Hewett



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# Implementation of Training Programs

- Age of Implementation – before ACL injuries occur
- Incidence of ACL Tears in Children / Adolescents
  - Females Age 12-13
  - Males Age 15-16
- Consider starting 2-3 years before ACL injury onset



# Acknowledgments

- Tim Hewett, PhD. - Neuromuscular research investigations
- Bert Mandelbaum, MD – Previous contributions to the ICL, PEP Program
- Ron Pfeiffer, EdD, ATC – Collaborator on ACL Injury Prevention Research
- Kevin G. Shea, MD – Center for Orthopaedic and Biomechanics Research (COBR), Boise State University; Intermountain Orthopaedics Sports Medicine Center, Boise, Idaho, USA



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# Female ACL Prevention Programs

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# ACL Screening Maneuvers

- 3 Components of Screening
  - Leg Dominance: side to side difference in leg control (one leg lands first)
  - Quad Dominance: increased use of quads as knee flexor (lack of knee and hip flexion)
  - Ligament Dominance: relying on knee ligaments, not muscles to dissipate ground reaction forces (large valgus moment at knee)

# ACL Screening Maneuvers

- Single Leg Squat:
  - **Ideal** to have hip directly over ankle, flat back, knee going forward.
  - **At Risk** population has valgus at knee, tibial external rotation, forefoot pronation, bent forward at hips.

# ACL Screening Maneuvers

- Box Drop Vertical Jump
  - **At Risk** athlete shows valgus at knees on take off or landing, one foot landing first, and lack of knee and hip flexion at landing

# ACL Prevention Training

- Current programs show decrease in incidence by up to 80% in female athletes who have gone through prevention programs
- Multiple authors show that 3 main factors must be incorporated for successful training outcomes

# ACL Prevention Training

- Key components must include
  - Neuromuscular re-training drills
  - Proprioception or balance work
  - Plyometric Drills

# ACL Prevention Training

- All training dependent on constant feedback from knowledgeable instructor so athlete keeps perfect form
- Lack of feedback allow athletes to practice pre-existing flaws in form and may increase risk on injury

# ACL Prevention Training

- Goals of Programs
  - Train to land and cut in good hip, knee, foot position
  - Work on “soft” landings with good knee and hip flexion
  - Start slow with good form and build up to speed of play and sport specific drills

# ACL Prevention Information

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