Prevention of Secondary ACL Injury

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OBJECTIVES

• Discuss the risk factors for secondary ACL injury
• Present studies related to primary and secondary ACL injury
• Discuss the FIFA 11+ soccer prevention program
• Present strategies to reduce injury risk
SECONDARY INJURY

What is the greatest risk factor for reinjury
PRIOR INJURY
• 2-19 times greater risk of injury based on multiple prospective studies
• Soccer: Previous injury greatest predictor of future injury (Eckstrand, Soccer Industry Medical Symposium 2009)
• Athletes with knee surgery prior to college more likely to suffer a knee injury (6.8 fold) or ACL injury (19.6 fold) and have another knee surgery (14.4 fold) or ACLR (892.9 fold) compared with controls (Rugg et al., AJSM 2014)
SECONDARY ACL INJURY STATISTICS

- Risk of secondary injury rates range from 4%-25% depending on author
- Risk of secondary ACL injury 5.8% for ipsilateral knee and 11.8% for contralateral knee in first 5 years. Wright et al JBJS 2011
RISK FACTOR- AGE

• Swedish Registry of 16,000 patients: Ahlden et al, AJSM 2012

  • Followed for 5 years after index procedure
  • 4.1% revision rate; 5% contralateral injury (9.1% total rate of second ACL injury)
  • Age 15-18 = 16.7% reinjury rate in soccer players
  • Female soccer age 15-18 = 22% reinjury rate
  • Male soccer age 15-18 = 9.1% reinjury rate
RISK FACTOR- AGE

• Swedish Registry of 9000 patients: Andernord et al., AJSM 2015
  • Followed for 5 years after index procedure for contralateral ACL injury
  • Male and female patients < 20 years old had 3x higher risk of contralateral ACLR
RISK FACTOR- AGE

• Shelbourne et al, AJSM 2009 study of 1415 patients followed for 5 years after index procedure for second ACL injury
  • Age < 18 = 17.4 % ipsilateral or contralateral tear
  • Age > 25 = 3.9 % ipsilateral or contralateral tear

• Danish Registry of 12,000 patients: Lind et al, AJSM 2012
  • Age < 20 = 8.7 % revision rate
  • Age > 20 = 2.8 % revision rate
RISK FACTOR- GENDER

• Paterno et al, Clin Journ Sp Med 2012
  • Females with prior ACLR 16x more likely suffer 2nd ACL injury relative to controls
• Shelbourne et al, AJSM 2009 study of 1415 patients followed for five years. 9.6% overall reinjury rate (4.3% revision; 5.3% contralateral)
  • Women 12.5%
  • Men 7.8%
RISK FACTOR - GENDER

• Gender not a factor in studies by:
  • Andernord et al., AJSM 2015
  • Kaeding et al., MOON Study Group of 2500 patients, AJSM 2015 (Females not a risk factor for second injury but is for native ACL injury)
  • Persson et al., AJSM 2014 Norwegian ACL Registry of 12,600 patients
RISK FACTOR- ACTIVITY LEVEL

- Kaeding et al, MOON Study Group of 2500 patients, AJSM 2015
  - Marx Activity score average for no tear= 11.3 vs. Tear= 14.4
  - Odds of retear increase by 11% for increase in one point for Marx score

- Borchers et al, AJSM 2009 study of 322 patients followed for 2 years
  - Marx Activity score ≥ 13 had 5.53 greater odds of reinjury
RISK FACTORS - GRAFT AND TIME

• Borchers 2009 and Kaeding 2015 studies
  • Allograft 5.56 greater odds Borchers study
  • Allograft 5.2 greater odds Kaeding study

• Laboute et al, Ann Phys Rehabil Med 2010
  • Highest risk of re-injury occur within first 7 months post op

• Delaware- Oslo cohort ongoing
  • revealed increased risk of 2nd ACL injury if RTP before 9 months

• Paterno et al, AJSM 2014
  • 30% of repeat injuries occur within first 20 games or practice
CAN YOU SCREEN FOR ACL INJURY?
ACL INJURY PREVENTION: MODIFIABLE FACTORS

• Trunk control and proprioception- Zazulak et al, AJSM 2007
• Hip strength- Khayambashi et al, AJSM 2015
• Delaware-Olso cohort study- Grindem et al
• FIFA 11+ Study- Silvers-Granelli et al, AJSM 2015
HEWETT ET AL, AJSM 2005

• Study measured landing mechanics in 205 female basketball, volleyball and soccer athletes
• Jump-landing task measured and athletes followed for 13 months
• 9/205 (4.4%) sustained ACL injury
• **Key finding**: knee valgus moment and angles were predictors of ACL injury risk (ligament dominance)
HEWETT ET AL, AJSM 2005

Drop Vertical Jump

Dynamic Valgus
PATERNNO ET AL, AJSM 2010

- Prospective study of 56 athletes post ACLR
- Tests studied: drop vertical jump (DVJ), postural stability
PATERNOSTO ET AL, AJSM 2010

- 56 athletes followed for 12 months via email or phone
- 13 athletes suffered 2nd ACL tear
- 4 variables predicted 2nd injury to ACL
- Uninvolved limb transverse plane hip net moment during initial 10% landing phase
- 2 dimensional frontal knee plane ROM
- Asymmetries in sagittal plane knee moments during initial contact
- Deficit in postural stability of involved limb
- **Key finding:** Multiplanar asymmetries found in drop vertical jump and postural stability predicted a 2nd injury with 92% sensitivity and 88% specificity
DROP VERTICAL JUMP ABNORMALITY
SMITH ET AL, AJSM 2012

- Study screened 5047 high school and college athletes using VDJ test
- 28 ACL injuries occurred
- **Key finding**: Video analysis unable to identify trunk or lower limb factors in injured athletes vs. matched controls
KROSSHAUG ET AL, AJSM 2016

• Study looked at VDJ test as a screening tool in 710 soccer and handball athletes at elite level
• 5 factors analyzed based on previous literature
  • Knee valgus angle at initial contact
  • Peak knee abduction moment
  • Peak knee flexion angle
  • Peak vGRF
  • Medial knee displacement
• 53/710 (7.4%) suffered ACL injury; 42/53 non contact injuries analyzed
• 1 factor (medial knee displacement) associated with increased ACL injury risk
• Difference in displacement for 42 injured was 0.5cm
• **Key finding**: Authors suggest VDJ may not be sensitive enough to screen for ACL injury risk or test is not challenging enough task
Study measured trunk proprioception and trunk displacement in 277 male and female collegiate athletes (two different studies).

Core stability measured by trunk displacement after sudden force release and proprioception measured by repositioning testing.

Athletes followed for 3 years; 25/277 sustained knee injuries; 6/25 ACL injuries.
Key Finding: Trunk displacement was greater in athletes that injured their knee and ACL; lateral trunk displacement strongest predictor of injury in females. History of LBP and active proprioceptive repositioning all predictors.

Key finding: History of LBP strongest predictor of injury in males.
TRUNK DOMINANCE THEORY
KHAYAMBASHI ET AL, AJSM 2015

- Study measured isometric hip abduction and external rotation strength in 501 athletes with handheld dynamometer
- Athletes followed for 1 season
- 15/501 (3%) athletes suffered ACL tear
- **Key findings:** Hip strength significantly lower in injured athletes
- Athletes targeted high risk ≤ 20.3% BW external rotators and 35.4% BW abductors
DYNAMOMETER TESTING OF HIP

Hip External Rotation

Hip Abduction
DELAWARE – OSLO COHORT - GRINDEM ET AL- FIRST RTP CONFERENCE BERN, SWITZERLAND 2015

• 2 year prospective follow up on 106 ACLR athletes for re-injury
  • Quad index > 90% re-injury risk 5.9%
  • Quad index < 90% re-injury risk 32.7%
  • RTP at level 1 sport = 4.9x higher re-injury risk vs level II-III sport
  • RTP < 9 months re-injury risk 39.5%
  • RTP > 9 months re-injury risk 19.4%
WHAT WORKS BASED ON THE LITERATURE

• Time-reinjury rate decreases with time
• Screening for reinjury is equivocal
• ACL prevention programs for primary ACL injury have been validated
  • Do they work for secondary ACL injury?
FIFA 11+ STUDY - SILVERS-GRANELLI ET AL., AJSM 2015

• Soccer specific program proven to reduce soccer related injuries and prepare the athlete to play
• Many studies validate ACL prevention in women (Faude, Gilchrist, Hewett, Mandlebaum) but less studies in males
• Study focused on Division I and II male soccer players
FIFA 11+ COMPONENTS

• 20 minute program that replaces prior warmup program
• Website: f-marc.com/11plus/home/
• 15 exercises- Three parts; Parts 1 & 3 on game day; all parts before practice
  • Part 1- Agility exercises (8 minutes)
  • Part 2- Balance/ strength/plyometric exercises (10 minutes)
  • Part 3- Running exercise (2 minutes)
**FIFA 11+ STUDY**

- Sixty one division I and II teams: 675 intervention group and 850 controls
- **Key Finding:** 46.1% decrease in injury rate in intervention group
- Incidence rate per 1000 athlete exposures: 15.04 control group vs. 8.09 intervention group
- Higher compliance resulted in lower injury rates per team
- **Key Finding:** For every 3 athletes that participated in the intervention 1 injury was reduced
TIPS FOR USE IN CLINIC

- Quadriceps strength testing
- Plyometric assessment
- Augmented feedback during drills
- Therapeutic exercise and neuromuscular re-education

“A GOAL WITHOUT A PLAN IS JUST A WISH”

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# TUCK JUMP TOOL

**COURTESY OF GREG MYER, AJSM 2013**

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<thead>
<tr>
<th>Tuck Jump Assessment</th>
<th>Pre</th>
<th>Mid</th>
<th>Post</th>
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<tbody>
<tr>
<td>Knee and Thigh Motion</td>
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<td>1. Lower extremity valgus at landing</td>
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<td>2. thighs do not reach parallel (peak of jump)</td>
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<td>3. Thighs not equal side-to-side (during flight)</td>
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<td>Foot Position During Landing</td>
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<td>4. Foot placement not shoulder width apart</td>
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<td>5. Foot placement not parallel (front to back)</td>
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<td>6. Foot contact timing not equal</td>
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<td>7. Excessive landing contact noise</td>
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<td>Plyometric Technique</td>
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<td>8. Pause between jumps</td>
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<td>9. Technique declines prior to 10 seconds</td>
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<td>10. Does not land in same footprint (excessive in-flight motion)</td>
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WHAT TO LOOK FOR ON VIDEO

• Trunk posture
• Hip and knee at initial contact
• Force plates for loading strategies
AUGMENTED FEEDBACK

• Myer et al, AJSM 2013 study demonstrated augmented feedback of deficits found on tuck jump could enhance biomechanics on different task.

• Different types of feedback: verbal, visual, partner
FIXING WHAT YOU FIND

• Strength problems on dynamometer Hip program; Quad program
• Trunk problems- perturbation program, Core work
• Landing technique- practice and Augmented feedback
DOES IT REALLY WORK?

• Pappas et al, BJSM May 2015 systematic review revealed exercises were effective in decreasing neuromuscular deficits associated with ACL rupture.

• Exercises most helpful in post-pubescent females
EXERCISE IN CLINIC

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EXERCISES IN THE CLINIC
SUMMARY SLIDE

• Secondary ACL injury in first 5 years after primary ACL reconstruction is common
• The key to prevention is knowledge of risk factors
• Examination may identify modifiable risk factors
• FIFA 11+ program has been proven to be an effective injury prevention tool in soccer
• Combination of feedback and corrective exercises can enhance biomechanics and improve neuromuscular deficits