Soccer Knee Injury: Rehabilitation Considerations

June 25, 2014
Katie Foster, MPT, OCS, SCS, MTC

Introduction

<table>
<thead>
<tr>
<th>Group</th>
<th>W</th>
<th>L</th>
<th>T</th>
<th>Pts</th>
<th>GD</th>
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<tbody>
<tr>
<td>Germany</td>
<td>1</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>+4</td>
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<tr>
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<td>0</td>
<td>1</td>
<td>4</td>
<td>+1</td>
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<td>1</td>
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<td>-1</td>
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<td>Portugal</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>-4</td>
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</table>
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Overview

* Mechanism of Injury
* Rehab Progression
  * Focus on non-contact ACL rehab
  * Concepts can be applied to other lower extremity injuries
* Return to Play Criteria
* Soccer Specific Sport Demands
* Prevention

Intro - Soccer

* Approximately 300 million players worldwide
* Fastest growth rate among all major U.S. sports
* Number of club organizations has increased exponentially in the last 25 years
* Number of high school players has doubled from 1990-2012
* More kids have opportunity to play at higher level

* Early specialization – more overuse injuries, fewer overall coordinated athletes – more “specialists”
Mechanism of Injury

* Majority are non-contact → Sudden deceleration from cutting, landing, jumping, twisting

MOI – Risk Factors

* Female soccer players 3x > males
* Plant/Cut differently:
  * ↑hip IR, ↓hip & knee flex
* Poor landing mechanics
  * Land in dynamic LE valgus position
  * Increased hip add & IR
  * Tibial abd/ER
  * Foot eversion
  * Land <30 degrees knee flexion
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MOI – Risk Factors

* **Male/Female differences**
  * Kicking
    * Females > trunk lean & > med/lat GRF than males
  * Males activate hip flexors in kicking leg and hip abductors in their stance leg > females
  * Greatest ACL risk to plant leg more than kicking leg

When Designing Rehab Program

Surgery won’t fix this….
This is a PT/ATC problem and a strong predictor for injury and re-injury

What Is “This?”... Could be:

- Poor core strength
- Poor balance
- Poor coordination & neuromuscular control
- Decreased hip & knee flexion mechanics
- Hip abd, ER weakness
- Decreased ankle dorsiflexion
- Excessive foot pronation
- Poor eccentric quad control
- Positive Beighton’s (9/9) generalize joint hyperlaxity
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- Not a cookbook progression
- Goal-based phase advancement, not time-based
- Progression for RTP progresses from thoughtful control → automatic/reflexive/reactive
- Evaluate the entire kinetic chain → address pre-injury predisposing factors
- Focus on quality of movement – empower patients to self-correct
- Understand the position patient plays & level they need to return to

Meniscus
Meniscus – Non-surgical Considerations

* Healing potential dependent on:
  * Longitudinal vs. radial
  * Traumatic vs. degenerative
  * Red-white vs white-white

* Biomechanical eval
  * Rehab dependent on physical findings with goal of dispersing rotational forces
  * Correct biomechanical faults – more on this in ACL section

Meniscus - Repair

* **Phase 1** – Maximal Protection (Wks 1-6)
  * ROM & WB set by MD – usually limited first 3-4 wks

* **Phase 2** – Moderate Protection (Wks 5-12)
  * Gradual strengthening – avoiding twisting, pivoting, running & deep squatting
  * Limited ROM CKC quad strengthening
  * No HS curl with posterior medial repair secondary to semimembranosus attachment

* **Phase 3** – Controlled Activity Phase (Wks 9-16)
  * Balance training
  * Pool running wk 12
  * Preparation for unrestricted activities
Meniscus - Repair

<table>
<thead>
<tr>
<th>Activity</th>
<th>Peripheral Tears</th>
<th>Complex Tears</th>
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</thead>
<tbody>
<tr>
<td>Deep squat</td>
<td>4 mos</td>
<td>5 ½ mos</td>
</tr>
<tr>
<td>Straight line run</td>
<td>4 mos</td>
<td>6 mos</td>
</tr>
<tr>
<td>Pivot/Cut</td>
<td>5 mos</td>
<td>7 mos</td>
</tr>
<tr>
<td>Agility training</td>
<td>5 mos</td>
<td>7 mos</td>
</tr>
<tr>
<td>Return to sport</td>
<td>6 mos</td>
<td>7-8 mos</td>
</tr>
</tbody>
</table>

Partial Meniscectomy

- Progress WB/ROM to tolerance
- Correct biomechanical faults that lead to increased torsional stress
  - Meniscectomy will lead to increased contact forces on articular cartilage
  - Directly correlated to how much tissue is removed
- RTP – running 4-6 wks, training with team 6-8 wks
Phases of ACL Rehab

<table>
<thead>
<tr>
<th>Phase</th>
<th>Description</th>
<th>Week (post op)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protection and controlled ambulation</td>
<td>0 to 4-6</td>
</tr>
<tr>
<td>2</td>
<td>Initial strengthening and controlled training</td>
<td>4-6 to 8-12</td>
</tr>
<tr>
<td>3</td>
<td>Advanced strengthening and neuromuscular training</td>
<td>8-12 to 16-24</td>
</tr>
<tr>
<td>4</td>
<td>Return to play training/testing</td>
<td>6 to 9 mos.</td>
</tr>
<tr>
<td>5</td>
<td>Return to full participation soccer</td>
<td>9 to 12 mos.</td>
</tr>
</tbody>
</table>

* Majority of today’s presentation
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Protection & Controlled Ambulation
(Weeks 0 to 4/6)

Key points of this phase:
※ Get the op report – graft type, concomitant meniscal repair, joint surface chondromalacia?
※ Early weight bearing for sufficient quad control
※ Graft is stronger than native ACL
※ Bone/bone tunnel ossification occurring (BPTB)
※ Bone/tendon healing (HS) – up to 12 weeks
※ **Weakest link @ 3-6 weeks p.o. is the fixation**
  ※ Prevent tunnel widening – avoid cycling the knee

**ROM**
※ If possible, know pre-op ROM
  ※ Extension!! Including hyperextension!
    ※ 95% population has some degree of hyperextension
    ※ Loss of extension compared to non-involved side has huge impact on:
      ※ Gait
      ※ Quad facilitation
      ※ Normal patellafemoral and tibialfemoral arthrokinematics (early OA, PF pain)
**Weeks 0 to 4/6**

*Effusion – control it!*

* Little as 5 ml of fluid can inhibit the quad, acutely
* Barrier to regaining ROM and quad control
* Watch for DVT & signs of infection & call MD
  * + Homan’s sign \( \rightarrow \) < 1/3 patients have confirmed DVT (Poor Sn, Fair Sp)

Weeks 0 to 4/6

• Normal gait
  • Watch for quad avoidance pattern
  • Crutch gait longer if patient can’t control

• Early quad strengthening/facilitation
  • Closed chain squat 0-45 degrees to decrease PF stress
  • Sit \( \rightarrow \) stand 2 legs to 1 leg progression
Weeks 0 to 4/6

- Neuromuscular control for motor memory
  - Mechanoreceptor repopulation most active between 2-8 weeks post op
  - Incorporate soccer ball as much and as safely as possible

Initial Strengthening & Controlled Training
(Weeks 4/6 to 8/12)

- Key points
  - Ligamentization / “stupid” phase
  - Avascular necrosis
  - Cell repopulation → Revascularization (20 wks → up to 2 yrs?)
  - Neuromuscular training
  - At 12 weeks, weak link in the chain is the graft itself
    - Can be 24% of native ACL
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### Weeks 4/6 to 8/12

- **Cardio** – soccer specific – interval training on bike/UBE
- Avg. HR for 90 min game 160 bpm

<table>
<thead>
<tr>
<th>Sport</th>
<th>Miles run per game/match</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseball</td>
<td>1,080 feet</td>
</tr>
<tr>
<td>Football</td>
<td>1.25 miles</td>
</tr>
<tr>
<td>Basketball</td>
<td>2.7 miles</td>
</tr>
<tr>
<td>Tennis</td>
<td>3 miles</td>
</tr>
<tr>
<td>Field hockey</td>
<td>4.5 miles</td>
</tr>
<tr>
<td>Soccer</td>
<td>7.9 miles</td>
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</table>

### Soccer Demands

**CHANGE DIRECTION/PACE EVERY 2-4 SECONDS**

- 36% jogging
- 20% cruising
- 7% back pedaling
- 11% sprinting
- 2% with ball
- 24% walking

Sprint approx. 10-25 yds length in 3-5 sec

**SOCcer DEMANDS 90 MINUTE MATCH DISTANCE 7-9 MILES**

- Jogging
- Cruising
- W/ball
- Sprinting
- Back pedal

Walking
**Weeks 4/6 to 8/12**

* Core
  * Weak core is a risk factor for increased ACL tear
  * Strong core increases players’ ability to return to equilibrium after perturbation

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**OKC/CKC exercises & activities & peak ACL strain**

* Failure strains of normal ACL 15%

<table>
<thead>
<tr>
<th>Rehab exercise/activity</th>
<th>Peak ACL strain %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isometric quad @ 15 degrees flexion (OKC)</td>
<td>4.4</td>
</tr>
<tr>
<td>Active flexion-ext knee w/ 10 lb wt boot (OKC) <em>(soccer ball weight is 15 oz.)</em></td>
<td>4.0</td>
</tr>
<tr>
<td>Lachman</td>
<td>3.7</td>
</tr>
<tr>
<td>Active flexion-ext knee no weight (OKC)</td>
<td>2.8</td>
</tr>
<tr>
<td>Isometric quad @ 30 degrees flexion (OKC)</td>
<td>2.7</td>
</tr>
<tr>
<td>Stair climbing (CKC)</td>
<td>2.7</td>
</tr>
<tr>
<td>Leg press @ 20 degrees flexion w/ 40% BW (CKC)</td>
<td>2.1</td>
</tr>
<tr>
<td>Lunge (CKC)</td>
<td>1.9</td>
</tr>
<tr>
<td>Stationary cycle (CKC)</td>
<td>1.7</td>
</tr>
<tr>
<td>Isometric quad at 60 &amp; 90 degrees flexion</td>
<td>0.0</td>
</tr>
</tbody>
</table>
**Weeks 4/6 to 8/12**

- Improving **neuromuscular control**
  - Unstable surfaces
  - Kicking – volley – side foot, laces, thigh, chest, stance/swing limbs

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**Weeks 4/6 to 8/12**

- Improving **strength** – multi muscle group strengthening, coordination
  - Incorporate balance, NM control into strengthening
  - Minimize single muscle group exercises
  - Trunk rotary & core stability
**Weeks 4/6 to 8/12**

- **Strength** – quality over quantity
- Empower patients to self-correct
- Use mirrors, use their phone camera

**Remember: Surgery Didn’t Fix This!**

Address all these issues with your rehab program
Advanced Strengthening & Neuromuscular Training
(Weeks 8/12 to 16/24)

- **Cardio** – initiation of running program
  - Jump forward with good cushioning knee flexion & control
  - Single limb squat good alignment and control
  - Stand from chair with one leg
  - Once able to run 2 miles – frequent change of pace

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**Weeks 8/12 to 16/24**

- **Strengthening**: Traditional strengthening exercises combined with additional challenges to the nervous system
  - Perturbations
  - Mental distraction tasks
  - Activities which progressively force the COG away from the BOS
  - Progressively challenge the patient when he/she is fatigued
  - Multi-muscle group – incorporate entire kinetic chain
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**Weeks 8/12 to 16/24**

* **Perturbations** under fatigued conditions
  * SL squat position (40-60 degrees flexion) for 20 sec with manual perturbations

* **Agility/footwork**
  * Ladder drills – athletic stance (female/male cutting differences)
  * Side shuffle shadowing (reactive)
  * Shuffle or Run/stop/stabilize – set distance, random distance
    * Accelerate/decelerate with control
    * Incorporate ball (positive psychological attitude)
No consensus on RTP criteria

- Noyes: Systematic search to ID factors investigators used to determine when athletes RTP
  - 40% - no reported RTP criteria
  - 32% - time-based
  - 15% - time + subjective criteria
  - 13% - objective criteria
RTP Criteria

* Only 55% of patients report returning to their prior level of athletic function after ACL reconstruction (JOSPT vol 42 no 11 Nov 2012)
  * 45% reported fear of re-injury/lack of confidence
  * 40% objective measures
    * Swelling
    * Weakness
    * Instability

Return to Soccer

If < 55% return to prior level, which ball are we dropping?
**RTP - Criteria**

- Time of season
- Pressure from parents, coaches for early RTP

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**RTP – Objective Criteria**

- **Objective criteria**
  - ROM, swelling, KT, strength
  - Core testing
  - Functional strength/single limb assessment
  - Balance/proprioception
  - Agility testing
  - Hop testing
RTP – Core Testing

* **Core**
  * Bunkie test
    * Pass = 40 sec pro, 20 sec amateur athlete

RTP – Single Limb Assessment

* **Asymmetries persist** in functional hop tests, lower extremity kinematics and strength 6-9 months following ACLR *(JOSPT vol 43 no 3 March 2013)*

* **Fatigue** alters LE kinematics during a single-leg jump task
RTP – Single Limb Assessment

* Single limb squat
* Sit to Stand

* Single limb balance – eyes open/closed
* Star excursion balance test – SEBT
* Step down with control

RTP – Balance/Proprioception

* **Balance/proprioception – Janda**
  * Technique: arms @ side, hip flex 45, knee flex 90, eyes open first 5 sec, then close
  * Assessing proprioception first 10 sec
  * Assessing glut medius function >15 sec

<table>
<thead>
<tr>
<th>Age</th>
<th>Time (sec.) Eyes closed</th>
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<tbody>
<tr>
<td>20-49 (ACL population)</td>
<td>24-29 sec</td>
</tr>
<tr>
<td>50-59</td>
<td>21 sec</td>
</tr>
<tr>
<td>60-69</td>
<td>10 sec</td>
</tr>
<tr>
<td>70-79</td>
<td>4 sec</td>
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</table>
**Agility** – ability to change direction and body position quickly and under control

Soccer players change direction every 2-4 sec during match (approx. 1,200-1,400 times per game)

**Agility tests**
- Modified T-test
- Modified pro shuttle
- Modified long shuttle

**RTP – Agility Testing**

**RTP Agility**

**Modified T-Test – compare directions**
- (Shuffle right, testing left limb push-off)
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**RTP Agility**

- **Modified Pro Shuttle**
  - Limb with initial push-off is the involved trial

**RTP Agility**

- **Modified Long Shuttle**
  - Test limb is the push-off limb
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RTP – Hop testing

- Pass = >90% side/side symmetry
- Quality – good coordination, neuromuscular control, adequate cushioning knee flexion
- When to test – soccer = best after fatigued
- Highest correlation RTP = crossover hop for distance
RTP – Emotional
(Adrian Peterson or Derrick Rose)

* TSK-11 (Tampa Scale of Kinesiophobia)
* Subjective – 11 statements
  * 1-4 scale from strongly disagree (1) → strongly agree (4)
  * Example questions:
    * I’m afraid I might injure myself if I exercise
    * My body is telling me I have something dangerously wrong
    * Pain lets me know when to stop exercising so that I don’t injury myself
  * Score – 11 → 44 (higher score, higher kinesiophobia)

Return to Play
Return to Confidence
Prevention

FIFA

Scripps

Prevention – FMARC 11+

* Injury prevention program developed in 2003 by FIFA
* Performed by soccer players 2x/week
* **Reduced number of knee injuries 30%-50%**
* 3 parts:
  * Running exercises, slow pace and active stretching
  * 6 sets of strengthening exercises – core, legs, balance, plyo/agility
  * Running exercises mod → high speed combined with planting & cutting
**Prevention – FMARC 11+**

- Phase 1 – Running exercise

**FMARC – 11+**

- Phase 2 = 6 sets of exercises
- Core, leg strength, balance, plyometrics/agility
**FMARC 11+**

* Phase 3 – Running exercises @ mod-high speed, combined with planting and cutting

**Prevention – FMARC 11+**
Summary

- Address predisposing factors to initial injury
- Know the sport, demands and position the player is returning to
- Design your rehab program based on the patient’s needs, not on a cookbook protocol
- Communicate with the surgeon, ATC, coach, parents for a team approach getting patient back on field
- Communicate prevention
- Strive for better than 55%

“For one month, let’s all be futbol fans”

Set DVR – Tomorrow 9:00 AM on ESPN

USA vs. Germany