

BIOMECHANICS

MOTION ANALYSIS PROJECT



**ACL INJURIES IN
FEMALE FOOTBALL
PLAYERS**



Why We Chose This Topic ?

→ ACL injuries are 2–8x more common in female athletes than in males.

→ Most injury prevention research, footwear design, and rehabilitation protocols are based on male data.

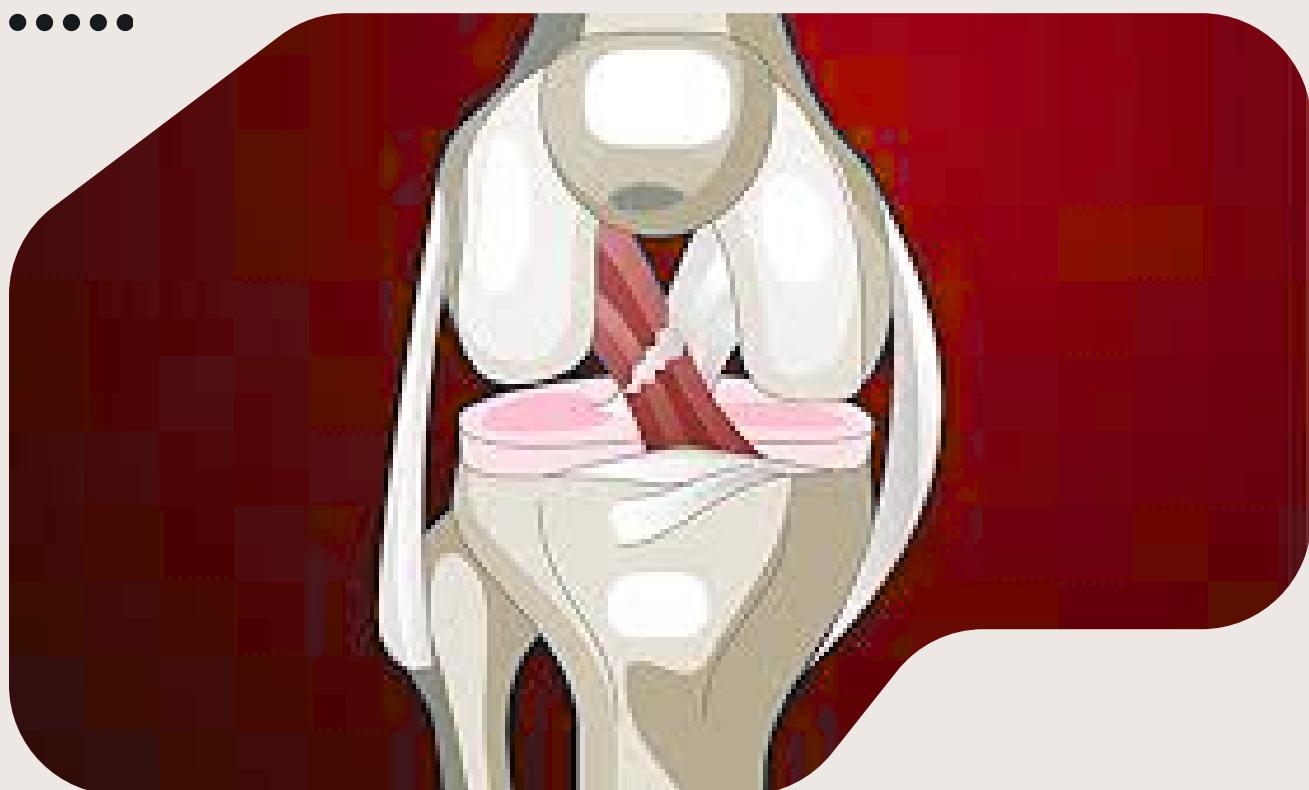
→ Investigate how biomechanics, hormonal factors, and sports gear contribute to ACL injury risk in women.

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What is an ACL Injury ?

The Anterior Cruciate Ligament is a major knee ligament that connects the thigh bone to the shin bone and helps stabilize the joint during quick movements.

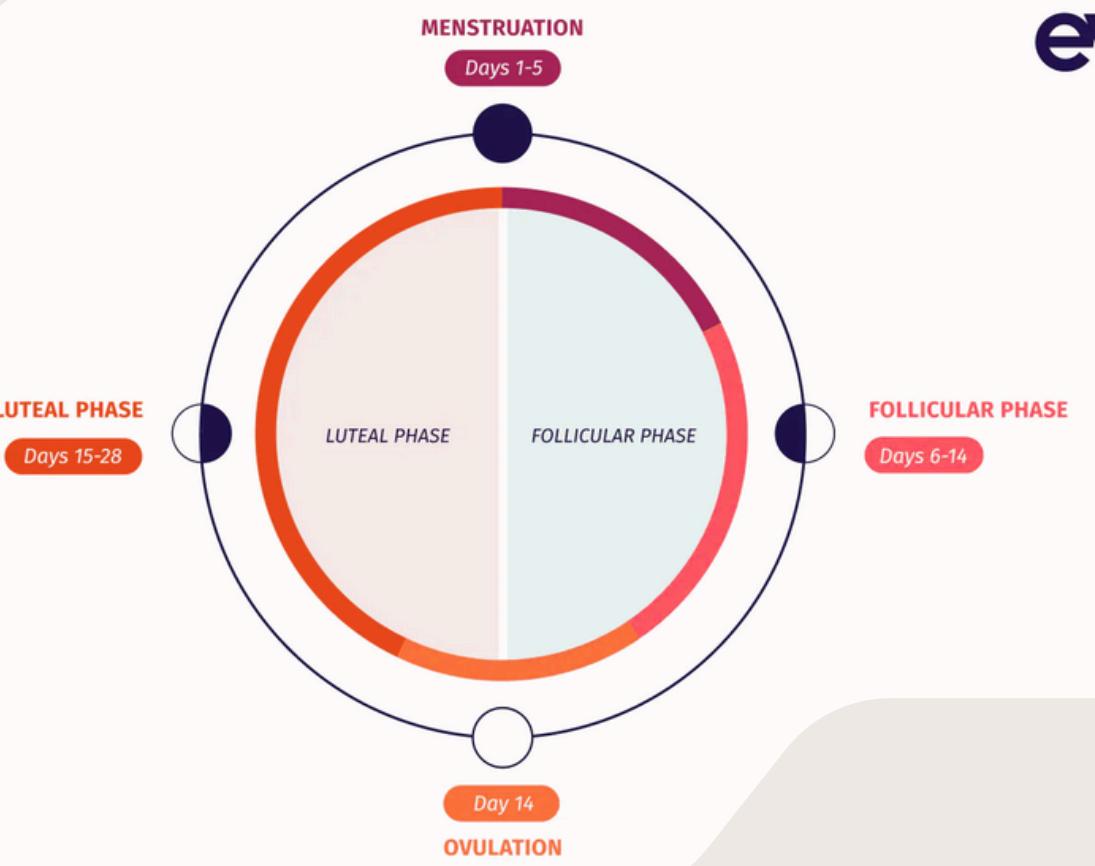


- Tears typically occur when the knee twists or collapses inward unexpectedly, often without physical contact.
- Recovery is lengthy, often requiring surgery and up to 9–12 months of rehabilitation, with a high reinjury risk.

- **What are the factors?**



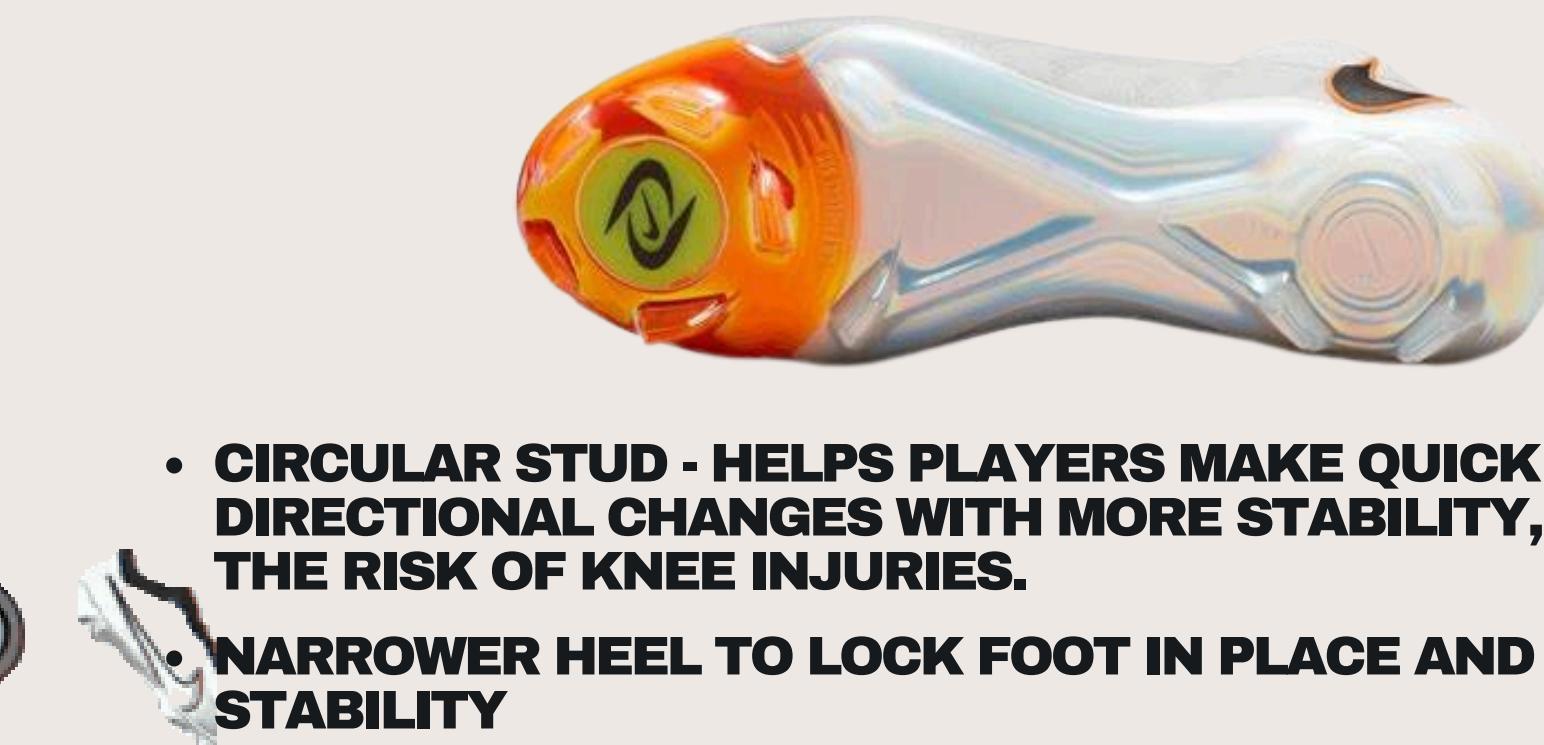
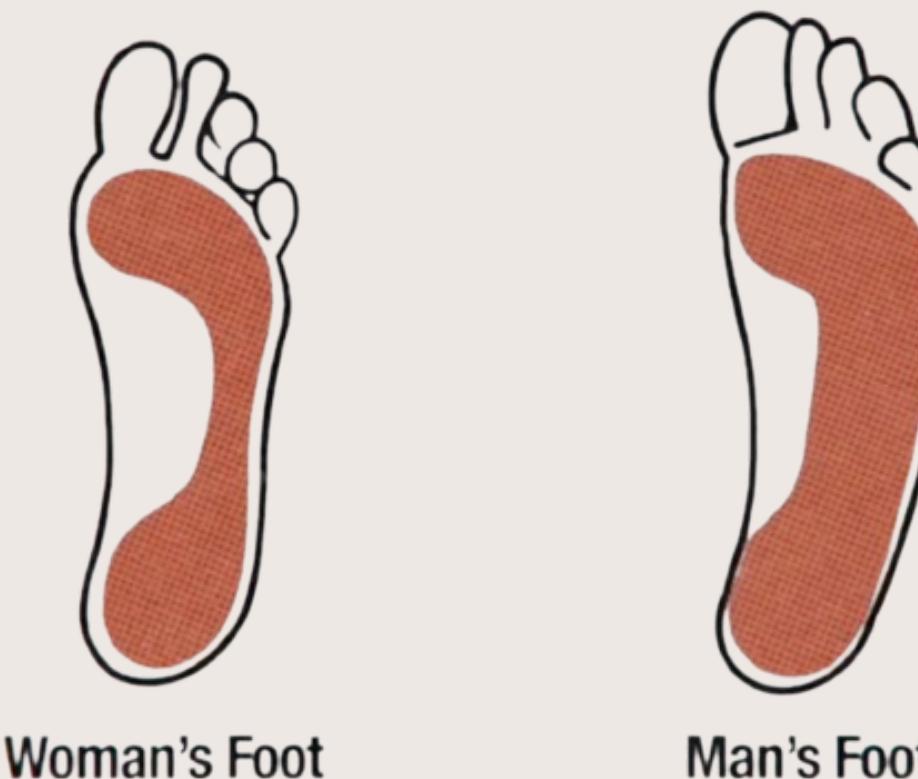
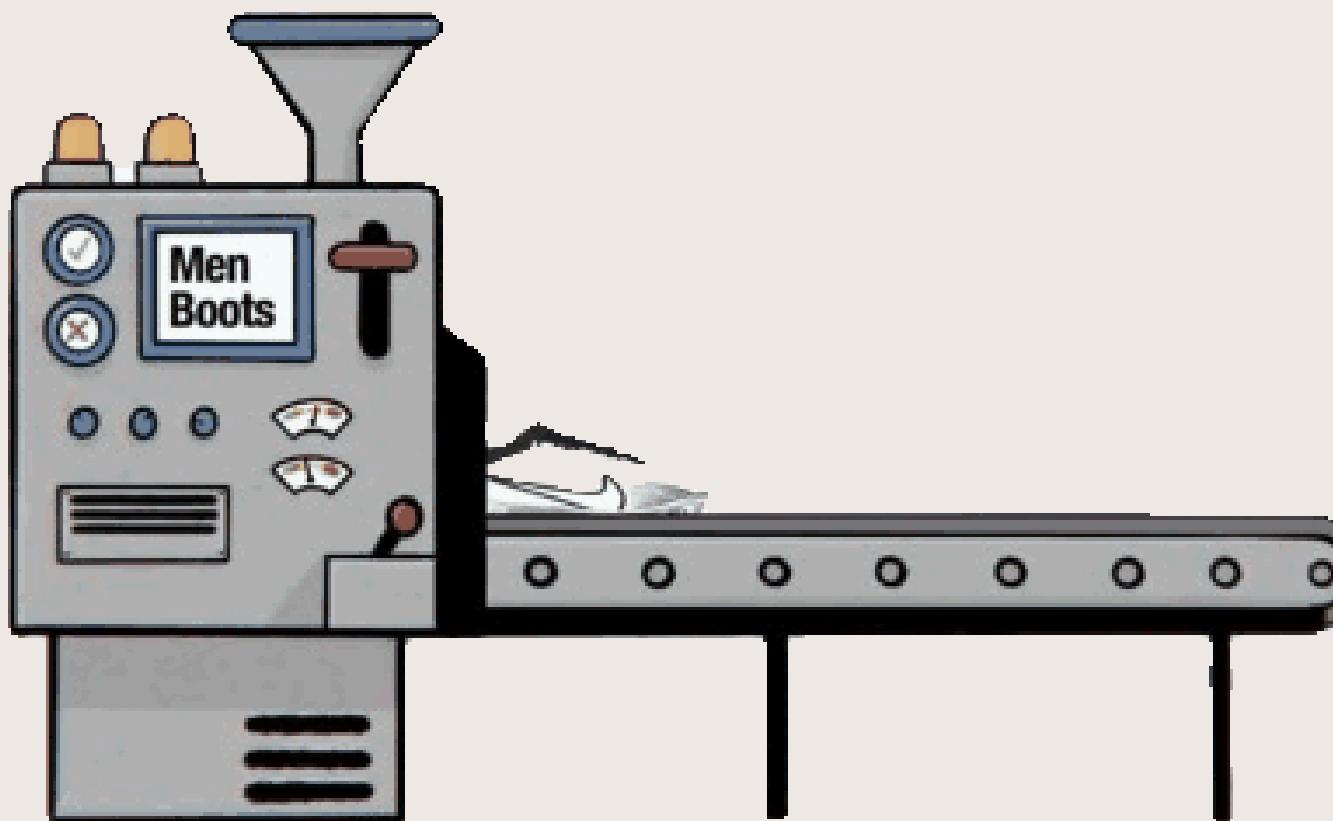
Hormonal Influences on Joint Stability



- Natural hormonal changes in females can affect the structure and behavior of ligaments.
- Elevated estrogen levels may reduce collagen stiffness, leading to more flexible and less stable joints.
- This temporary increase in joint laxity can raise the risk of ACL injuries during play.

FOOT SHAPE

- MALE FEET ARE GENERALLY LARGER AND BROADER
- FEMALE FEET TEND TO BE NARROWER AT THE HEEL AND WIDER AT THE FOREFOOT
- WOMEN HAVE A SHALLOWER BIG TOE, A LOWER INSTEP AND A MORE CURVED INSIDE LINE THAN MEN



- CIRCULAR STUD - HELPS PLAYERS MAKE QUICK DIRECTIONAL CHANGES WITH MORE STABILITY, REDUCING THE RISK OF KNEE INJURIES.
- NARROWER HEEL TO LOCK FOOT IN PLACE AND IMPROVE STABILITY
- HIGHER ARCH SUPPORT TO MATCH FEMALE FOOT ANATOMY



OpenSim



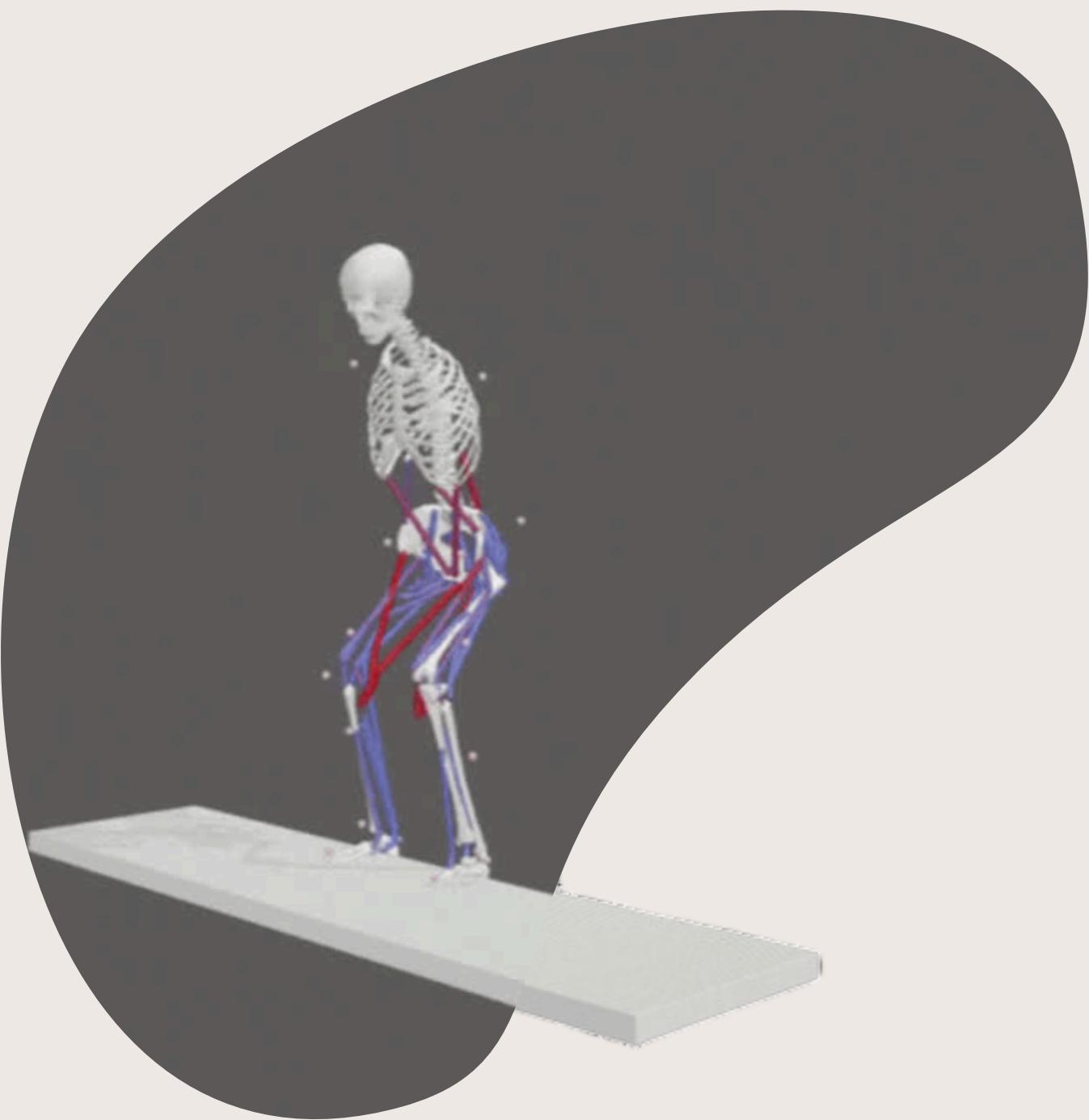
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Steps to Effectively Present our Objective

How We Collected and Analyzed Data

- **PARTICIPANTS:** 7 MALE AND FEMALE FOOTBALL PLAYERS.
- **MOVEMENTS ANALYZED:** LANDING, PIVOTING, AND STOPPING ALL HIGH-RISK FOR ACL INJURIES.
- **TOOLS & METHODS:**
 - MOTION CAPTURE USING PHONE CAMERAS TO TRACK JOINT ANGLES AND TRUNK POSITION
 - FORCE-ANGLE DATA COLLECTED FOR JUMPING/LANDING
 - KINEMATIC ANGLE-TIME GRAPHS FOR PIVOTING AND STOPPING

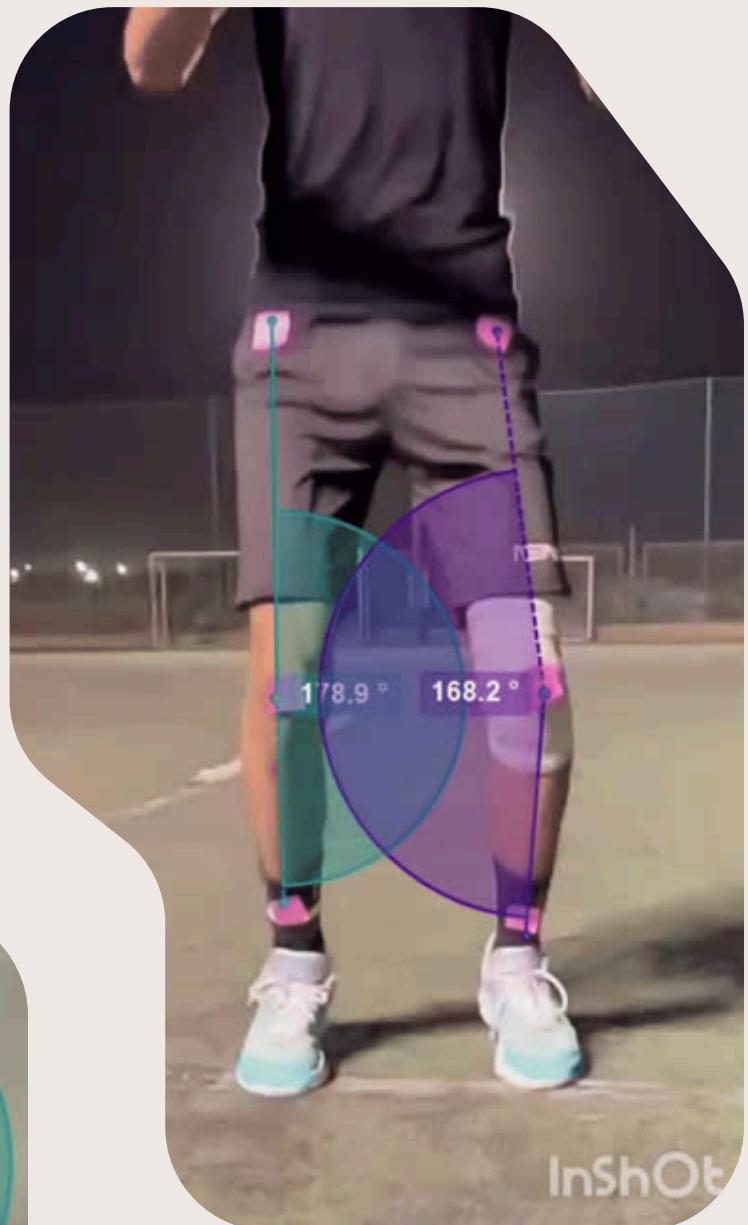




LANDING FROM A JUMP

LANDING FROM A JUMP

- KNEE ANGLE TRANSITIONS FROM DEEP FLEXION TOWARD NEAR EXTENSION
- ACL LOADING RISES SIGNIFICANTLY IN THIS PHASE, RAISING INJURY RISK.
- FEMALES SHOW 7°–12° MORE KNEE VALGUS THAN MALES, INCREASING INTERNAL JOINT STRESS.

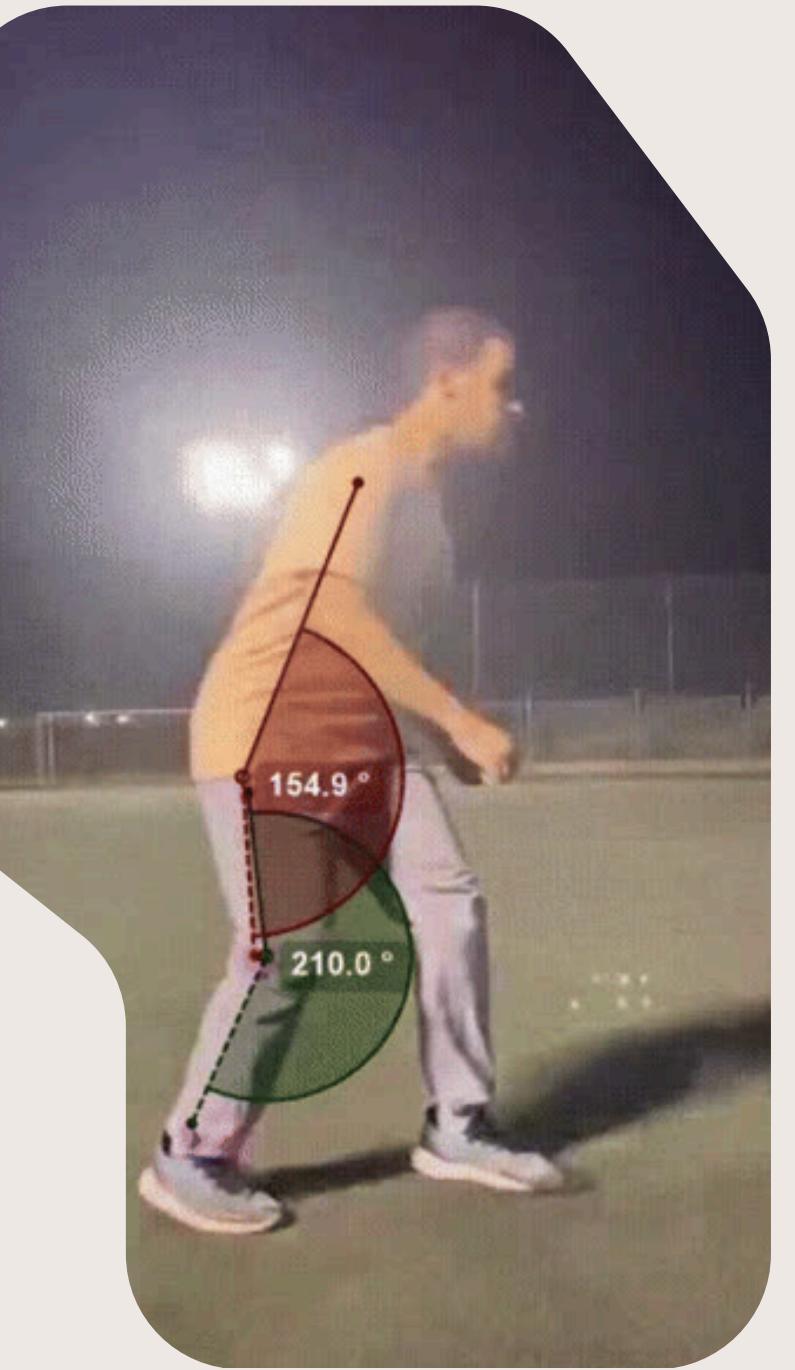
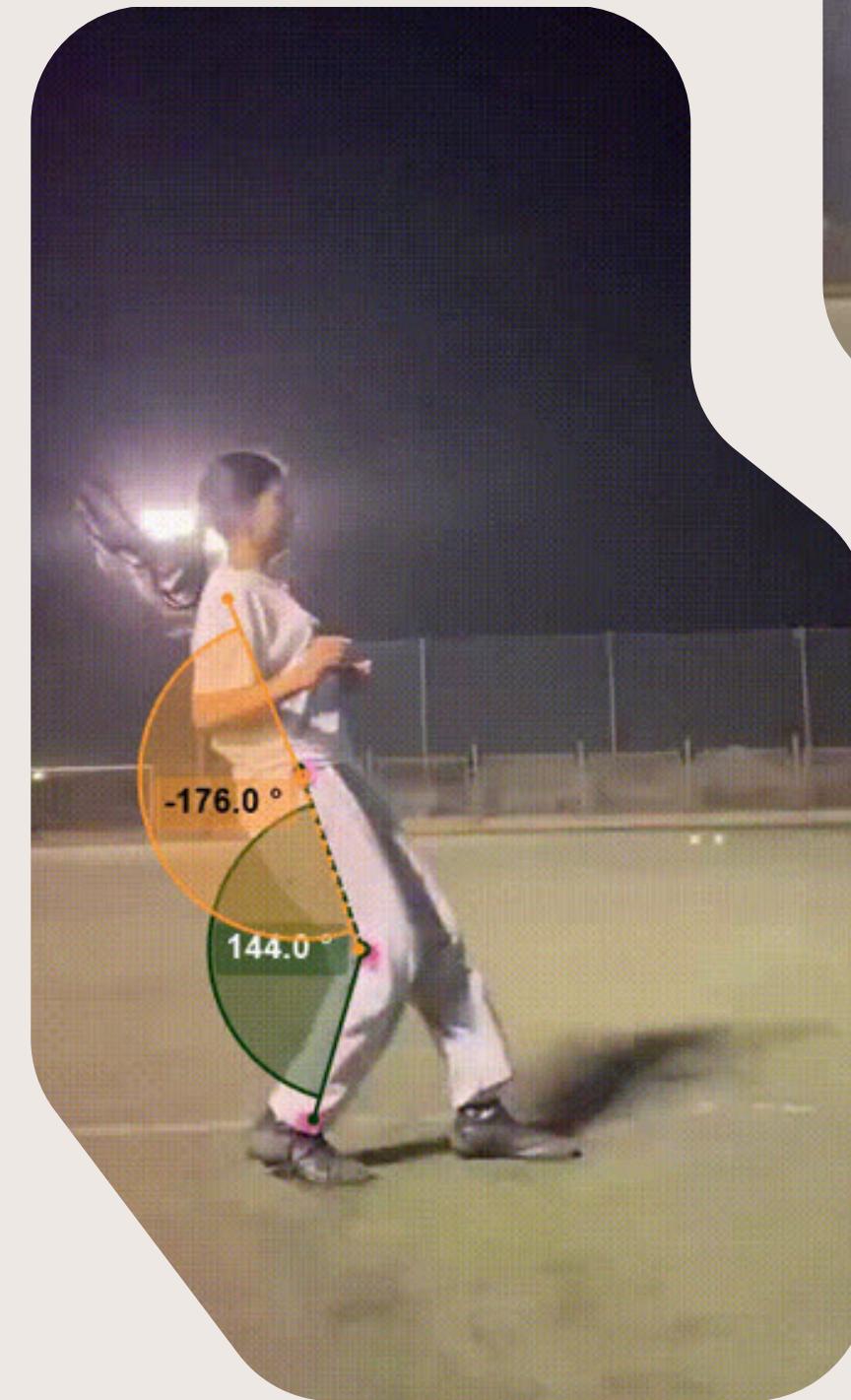




DECELERATING AND STOPPING

Our Observation

- FEMALE ATHLETES SHOW MORE UPRIGHT POSTURE DURING DECELERATION
- CENTER OF GRAVITY SHIFTS BACKWARD
- 20-30% LESS GLUTE & HAMSTRING ACTIVATION
- INCREASES RELIANCE ON PASSIVE STRUCTURES
- MORE STRESS ON ACL & LIGAMENTS





PIVOTING AND TWISTING

Our Observation

- FEMALES SHOWED MORE INWARD KNEE (VALGUS) MOTION DURING PIVOTING AND TWISTING.
- MALES EXTENDED KNEES MORE DURING TURNS (SIDE VIEW).
- FLEXION + VALGUS + PLANTED FOOT = ACL STRAIN RISK (UP TO 2-3× HIGHER IN FEMALES).



CONCLUSION & FUTURE



FEMALE FOOTBALLERS FACE HIGHER ACL INJURY RISK DUE TO



PREVENTION IS POSSIBLE THROUGH



- GREATER KNEE VALGUS
- LESS MUSCLE ACTIVATION DURING LANDING & STOPPING
- GEAR NOT DESIGNED FOR FEMALE BIOMECHANICS

- TARGETED NEUROMUSCULAR TRAINING
- MOTION ANALYSIS-BASED FEEDBACK
- BETTER EQUIPMENT DESIGN

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**THANKS FOR YOUR
ATTENTION**
Good game

