INJURY IN FEMALE SOCCER PLAYERS

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Before the 1970s, girls were discouraged from participating in sports.

Not until the 1950s that distances of greater than 200 meters for women introduced into Olympic games.

First women’s Olympic marathon in 1984.
Introduction

• Millions of girls participate in organized sports on all levels
• Number of female soccer player is increasing +++
• Professional teams of women
  – Basketball
  – Football
What do we know (already)?

• Information on professional female players is limited.
• Studies on amateur and youth females have identified injury rates:
  1.5 - 7 in practice (per 1000 players hours)
  9.1 - 24 in game
• 4 times higher risk in ACL injury than males....
What do we know (already)?

- 1991: study in elite female soccer players (n=41)
  - 80% sustained an injury mostly at the lower limb (88%)
  - 50% of the injury: knee or ankle.
- Major injuries (N = 12): knee ligament or meniscal tears (58%)
- Overuse injuries: 28% of all injuries

In 91, conclusion was:

female elite soccer players sustain a high incidence of injury...
What do we know?
Which injury?

- Data from WUSA (Women’s united soccer association)
Epidemiology, which injury?
Location of injury?
Time of injury?

- Relationship of time of season with injury occurrence
Time of injury?

Increase in injuries during the end of the seasons?
- deconditioning
- increase in play intensity (tournament, play-off)
Women’s soccer injuries

Data from the NCAA (National Collegiate Athletic Association) 2012

- The overall rate of injuries 7.3 per 1,000 athlete exposures (games and practices combined)
- Surgery: only performed for 2.4% of the women’s soccer injuries.
- Greater injury rate (9.1 per 1,000 athlete) : preseason

Data occurred in the NCAA between the 2004/05 and 2008/09 seasons.
Women’s soccer injuries
Data from the NCAA 2012

• Higher rate of ACL injuries but ... only 0.7% of all women’s soccer injuries > men
• Much higher rate of concussions men’s soccer at the NCAA level

Girls’ soccer is one of the top sports for concussion incidence. In NCAA women’s soccer
Women’s soccer injuries
Data from the NCAA 2012

- high rate of concussions
- heading the balls the sixth most common activity at the time of injury
- female athletes should learn proper heading and landing techniques ..... avoid head-to-head contact or contact with the head to the ground or goalpost
  - minimize the risk for traumatic brain injury
Women’s soccer injuries
Data from the NCAA 2012

Injury Percentage Breakdown
Concussions: 9.2%
Head, face and neck: 13.3%
Upper limb: 5.6%
Torso and pelvis: 12.3%
Lower limb: 65.3%
Location of injury?

Injuries in women’s professional soccer

E Giza, K Mithöfer, L Farrell, B Zarins, T Gill

Women’s soccer injuries
Data from the NCAA 2012

Most common specific injuries:
Ligament sprains of the lateral ankle complex (12.8%)
**Concussions (9.2%)**
Partial quadriceps muscle strains (7.0%)
Partial hamstring muscle strains (4.8%)
Injuries in Female Soccer Athletes

• Most Common injuries
  – Knee (ACL)
  – Concussion
  – Ankle
Injuries in Soccer Athletes

female § male which difference?
Type of injury?  
Difference M § F : CONCUSSION and/or BRAIN?

- Concussions (9.2%) in NCAA women’s soccer players is nearly double the proportion seen in NCAA men’s soccer players (5.5%)  
- Difference in the types of symptoms reported: males : more amnesia and confusion/disorientation females : more drowsiness and sensitivity to noise
Type of injury?
Difference M § F: KNEE

Men have an overall higher incidence rate of hamstring strains than women.
Women have a higher incidence rate of ACL tear.

Comparison of hamstring strain injury rates between male and female intercollegiate soccer athletes. Cross KM et al.
ACL

- Women have an increased predisposition to ACL injury
- Many theories, but no one proven definitive cause
ACL Injuries In Females

Mechanism of Injury?

• Internal rotation of the femur with external rotation of the tibia and foot.
• Valgus force added.
ACL Injuries

- **Intrinsic factors:**
  - Joint laxity
  - Hormones
  - Limb alignment
  - Ligament size
  - Notch size

- **Extrinsic factors:**
  - Conditioning
  - Experience
  - Skill
  - Strength
  - Muscle recruitment patterns
  - Landing techniques
Intrinsic factors
INTERCONDYLAR NOTCH

WIDTH  F < M

NWI : notch width index
Intrinsic factors

INTERCONDYLAR NOTCH

- Tillman et all. *Differences in three intercondylar notch geometry indices between males and females: a cadaver study* – The Knee 2002
  100 F/ 101 H


Intrinsic factors

INTERCONDYLAR NOTCH

• Intercondylar notch width well studied
• Some studies have shown differences in size between the sexes; others have not
• Smaller notch = smaller and weaker ACL?
• “Normal size ACL but smaller notch may cause impingement on the ligament

• ..... Controversial
Intrinsic factors
« anatomical » risk factors?

- Intercondylar notch
- Hyperlaxity
- Genu valgum, Femoral antversion
- ACL size (thickness)
- Muscle Mass and center of gravity
Intrinsic factors
ANATOMICAL FACTORS

Excessive Femoral anteverision
External tibial torsion

Landing closer to extension
Greater quadriceps activity
Intrinsic factors hormones

- Progesteron, Oestrogen ?
- Role of relaxin (pregnancy)

Blecher, *Arthroscopy* 98

Female sexual hormone

Role in structure, composition and biomechanical properties of ACL
Intrinsic factors hormones

- Gender-specific expression of receptors for relaxin, hormone promoting ACL remodeling.
- Serum relaxin concentration
- Elite female athletes with ACL tears: higher SRC than those without tears.
- SRC greater than 6.0 pg/mL: increased risk for an ACL tear (+ 4x)

Prospective correlation between serum relaxin concentration and anterior cruciate ligament tears among elite collegiate female athletes.
Dragoo JL et al
Extrinsic Factors

- Muscular imbalance Quad-Hamstring
- Technical issues
- Hip imbalance, « dynamic valgus »?
  gluteus medius weakness?
Extrinsic factors

• Skill and Experience
  – Hamstring activation is protective of the ACL
  – Female athletes rely less on their hamstrings and more on quads and gastrocs
  – Landing techniques in women are different
  – Unclear if it is training differences or innate neuromuscular function
Recent studies highlighted worse performance on neurocognitive tests for female in comparison with male soccer players. Sex differences on some spatial tasks and during the solution of complex mental rotation tasks.

NEUROMUSCULAR SYSTEM
FEMALE/MALE

FEMALE

Quadriceps first

ACL antagonist muscle

MALE

Hamstring first

ACL control muscle
MUSCULAR SYSTEM

• role of “dynamic valgus” is still studied
• role of adductor/abductor hip muscle on investigation
  higher knee adduction moment in females compared with males
• insuffiisiency of gluteus medius in female leading to higher knee adduction moment comparing to male population
• differences in neuromuscular patterns during cutting manoeuvres or kicking
MUSCULAR SYSTEM

- **kicking leg**: men generated almost four times as much hip flexor activation as females (123% in males compared to 34% in females)
- **supporting leg**: males generated more than twice as much gluteus medius activation (124% in males compared with 55% in females) and vastus medialis activation (139% in males compared with 69% in females).

*Differences Between Sexes in Lower Extremity Alignment and Muscle Activation During Soccer Kick, Brophy et al.* JBJS Am. 2010; 92:2050-2058
Your kick like a girl …. 

Decreased activation of the hip abductors and greater hip adduction in the supporting limb during the soccer kick in female athletes

*MUSCULAR SYSTEM*

* Differences Between Sexes in Lower Extremity Alignment and Muscle Activation During Soccer Kick, Brophy et al. JBJS Am. 2010; 92:2050-2058*
- Gender differences in strength and muscle fiber characteristics is well known.

- Lower body, women are approximately 66% as strong as the men due primarily to larger fibers in male.
MUSCULAR SYSTEM
FEMALE/MALE

FEMALE

Quadriceps first

ACL antagonist muscle

MALE

Hamstring first

ACL control muscle

For ACL reconstruction?
CONSEQUENCES FOR TREATMENT in ACL tear

No difference


CONSEQUENCES FOR ACL R?

Barrett et all.

*Reconstruction of the anterior cruciate ligament in females: A comparison of hamstring versus patellar tendon autograft – Arthroscopy 2002*

Failure: **23% Hamstring** (n=39) / **8% BTB** (n=37)

BUT … non significant and same rehabilitation protocol
WHAT SOLUTION ??

• Prevention and education .....
The 11+

- Randomized controlled trial
  - 1892 girls aged 14-16 yrs
  - 2007 football season

Comprehensive warm-up programme to prevent injuries in young female footballers: cluster randomised controlled trial

Torbjørn Soligard, PhD student,1 Grethe Myklebust, associate professor,1 Kathrin Steffen, research fellow,1 Ingar Holme, professor,1 Holly Silvers, physical therapist,2 Mario Bizzini, physical therapist,3 Astrid Junge, associate professor,3 Jiri Dvorak, professor,3 Roald Bahr, professor,1 Thor Einar Andersen, associate professor1
Extrinsic factors?

• What to do?
  – Teach preventive skills
  – Learn how to fall, jump and to cut
  – Plyometric training
    • Reduce landing forces and improve strength ratios
  – Increase hamstring activation
Prevent Injuries In Females

• Prevention
  – 6-week preseason training program to reduce landing forces
  – Increase hamstring power through plyos
  – Proprioceptive training
  – Equipment changes
  – Improving technique
Develop and teach the 11+

- A comprehensive warm-up program over 20 min
  - Running exercises combined with strength, plyometric and balance exercises
1C. Backward running

**Elapsed time:** 1–1.5 minutes

**Purpose:** To continue your warm-up and engage your hip extensors/hamstrings. Make sure you land on your toes. Watch for locking of your knee joint. As you bring your feet back, make sure you maintain a slight bend in your knees.

**Instructions:** Run backwards from sidestep to sidestep. Land on your feet without snapping the knee back. Stay on your toes, and keep the knees slightly bent at all times.

2. Stretching

It is important to warm-up prior to stretching – never stretch a cold muscle. By doing the exercises outlined here, you can improve and maintain your range of motion, reduce stiffness in your joints, reduce post-exercise soreness, reduce the risk of injury and improve your overall mobility and performance.

- Do a large muscle warm-up such as brisk walking for five to ten minutes before stretching.
- Do not bounce or jerk when you stretch. Gently stretch to a point of tension and hold.
- Hold the stretch for 30 seconds. Concentrate on lengthening the muscles when you are stretching.
- Breathe normally. Do not hold your breath.

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Elapsed Time</th>
<th>Purpose</th>
<th>Instructions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A. Jog line to line (time to cone)</td>
<td>0-30 seconds</td>
<td>To ensure a great running technique. Keep your head forward, in a straight alignment, without your knees coming in or out on your feet, swinging out to the side.</td>
<td>Complete a slow jog from the near to the far sidestep.</td>
</tr>
<tr>
<td>1C. Backward running</td>
<td>1-1.5 minutes</td>
<td>To continue your warm-up and engage your hip extensors/hamstrings. Make sure you land on your toes. Watch for locking of your knee joint. As you bring your feet back, make sure you maintain a slight bend in your knees.</td>
<td>Run backwards from sidestep to sidestep. Land on your feet without snapping the knee back. Stay on your toes, and keep the knees slightly bent at all times.</td>
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<tr>
<td>2A. Calf stretch (30 seconds x 2 repetitions)</td>
<td>1-1.5 minutes</td>
<td>To stretch the calf muscles of your lower leg.</td>
<td>Stand facing the wall, placing your hands on the wall. Keeping your elbow straight, stretch your leg as far as you can. Hold for 10 seconds, then switch sides.</td>
</tr>
<tr>
<td>2C. Hamstring stretch (45-60 seconds x 2 repetitions)</td>
<td>1.5-2.5 minutes</td>
<td>To stretch the hamstring muscles of the back of your thigh.</td>
<td>Lie on the ground with your right leg extended out in front of you. Bend your left knee and rest the bottom of your foot on your right inner thigh. With a straight back, try to bring your chest toward your right thigh. Do not cross your back. If you can, reach down towards your toes and pull them up toward your head. Do not bounce. Hold for 30 seconds and repeat with the other leg.</td>
</tr>
<tr>
<td>2B. Quadriceps stretch (30 seconds x 2 repetitions)</td>
<td>2-2.5 minutes</td>
<td>To stretch the quadriceps muscles of the front of your thigh.</td>
<td>Place your left hand on your partner’s left shoulder. Reach back with your right hand and pull out of the front of your right thigh. Using your hand, make sure your knee is pointing down towards the ground. Keep your right leg close to your left. Do not allow your knee to swing out to the side and do not bend at the waist. Hold for 30 seconds and switch sides.</td>
</tr>
<tr>
<td>2D. Inner thigh stretch (30 seconds x 2 repetitions)</td>
<td>3-4 minutes</td>
<td>To elongate the muscles of your inner thigh (adductors).</td>
<td>Recline seated on the floor. Spread your legs very apart. Slowly lower yourself to the floor with a straight back. Use your hand to stretch in the inner thigh. Now reach towards the right with the right arm. Swing your left arm over your head and stretch over to the right. Hold the stretch and repeat on the opposite side.</td>
</tr>
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CONCUSSION?

• What to do?
  - female athletes should learn proper heading and landing techniques .....  
  - avoid head-to-head contact or contact with the head to the ground or goalpost  
    minimize the risk for traumatic brain injury
Head injuries and how to avoid them

The most common head injury in sport is a contusion of the head, which may vary widely in severity. Many head injuries in football are the result of unsuitable playing techniques and can be reduced by employing proper skills, ensuring good medical care and enforcing safety through the Laws of the Game.

For both men and women, the most frequent injury in football is a contusion to the lower leg. But one injury is particularly troubling, not just in football, but in all contact sports and that is an injury to the head. Numerous injuries are possible such as contusions (bruises) and abrasions, dental injuries, eye injuries (e.g. detached retina), lacerations (cuts), fractures and concussions. The injury that gets everyone’s attention is concussion. Why? Because concussion has the potential to have long-term consequences affecting memory concentration, planning, problem solving and more.

**What is concussion?**
Concussion is the temporary loss of normal brain function as a result of an injury. A player does not need to have lost consciousness to suffer concussion. The player may be confused or aware of his head, face, or place for a while after the injury. Other typical symptoms are headache, dizziness, nausea, unsteadiness or balance. The only injury that may result in a brief headache or unconsciousness.

Head injuries are predictable. They usually occur near the halfway line when players are competing for headers, goal kicks, long passes etc. They can also happen, though much less frequently, in the penalty area when many players compete for crosses or corner kicks. Head injuries are spread out fairly evenly across female strikers, midfielders, and defenders. Goalkeepers have unique challenges when coming out to an oncoming striker or working around the goalposts.

The majority of injuries are due to head-head, head-elbow, head-ground contact or when the head impacts another hard object like the foot, knee, point or even some object near the touchline. Generally, head injuries to women happen from head-head contact. For men, it is head-elbow contact. This is why the FIFA Medical Assessment and Research Centre (F-MARC) has recommended changing the laws to the International Football Association Board (IFAB) and sanctioning every elbow blow with a red card.

Concussion can occur if the ball hits you when you are unprepared for the contact. However, purposeful heading carries little risk of concussion injury. Nevertheless, heading is a complex task. It involves skill, courage, timing and decision-making. In preparing to head the ball, you tighten your neck muscles that tie the head to the trunk giving you a large mass to overcome the mass of the ball. Then you have to time your actions according to the velocity and direction of the ball while you are running forward, sideways or backwards or jumping (off one or both feet) while trying to decide what the opponent will do and then direct the ball to a specific location. All this is done in a split second. There are players who are skilled headers who seek out every chance to head the ball and there are players who rarely head the ball.

Injuries to the head are not uncommon. If we add up all the recorded head injuries, we see that between 4% and 20% of all injuries in football are to the head. Around half of all injuries to the head are common contusions and abrasions injuries. In men, the next most common head injury is a laceration, but in women, the next most common injury is concussion. For men, concussion is the fourth most common type of head injury. In some studies, the concussion injury rate for women is nearly 2.5 times higher than for men. Why? Women seem to have some differences in how they handle some tasks relating to impact that may relate to how well they can handle impact to the head. There are two major points in concusion that everyone associated with football needs to be aware of: recognition that an injury has occurred and when to allow a player to return to play.

The first concern is recognizing that an injury has occurred. The common perception is that one needs to lose consciousness to have sustained concussion but this is not true. Medical definitions of concussion state that there has been a ‘rapid onset of short-lived impairment of neurological function’. Impact, not always to the head, can lead to this impairment. So, if you see two players knock heads and one bends over, holds her head and is oblivious to the game around her, the chances are that she has suffered ‘short-lived impairment of neurological function’.

**When in doubt, keep them out**

It is important to recognize that an injury has occurred so the player can be removed from play and assessed. While there are many recommendations regarding when to allow a player to return to play, the safest decision is to keep them out of play until a medical professional says they can return. Most coaches and players are not in a position to make such a decision on the field, so
CONCLUSION

- Training program?  yes!! But adapted to woman
- Prevention and testing
- You kick like  

![Image of a muscular woman]