

PREVENTION OF ANTERIOR CRUCIATE LIGAMENT (ACL) INJURY AND ENHANCE PERFORMANCE PROGRAM

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ABSTRACT

BACKGROUND: Faulty mechanics during dynamic movement that cause excessive valgus force at the knee increases the risk of ACL injury. Faulty mechanics may be a result of lateral displacement of the trunk, unequal limb loading, and lack of control to avoid the valgus knee position. Altered movements that place the ACL at risk are best identified in a fatigued state; however, could be recognized in a standard dynamic assessment. The faulty movement patterns are modifiable and should be addressed in an injury prevention program. Prevention programs include various modes of exercise such as plyometrics, neuromuscular training, and strength training. This review concludes that those programs which utilize neuromuscular training and strength training at a young age show the most promise in reducing ACL injuries. An ongoing thorough dynamic examination is necessary for all athletes while adjusting the intervention program in order to decrease the risk of ACL injury.

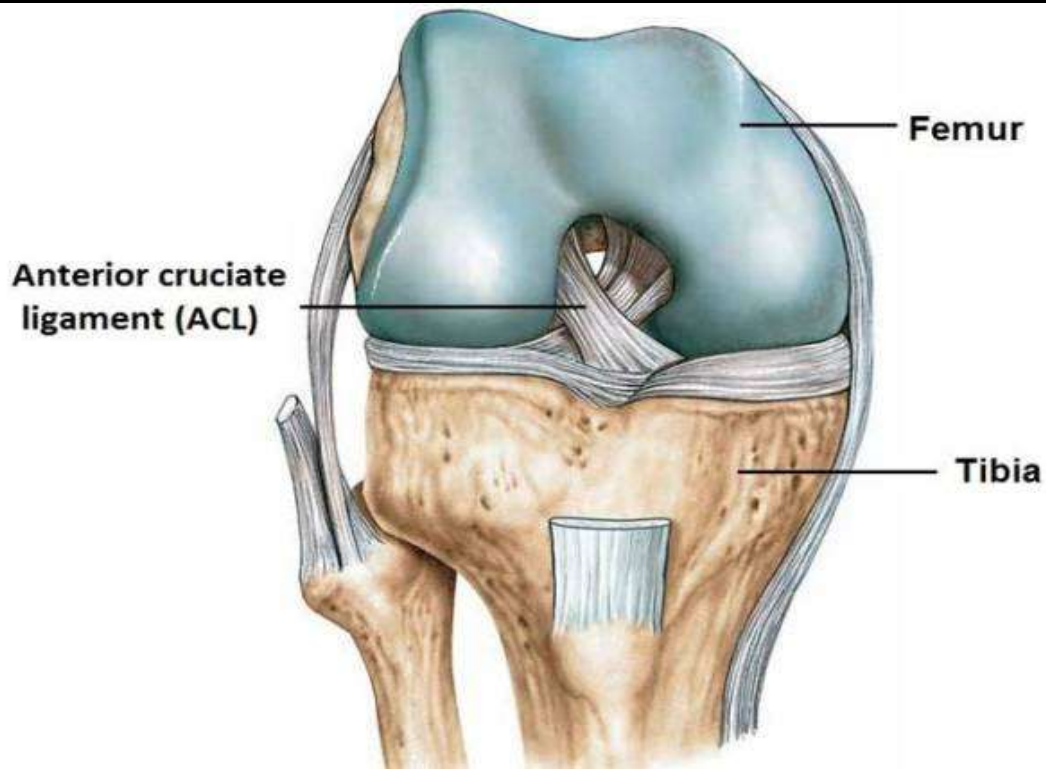
PURPOSE OF REVIEW:

Mechanisms leading to anterior cruciate ligament (ACL) injury have been identified, yet re-injury or a secondary injury persists in the athletic population. The purpose of this review is to identify risk factors associated with ACL injury and investigate programs to prevent injury.

KEYWORDS : Anterior cruciate ligament (ACL); Knee injury; neuromuscular training; Plyometrics; Prevention program; Strength training.

INTRODUCTION:- Athletes who participate in high demand sports like: soccer, football, & basketball are more likely to injure their ACL. ACL injuries cause many problems for an athlete. Besides the chance of having to sit out an entire season, they might face loss of funding, lowered academic performance, & long-term disability from O.A. More than 50,000 debilitating ACL injuries occur in athletes every year.

Anatomy of ACL:- Originated from Lateral femoral condyle and inserted at Tibial plateau medial to anterior horn of lateral meniscus.

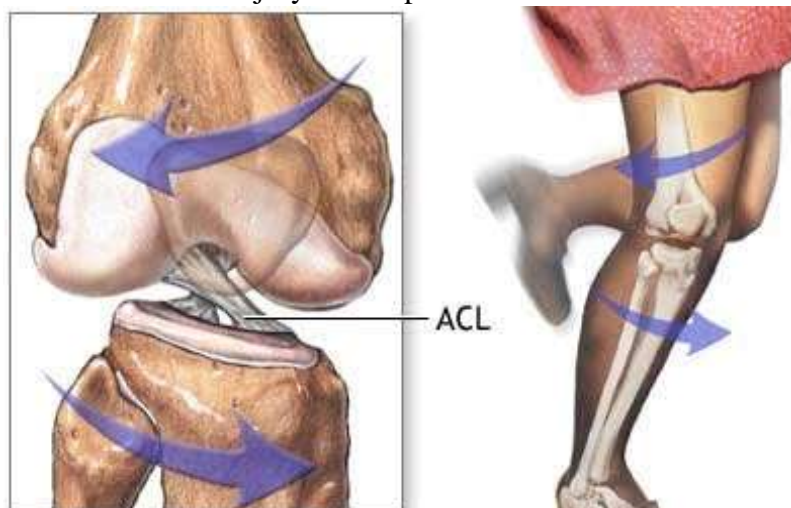


Functions of ACL:-

- 1. Primary restraints to anterior tibial displacement: Accounting for 85% of the resistance to anterior drawer test, when the knee is at 90° of flexion & neutral rotation.
- 2. Secondary restraints to tibial rotation & varus: valgus angulation at full extension.
- 3. Proprioceptive function: presence of mechanoreceptors in the ligaments.

Mechanism of injury:-

- 1. Contact injuries v/s Non-contact injuries
- 2. ~80% Non-contact injuries.
- 3. ~20% Contact injuries.
- 4. Non-contact injury usually with landing, rapidly stopping, cutting, or change in direction.
- 5. ~Altered biomechanics & neuromuscular patterns.
- 6. Female athlete have 3.5x risk of non-contact injury as compared to males.



ACL injuries occur when bones of the leg twist in opposite directions under full body weight

Pattern of injury



A twisting and hyperextension injury commonly causes an ACL +/- PCL tear.

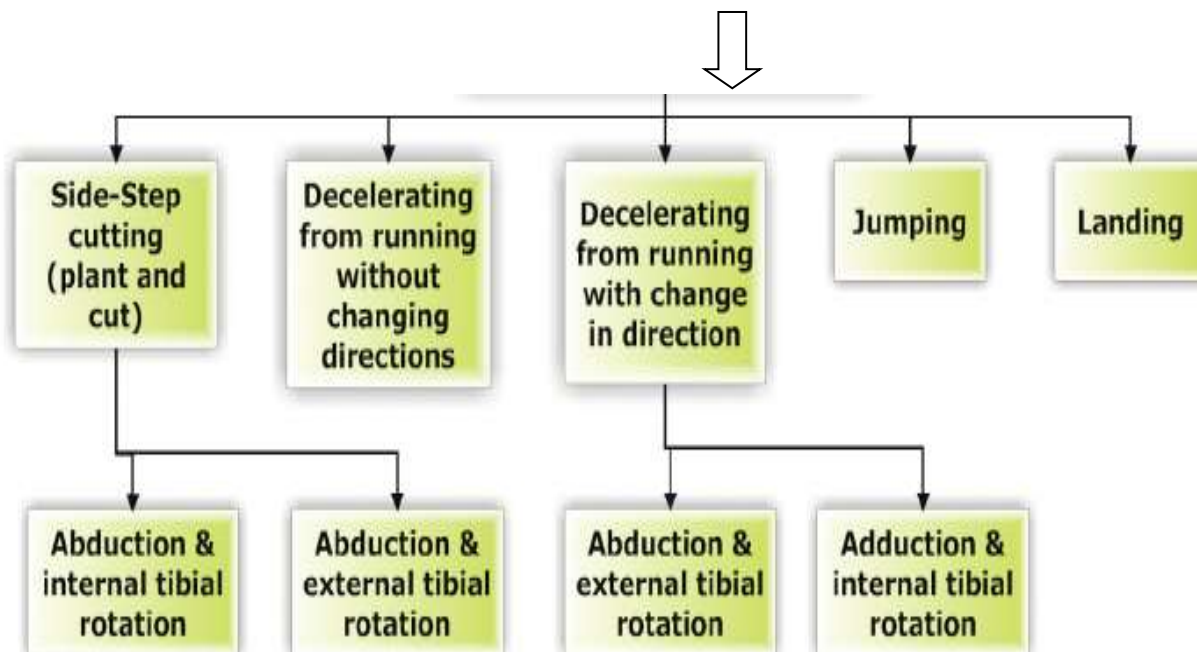


A hyperextension injury in a nonweight bearing leg can cause an ACL or PCL tear.



A hyperflexion injury such as a fall in skiing causes an ACL tear.

Non-contact ACL injury



Biomechanics of ACL injury:-

1. External loads of valgus & external rotation do not load the ACL b/w 10°-30° flexion.
2. Quadriceps activation can load the ACL b/w 10°-30° flexion, this is increased if no hamstring activation.
3. Strong quadriceps activation during eccentric contraction a major factor in injury to ACL.
4. Neuromuscular factors appear to be the most important reason for the differing ACL injury rates b/w males & females.

Clinical presentations:-

When injury occur, there is "popping" noise & feel of knee out. Other typical symptoms include:-

1. Pain with swelling.
2. Loss of full ROM.
3. Tenderness along the joint line.
4. Discomfort while walking.

Risk factors:-

- A. Intrinsic factors:
 1. Anatomical.
 2. Physiological.
 3. Biomechanical.
- B. Extrinsic factors:
 1. Environmental.
 2. Clothing.
 3. Appliances.

Phases of Prevention Program:-

A. Should be performed at least 2-3 times per week during the season & includes:

1) Warm Up.

Warming up & cooling down are a crucial part of a training program.

The purpose of the warm-up section is to allow the athlete to prepare for activity.

By warming up muscles first, there will be great reduction in injury.

1 STRAIGHT LEG MARCH
20 seconds

Walk with both legs straight. Alternate bringing up each leg as high as possible without jeopardizing form (no bent knees) or leaning backward. The entire body should remain tall and facing forward.



2 HAND WALK
20 seconds

Bend at the waist and place the palm of the hands on the ground. Keeping the legs & back straight, walk using hands and feet. Try to keep the legs shoulder-width apart.



3 CRADLE WALK**20 seconds**

Walking forward, lift one leg in front of the body, bending at the knee. Rotate the knee outward and the foot inward. Hold the foot with both hands, standing on one leg. Hold for 3 sec. and repeat on other leg.

**4 HIP ROTATOR WALK****20 seconds**

Pretend that there is an obstacle beside you. Facing forward and keeping shoulders and hips square, rotate one leg out at the hip then bring the leg up and over the obstacle placing it back on the ground. Repeat with other leg.



2) Plyometrics.

These exercises are explosive & help to build, power, strength & speed.

The most important element is to performance good technique is the landing. It must be soft!

For eg. when you Land from a jump, you want to softly accept your weight on the balls of your feet slowly rolling back to the heel with a bent knee & a straight hip.

These exercises are basic, however, it is critical to perform them correctly.

Time taking to ensure safe & correct completion of these exercises.

1 TUCK JUMP**30 seconds**

Start in an upright neutral stance and jump to tuck the knees simultaneously to chest and repeat. *Mistakes to correct: bringing chest to knees with head down, double bouncing between jumps, landing loudly or with straight legs.*



2 SQUAT JUMP

30 seconds

Begin in squat position with chest/head up and back straight. Reach hands to the outside of heels, then jump up reaching as high as possible. Return to squat position and repeat. *Mistakes to correct: knees over toes, knees going inward.*



3 180 DEGREE JUMP

30 seconds

Starting from an upright neutral stance, jump straight up into the air and make a 180-degree turn before landing. Reverse direction and repeat. *Mistakes to correct: over-rotating, body not turning as a unit, loud, straight leg landing, and jumping in the same direction.*



4 SCISSOR JUMP

30 seconds

Start in a deep lunge position with front knee directly over ankle. Alternate legs by pushing off the front leg and landing with opposite leg bent in front. *Mistakes to correct: landing with wobbly knees or knee past toe, switching legs without power or height and landing straight-legged.*



5 BARRIER HOP SIDE/SIDE

15 seconds/leg

Using a 6-8" barrier, perform a single leg hop side to side over the barrier. Start with a double leg jump if the single leg hop is too difficult. *Mistakes to correct: landing with stiff, straight knees or wobbly knees and ankles.*



b) Strengthening.

Having adequate strength in hips & thighs is key to providing support for knees & preventing ACL injuries. It includes: Squatting, Lunges, Core strength training

1 STEAMBOATS 30 seconds/leg

Place band around ankles. Begin with feet shoulder width apart. Slightly bend one knee so the foot is off the ground. Balancing on one leg, begin kicking the bent leg forward and backward at the hip. Be sure to keep upper body still, not swaying back and forth. Body control is key.



2 LATERAL STEP 30 seconds/direction

Place band around ankles. Start with feet shoulder width apart and step out to the side approx. 10 to 12". Slowly and under control, follow with the other foot to return to the initial position. Repeat for the allotted amount of time, then switch direction so other leg leads.



3 SUPINE HAM BRIDGE 30 seconds/leg

Lie flat on back, bend one knee and place heel close to the gluts. Extend other leg straight up in the air. Push with the heel to lift gluts off the ground and the extended leg higher in the air. Keep abs tight and upper back on ground. Repeat for the allotted amount of time, then switch legs.



4 AB CRUNCH 60 seconds

Lie on back with knees bent and feet flat on the floor. Raise upper body off the ground until shoulders are no longer touching the ground. Hold for 3 seconds and return to start. Repeat for the allotted amount of time. Hands can be placed behind head or across the chest as long as the neck remains neutral and relaxed.



5 PLANK 60 seconds

Lie facedown placing elbows under shoulders and forearms on the ground. Place legs hip-distance apart and curl the toes under. Lift the body up onto elbows and toes. Maintain a neutral position with back flat and neck straight. Hold the position for the allotted amount of time.



- Flexibility/Stretching.
- Being flexible enough to move freely can help to maintain ideal form.
 - Never stretch a “cold muscle”.
 - By doing these stretching outlined here, it helps to:
 - ✓ improve & maintain your range of motion,
 - ✓ reduce stiffness in your joints,
 - ✓ reduce post-exercise soreness,
 - reduce the risk of injury &
 - improve overall mobility & performance.
 - Don't bounce or jerk during stretch. Gently stretch to a point of tension & hold.
 - Hold the stretch for 30 seconds.

1 HAMSTRINGS 20 seconds/leg

While seated, extend left leg fully and bend right leg placing the inside of the foot along the left calf. Keeping the back straight, bring the chest toward the knee. Reach with both hands toward the toes.



2 HIP FLEXOR 20 seconds/leg

Stand with feet in a lunge position with the front knee slightly bent. Push up on the rear toe. Press the hips forward while tightening the gluts until a stretch is felt in the front of the hip. The upper torso should remain upright and centered directly over the hips.



3 QUADRICEPS 20 seconds/leg

While standing, grab the foot or ankle and lift it up behind the body. Press the foot into the hand while pressing the hips slightly forward. The lower leg and foot should be directly behind the upper leg with no twisting inward or outward. The foot should not rest on the gluts.



4 CALF 20 seconds/leg

Stand in a long lunge position with the front knee bent. Make sure the front knee does not extend past the ankle. Place hands on front of thigh, press forward and keep the back leg straight. Press the rear heel down.

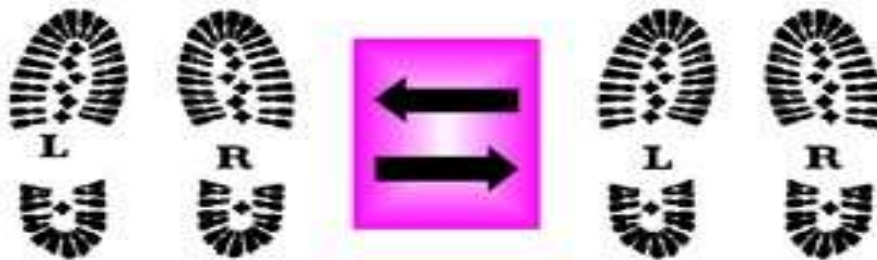
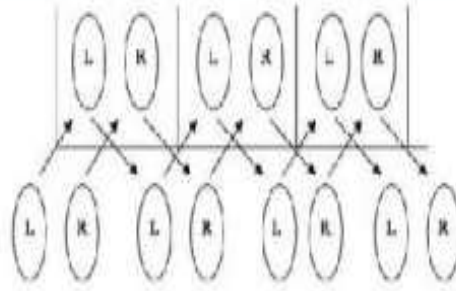


5) Agility Drills.

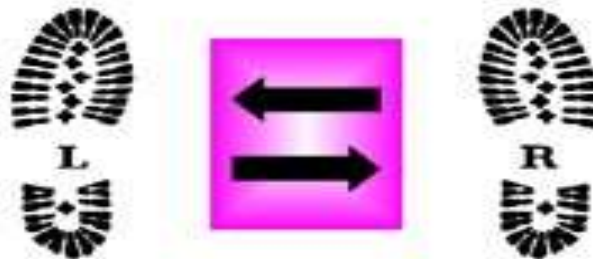
- Run to a line or cone, plant your outside foot without letting your knee collapse inward to change direction.
- Move in patterns that take you front to back, side to side & diagonally.
- Start by running slowly so you can concentrate on good position.
- Pick up the pace & maintain good technique.
- Remember: HIPS over KNEES over ANKLES!

1 QUICK FEET
30 seconds/direction

Start at left end of a sideline, in front of the line, facing the field/court. Step right foot forward and diagonally to the right over the line followed quickly by the left. Next step right foot backward and diagonally to the right over the line followed by the left. Repeat for the allotted amount of time, then switch direction so other leg leads.



Jump side-to-side with both feet over the line



Jump from your left to right foot over the line



Jump forward-&-back with both feet over the line



Jump forward-&-back over a line leading with your right foot. Keep feet hip width apart.
Now lead with your left.

- 5) Proprioception training.
- Proprioception is for balance.
- Many injuries occur when an athlete is off-balance.

It helps to gain in stability will pay off on the playing field.

Commonly used in injured athletes, but can be used for prevention, too. It includes:

✓ One-leg squat &

✓ Reach exercises.

7) Jumping & landing safely.

8) Cool Down.

Do not skip it.

It allows the muscles that have been working hard throughout the training session to elongate & deters the onset of muscle soreness.

Athletes should have a water bottle by their side during the cool down.

The cool down should take approximately 10 minutes. It includes:

✓ slow jog

✓ Followed by light strength training exercises.

✓ Finally, stretch the hamstrings, calves, inner thigh, quadriceps, & low back.

9) Rest.

Rest is physically necessary so that the muscles can repair, rebuild, & strengthen.

Optimal sleep is essential who exercise regularly, during sleep body produces GROWTH HORMONE (GH) which is largely responsible for tissue growth & repair.

Adequate sleep, rest days, & alternating hard workouts with easier workouts are all important strategies in reducing risk of injury

ACL injury programs:

A. PEP Program (Prevent injury & enhance performance

it includes:

1. Area 1: Warm Up

2. Area 2: Stretching.

3. Area 3: Strength.

4. Area 4: Plyometrics.

5. Area 5: Agilities.

B. FIFA 11+ Program: it is an ACL injury prevention program designed to be performed by players prior to training & competitive games. Players & teams can reduce their rate of ACL injury using a series of simple warm up exercises.

C. The exercises take around 20 minutes to perform, & involve:-

1. Core stabilization.

2. Eccentric training of thigh muscles.

3. Proprioceptive training.

4. Dynamic stabilization.

5. Plyometrics with straight leg alignment.

Conclusion:-

Prevention of ACL injury is possible by:

✓ Neuromuscular training

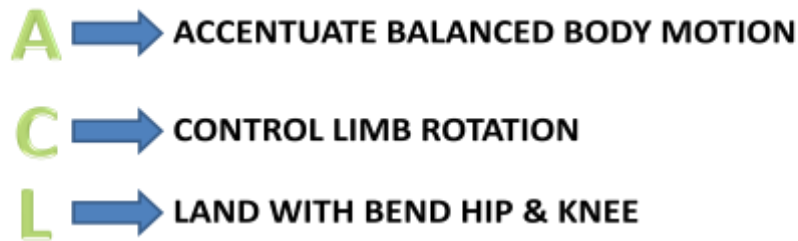
✓ Focus on knee position.

✓ Proprioceptive training.

✓ Change the plant & cut & landing technique.

There should be a study strictly upon the long term effects of various methods of prevention programs.

There are far too many programs & prevention methods to narrow down to just one specific most effect one until further research is done.



- Practice these guidelines, exercises, & drills on your own & with your team. Don't wait until the season starts.

Get in shape to play; don't play to get in shape!

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