Adjustment of Upper Body during Pivot for Prevention of Repeated ACL Tears

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Goal

Find upper body positioning that provides maximum pivot ability and minimum ACL injury risk
The Pivot
The Anterior Cruciate Ligament

- There are two cruciate ligaments (anterior and posterior) in a “X” formation inside the knee joint.
- They control the back and forth motion of the knee.
- ACL prevents the tibia from sliding in front of the femur.
Injuries of The ACL

The injuries are most commonly caused by:

- Landing incorrectly
- Collision
- Stopping
- Changing direction
Methods of Reconstructive Surgery

Bone-tendon-Bone:

- More stability
- Less extension ability

Hamstring grafts:

- Lower morbidity
Pivoting following ACL reconstructive surgery can be linked to:

- Degenerative joint disease
- A second sprain
- Osteoarthritis
Why?

- 200,000 ACL injuries/year in the US
  - 70% non-contact mechanisms
- Women 2-7x more likely than men in basketball
- Average of 6 months for rehabilitation
- 87% of girls returned to basketball
- 29.5% chance of a second ACL injury within 2 years
Prior Studies Completed

- Increased tibial translation following ACL reconstructive surgery
- Greater forces produced by the graft vs. ACL at 15°:
  - ACL=133 N
  - Graft=161 N
Current Solution: Knee Braces

- Knee braces can be uncomfortable and slide out of place during activity.
- Studies show the use of braces cause an increase in ACL strain values for the flexion-extension moment in the joint.
Possible Solution

Repositioning of the upper body during pivot may result in decreased risk of ACL rerupture
How?

• Upper body mass has impact on net joint-moment at knee
• Finding angle where upper body has lowest joint-moment on knee puts less strain on reconstructed ACL
Equipment

- MoCap system
- Force plates
Subjects

- Female basketball players (16-22 years)
- Two Groups (10 participants total)
  - No ACL Reconstruction (5)
  - ACL Reconstruction (5)
Analysis: Inverse Kinematics

- Obtained using motion capture device and software
- Used to find angles of upper body during pivot
Analysis: Inverse Dynamics

- Calculated using ground reaction forces, segment masses, segment lengths
- Used to find net joint-moments about knee
Advantages vs Disadvantages

Advantages
- Prevents excessive force on ACL
- No external equipment
- No cost

Disadvantages
- Different body types
- Possible decrease in effectiveness of pivot
Future Study

- Long-term effect of change in pivot technique may result in positive impact on reconstructed ACLs
  - Degenerative joint disease
  - Osteoarthritis
Conclusion

The pivot is a staple move in the game of basketball that impacts the ACL both short and long term. With research into change in pivot technique, such as upper body positioning, forces on the ACL may be reduced to prevent further injury and disease.
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Questions?