Preventing knee and ankle injuries

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Case 1: long jumper

- History: stretching sensation in the right hamstring after single long jump
- What do you think happened?
- Neurologist Dx: Hamstring tear
- My assesment

My assesment

- FB but stop before pain/stretching
- Extend the head/cervical spine

Case 1: long jumper

- At 50% of FB stretching sensation R hamstrings
- Head/neck extension eliminates symptoms
- Is it really a hamstring tear?
- Why extension decreases symptoms?
- Nerve can become sensitized when it is stretched or compressed.

Case II

- 12 y.o girl had lateral ankle sprain
- History: kayaking, cycling, running – injury
  – Unable to walk, ankle pain
- Testing of ATFL and CFL
- History = SLUMP test = head movements changes ankle symptoms

PROTECTIVE MUSCLE ACTION DURING NEURAL LOADING

- SLUMP test, SLR test, 90/90, ELY’s test, Femoral slump test


Motor control impairment in subjects with peripheral neuropathy

- Motor Control. 2015 Postural Steadiness and Ankle Force Variability in Peripheral Neuropathy.

Sensorimotor and balance function is impaired in adults with nerve root compression

- Clin Orthop Relat Res. 2002 Sensorimotor and balance function in older adults with lumbar nerve root compression.

Case I Case II

- Could positive neurodynamic testing be a screen test for injury prevention?
- Muscle stretching or neurodynamic mobilization?
- Could nerve sliding be a preventive exercise?

Slump test - mandatory test in the assessment of hamstring strain


  - Professional Australian Rules football players.
  - Grade I hamstring injuries
  - Positive responses to the slump test (a neural tension test).
  - 16 were treated traditionally, with the remaining 12 receiving slump stretch as an addition to the treatment regime.
  - Results indicated that traditional treatment plus slump stretch technique was more effective (p < 0.001) in returning the player to full function than the traditional regime alone.


  - Neurodynamic sliding technique increased hamstring flexibility to a greater degree than static hamstring stretching in healthy subjects
  - Hamstring flexibility in sports may lead to a decreased incidence in injuries; however, this needs to be formally tested.

Neurodynamic changes in subjects with anterior knee pain


Which screening tools can predict injury to the lower extremities in team sports?: a systematic review.


  - General joint laxity, hyperextension of the knee
  - Star excursion balance test (SEBT) may predict leg injuries.
  - Lower hamstring/quadriceps (H : Q) ratio
  - Decreased range of motion (ROM) of hip abduction
  - Side-to-side differences in anterior-posterior knee laxity
  - Differences in knee abduction moment between both legs are suggested to be predictive tests for sustaining an ACL injury and height was a predictive screening tool for knee ligament injuries.
  - There is some evidence that when age increases, the probability of sustaining a hamstring injury increases.
  - Hamstring flexibility (Debated predictive screening tool)
  - Body mass index and the age of an athlete could contribute to an ankle sprain.
  - There is support in the literature to suggest that greater strength of the plantar flexors may be a predictive measure for sustaining an ankle injury.
  - Postural sway is a predictive test for an ankle injury.
Prevention of non-contact anterior cruciate ligament injuries in soccer players. Part 1: Mechanisms of injury and underlying risk factors


• Most ACL tears in soccer players are non-contact in nature.
• Change of direction

Mechanisms of injury
– Cutting maneuvers combined with deceleration
– Landing from a jump in or near full extension
– Pivoting with knee near full extension and a planted foot.

• The most common non-contact ACL injury mechanism include a deceleration task with high knee internal extension torque (with or without perturbation) combined with dynamic valgus rotation with the body weight shifted over the injured leg and the plantar surface of the foot fixed flat on the playing surface.

Extrinsic non-contact ACL injury risk factors
– Dry weather and surface
– Artificial surface instead of natural grass.

Intrinsic risk factors include:
– Generalized and specific knee joint laxity,
– Small and narrow intercondylar notch width
– Pre-ovulatory phase of menstrual cycle in females not using oral contraceptives
– Decreased relative (to quadriceps) hamstring strength and recruitment
– Muscular fatigue by altering neuromuscular control
– Decreased "core" strength and proprioception
– Low trunk, hip, and knee flexion angles, and high dorsiflexion of the ankle when performing sport tasks
– Lateral trunk displacement and hip adduction combined with increased knee abduction moments (dynamic knee valgus), and increased hip internal rotation and tibial external rotation with or without foot pronation.

THE INFLUENCE OF HIP STRENGTH ON KNEE KINEMATICS DURING A SINGLE-LEGGED MEDIAL DROP LANDING AMONG COMPETITIVE COLLEGIATE BASKETBALL PLAYERS.

Int J Sports Phys Ther. 2015

• A smaller knee flexion angle and larger knee valgus angle during weight-bearing activities = risk factors for non-contact anterior cruciate ligament (ACL) injuries.
• Purpose
  — Influence of hip strength on knee kinematics in both genders during a single-legged landing task in the frontal plane.
• Three-dimensional motion analysis during a single-legged medial drop landing (SML).
• Hand-held dynamometer was used to assess hip isometric strength.
• CONCLUSIONS:
  — Significant correlations between hip strength and knee kinematics during SML were observed in both genders.
  — Study suggested that increased hip strength may help to prevent non-contact ACL injuries in athletes of both genders.

Foot posture as a risk factor for lower limb overuse injury: a systematic review and meta-analysis.

J Foot Ankle Res. 2014

• Strong evidence that a pronated foot posture was a risk factor for medial tibial stress syndrome (MTSS) development.
• Very limited evidence that a pronated foot posture was a risk factor for patellofemoral pain development.
• No relationship was identified between a pronated foot posture and any other evaluated pathology (i.e. foot/ankle injury, bone stress reactions and non-specific lower limb overuse injury).
• Evaluation of static foot posture should be included in a multifactorial assessment for both MTSS and patellofemoral pain.

Single leg balance

• Pelvic position
  — Hip muscle weakness?
  — Lumbopelvic stability?

Single leg squat/Single leg hop
Mechanism of knee injury

Specific for ACL injury
Inadequate Sensitivity: 1/3 of high risk individuals can't be detected.

Reliability and validity of observational risk screening in evaluating dynamic knee valgus.
Ekegren C, Miller WC, Celebro RG, Fagel H, Macintyre DL.

At >50° hip flexion the whole gluteus medius is internal rotator of the hip

- Lets say at 90° hip flexion gravity produces pelvic on femoral hip external rotation (sagittal axis)
- So gluteus medius is holding the pelvis from falling down and doing pelvic on femoral internal hip rotation

Imagine how eccentrically gluteus medius decelerates pelvis on femoral hip external rotation landing during single leg jump

For eccentric deceleration we need:
- Trunk muscles
  - Gluteus maximus / medio-lateral axis
- Gluteus medius / hip sagittal axis
- Quadriceps / medio-lateral axis
- Foot plantar flexors
- Etc.
Hop tests

- Hop – height
- Hop 1-5 quality/shock attenuation
- 1 Hop - distance
- 3 Hops – distance
- 6 m Timed Hop

Whether any of these tests can predict injury remains unknown.

Clinic-friendly lower extremity physical performance measures in athletes: a systematic review of measurement properties and correlation with injury, part 1. The tests for knee function including the hop tests


<table>
<thead>
<tr>
<th>Test</th>
<th>One leg hop for distance: 1 hop</th>
<th>One leg hop for distance: 3 hops</th>
<th>6 m timed hop</th>
<th>Crossover hop for distance</th>
<th>Triple jump</th>
<th>Single leg vertical jump</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability</td>
<td>Poor</td>
<td>No studies</td>
<td>Fair</td>
<td>Good</td>
<td>Poor</td>
<td>No studies</td>
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<tr>
<td>Agreement</td>
<td>Hypothesis testing</td>
<td>C</td>
<td></td>
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<tr>
<td>Correlation</td>
<td>Validity</td>
<td>Responisiveness</td>
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Neuromuscular Evaluation With Single-Leg Squat Test at 6 Months After Anterior Cruciate Ligament Reconstruction.


CONCLUSION:
- Nearly half of patients demonstrated persistent neuromuscular deficits on SLST at 6 months, which is when many patients return to unrestricted activity. Those with poor performance were of a significantly older age, decreased hip abduction strength, decreased single-leg hop distance

CLINICAL RELEVANCE:
- The SLST can be used to identify neuromuscular risk factors for ACL rupture. Many patients at 6 months have persistent neuromuscular deficits on SLST. Caution should be used when using time alone to determine when patients can return to unrestricted activity.

Star Excursion Balance Test as a Predictor of Lower Extremity Injury in High School Basketball Players

J Orthop Sports Phys Ther • Volume 36 • Number 11 • December 2006

<table>
<thead>
<tr>
<th>Test</th>
<th>SLST Test Category</th>
<th>SLST Test Reliability</th>
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</thead>
<tbody>
<tr>
<td>Single leg hop</td>
<td>Total hop distance</td>
<td>Fair to excellent</td>
</tr>
<tr>
<td>Crossover hop</td>
<td>Total hop distance</td>
<td>Fair to excellent</td>
</tr>
<tr>
<td>Medial hop</td>
<td>Total hop distance</td>
<td>Fair to excellent</td>
</tr>
<tr>
<td>Lateral hop</td>
<td>Total hop distance</td>
<td>Fair to excellent</td>
</tr>
<tr>
<td>Single leg squat task</td>
<td>Total hop distance</td>
<td>Fair to excellent</td>
</tr>
</tbody>
</table>

CONCLUSION:
- Single-leg squat task is a reliable tool that may be used to identify people with hip muscle dysfunction.
Conclusions:

- Physical activity can significantly reduce sports injuries
  - Acute injuries
  - Overuse injuries reduced by half

- Not effective
  - Stretching
  - Multiple exposure programs – emphasis on single effective...
  - Proprioception
  - Strength training – remains crucial

- Most effective