OCCURRENCE OF ANTERIOR CRUCIATE LIGAMENT INJURIES IN FEMALE PLAYERS DURING SPORTS ACTIVITIES

Dr. Akhtar Adil Shah
Mohammad Akram Ansari

Abstract

The number of female participants in all level of sports has risen greatly in less developing countries in recent years. So, also has changed the way women play. Once slow and defensive style has now changed into speed, precision and power. However, studies in less developed countries show that these changes have led to increased injuries and female athletes have higher injury rates than men in many sports, particularly basketball, skiing, volleyball and apparatus gymnastics.

Anterior Cruciate Ligament (ACL) injuries occur mostly commonly in sports such as basketball, soccer and volleyball. It is observed that female athletes injure the ACL more frequently than their male' counterparts do. The greater incidence of ACL injuries in women probably stem from complex interrelated factors, possibly including hamstring-quadriceps strength imbalances, joint laxity and the use of ankle braces. Successful treatment often includes surgery.

Given these findings a review of the incidence and causes of these injuries among female players of basketball, soccer and volleyballs is in order. Such a review might suggest areas of further study that could help physicians treat ACL injuries more effectively in their female patients.


Causes and Sites of Injuries

One reason physicians are seeing more ACL injuries in female patients is that more women play sports, and they play more intensely. But women's higher rate of ACL injury is probably due to a combination of intrinsic and extrinsic factors more than to the sheer increase in the number of athletes and intensity of play.

Musculoskeletal injuries are common in athletics (7,8,12-15). The knee, along with the ankle, consistently ranks as one of the most frequently injured joints. According to most studies (7,8,12,14). The majority of injuries are classified in general terms as "sprain" or "sprain/strain." Some studies looking at specific knee ligament injuries list the ACL as the most commonly injured ligament-alone or in combination with other ligamentous, chondral, and meniscal traumas.

The majority of ACL injuries suffered during athletic participation are of the noncontact variety (11,16,18). Three main noncontact mechanisms have been identified: planting and cutting, straight-knee landing, and one-step stop landing with the knee hyper extended (13). Pivoting and sudden deceleration are also common mechanisms of noncontact ACL injury (16,18).

The recent reports showed that overall knee injuries were more common among female soccer and basketball players than among their male counterparts. Noncontact injuries were more common for female soccer players, while contact injuries were more common in men. In basketball, noncontact mechanisms were the most common for both women and men (9). Basketball, soccer,

and volleyball consistently produce some of the highest ACL injury rates across various age-groups. Other activities with a high rate of injury are gymnastics (7,12,14), martial arts and running. In most sports, injuries occur more often in games than in practice. The data show that ACL injuries were significantly more common among women. The injury rate for female soccer players was over two times higher than for the men per 1,000 athlete exposures. The difference was even greater in basketball, where women were four times as likely to sustain ACL injury as were men. Recent data regarding ACL injuries among female volleyball players "re of particular interest. The data include retrospective information from surveys. Women's volleyball programs regarding ACL tears over the past 5 years. Fourteen programs reported a total of 26 grade 3 (complete) ACL tears in 24 athletes. The injuries were well distributed among all classes, freshman to senior. Most injuries (73%) occurred in game situations, especially in the middle to late portion of the season (after the 10th match of the season).

In a finding consistent with other reports (11,19) of volleyball injuries, the players at the outside-hit and middle-block positions accounted for most injuries (88.5%), with setters accounting for the remaining 11.5%. No injuries to defensive specialists were reported. Most injuries (64%) occurred when jumping or landing from a jump, and all were noncontact injuries.

Injuries were fairly equally divided between the right and left knee (54% and 46% respectively), and all of the injured athletes were right-hand dominant. About two thirds of the athletes were wearing some type of

prophylactic brace or tape on the ankle of the injured leg, although only 20% acknowledged a previous ankle injury.

All injured athletes included in this survey underwent surgical repair using patellar tendon grafts. At the time of this review, 13 of the 24 athletes had returned to play, 7 were still undergoing rehabilitation but were expected to return to play, and 4 did not resume competition.

Internal Factors

Intermal factors originate in the knee joint and are related to its anatomy. The ACL is a dynamic structure whose main function is to provide primary restraint to anterior tibial subluxation (18). It provides secondary restraint limiting internal rotation and restraint to varus and valgus angulation with the knee in full extension. Along with the posterior cruciate ligament, it provides the axis for knee rotation and links rotation with flexion and extension.

The ligament is primarily made up of two bands, the anteromedial and posterolateral, and an intermediate band is sometimes present (20). The ACL runs from the posteromedial portion of the lateral femoral condyle in an inferior, anterior, and medial orientation to an area just lateral to the medial tibial eminence. The posterolateral band is tightest when the knee is in extension, and the anteromedial band is tightest with the knee in flexion.

Intercondylar notch configuration has received a great deal of attention as a potential factor in ACL injury, but the research is contradictory. Some studies

have (23) shown that athletes with smaller intercondylar notch dimensions are at greater risk for ACL injury. Souryal and Freeman (22) reported that notch-width indexes were less in women than in men.

One of the internal factor is "loose jointedness," but research results here are also confusing. Some studies (24,25) have suggested that athletes who are loose jointed are at greater risk of injury than those with normal or "tight" joints. Other studies (26,27), however, have shown no relationship between native joint laxity and injury.

Anatomic alignment differences, especially the quadriceps angle (Q-angle), have been studied as the cause of gender discrepancies in injury rate. The Q-angle is the angle formed by the intersection of a line from the anterior superior iliac spine to the center of the patella and a line from the center of the patella to the tibial tubercle. Angles up to 17° are considered normal in females (28). While the relationship between increased Q-angle, patellofemoral tracking problems, and anterior knee pain has long been accepted, there is no apparent relationship between Q-angle and ACL injury. Other anatomic differences between male and female athletes (including women's wider pelvis, femoral anteversion, genu valgum, and external tibial torsion) that may playa role in the increased ACL injury rate in women.

Another internal factor is the *effect* of hormones on ligamentous tissue (6,30). Relaxin, a hormone found only in pregnant women, causes ligamentous relaxation, which allows for pelvic changes that accommodate fetal

passage through the birth canal. Studies also show that relaxin has systemic effects on ligamentous tissue and increases the risk of ligamentous injuries in pregnant women. The role of estrogen and estrogen receptors may shed light on ACL injuries in female athletes, but very few data are currently available.

External Factors

External factors responsible to ACL injury are those originating outside the knee joint. They include specific movements performed during sporting activity, muscle imbalances, playing surface, body contact and the use of braces.

Sports activities which are responsible for ACL injuries were discussed above. Attempts to decrease the occurrence of these activities or modify the way they are performed could conceivably decrease the rate of injury. In the heat of competition, however, an athlete can hardly avoid pivoting and sudden deceleration and still remain competitive.

A second external factor for explanation of women's ACL injury rate is the imbalance between hamstring and quadriceps muscle strength. Men tend to have more developed thigh musculature than women, and stability of the knee is thought to be more muscle-dominant in men and ligament-dominant in women. For female athletes, the quadriceps, an ACL antagonist, is the dominant muscle group contributing to knee joint stability, while the hamstring dominates in male athletes (5). Research indicates that women have decreased hamstring-to-quadriceps strength ratios relative to men,


but this has not been shown to cause ACL injuries in women. In fact, hamstring-to-quadriceps strength ratio has not been significantly related to knee injuries in general (3).

The playing surface is also one of the cause of ACL injuries, particularly when there is a high coefficient of friction. Artificial playing surface has long been blamed for causing many injuries(2) but injury data do not support this claim because severe injuries are just as likely to occur on natural playing surface and floors(1). This factor does not explain the gender difference in ACL injuries anyway, since both men and women play on a variety of surfaces in a variety of footwear. In body contact sports there is a lot of chance of direct blow on knee that can cause ACL rupture because of weak thigh muscles to stabilize the knees in women.

The use of prophylactic braces, particularly those guarding against ankle sprain, needs further investigation for its potential role in ACL injuries. One author suggests that the increased stability of the ankle and subtalar joint caused by bracing transmits the forces once absorbed by the ankle to the knee. However, another study did not show that ankle bracing increases the incidence of knee sprains. Further research regarding the use of prophylactic braces may provide some answers regarding the influence of brace use on women's ACL injury rate, but only if it demonstrates a significant gender-related difference.

Prevention

The number of ACL injuries in female athletes is rising. In some sports, the incidence is two to four times higher in women than in men. Many theories seek to explain this gender difference, but there appear to be multiple intrinsic and extrinsic causes. Because the causes are complex and our understanding of them incomplete, prevention is difficult. Leg muscle strength and the timing of hamstring firing are probably important and can be addressed with weight training and biofeedback. Avoiding straight-knee landing, one-step stop landing, and sharp planting and cutting maneuvers may decrease the incidence of injury. Future research into the role of hormones and braces may provide important information and assist physicians in decreasing the incidence of these injuries.

Diagnosis

Clinical History

Precise information about how the injury occurred can indicate the likelihood of ACL injury and associated injuries, such as meniscal or lateral collateral ligament tears. In the acute setting, the patient usually presents after a noncontact injury involving deceleration, flexion, or rotation (37). The knee may feel as if it is coming apart or giving way, and a commonly described "pop" may have been heard at the time of the injury. Most athletes are unable to continue participating in their activity, but some are able to stand and walk; a player's ability to do so should not preclude the diagnosis of an CL tear (8).

Oedema often begins in the first few hours after injury. Pain becomes worse, and muscle spasms may develop. In the history, inquire about previous trauma to the knee. An apparently fresh injury could actually be a reinjury or extension of prior damage to the ACL.

Examination

A complete exam at the time of injury is necessary, and efforts should be directed toward evaluating lesions suggested by the mechanism of injury. Throughout the knee examination, look at the uninjured knee first and compare it with the injured knee.

Observe the position of the knee and normal landmarks, any skin injuries, gross deformity, pulses, and sensation. An acutely swollen knee is held in a flexed position, and active range of motion may be limited by many factors, including the injury itself, effusion, meniscal tear, entrapment of the torn ACL, hamstring spasm, or partial medial collateral ligament (MCL) injury.

Intra-articular effusion is readily apparent and results in symmetrical swelling of the entire knee. With intra-articular effusion, the patella remains palpable; with extra-articular effusion from traumatic peripatellar bursitis, the patella is not palpable under the skin. Hemarthrosis is common with an acute ACL tear, and aspiration may significantly relieve pain.

Tenderness over the medial and lateral joint lines should be palpated (for meniscal injury) and the medial and lateral femoral epicondyles, adductor tubercle, and proximal medial tibia (for ligament attachments). Major tendons of the knee (patellar, quadriceps, popliteal, and

hamstring) should also be palpated for tenderness and swelling, as should the bursae of the knee (prepatellar, deep infrapatellar, pes anserinus, and tibial collateral ligament). Note alignment and biomechanics in female patients, since these have been implicated in knee injuries among women (9).

Lachman's test, the least stressful and most reliable indicator of ACL integrity, is traditionally the first test performed and assesses the forward translation of the tibia with respect to the femur. It is considered positive if excursion is larger on the injured side, or if no end point is reached. False negatives can occur with spasms or a displaced bucket-handle tear of the meniscus, and false positives can occur in MCL tears that extend into the posteromedial capsule and in posterior cruciate ligament (PCL) tears. Posterior subluxation of the tibia with the knee in 90° of flexion (a positive sag sign) indicates PCL disruption (l0).

The anterior drawer test (which also evaluates forward displacement of the tibia with respect to the femur) is less reliable than Lachman's test and is thus rarely performed in the acute setting (l1). The posterior drawer test (used to assess PCL adequacy) involves applying force to the proximal tibia and assessing posterior displacement of the tibial condyles. Care must be taken to ensure neutral alignment at the start of the test.

The MCL and lateral collateral ligament are commonly evaluated by applying varus and valgus forces to each knee at 0° and 30° of flexion. Significant

displacement or "opening up" of the joint under stress or loss of a distinct end point denotes a positive test. In full extension, a positive test indicates a severe capsular injury in association with collateral ligament disruption. McMurray's and Apley's tests are performed to detect or exclude meniscal injury. Both tests are considered positive if a painful pop is felt during manipulation and palpation of the knee. Even though the reliability of these tests, particularly of McMurray's, has repeatedly been questioned (12), performing them will likely continue since a clearly positive result can strengthen a presumed diagnosis and have prognostic value and implications for surgical management.

The pivot test can predict functional instability. Often this test is too painful or uncomfortable while the patient is awake and becomes a much better indicator with total muscle relaxation. Thus, many physicians perform it when the patient is under anesthesia.

X-Ray Evaluation: The anteroposterior, lateral, tunnel, and Hughston views should be evaluated carefully on X-ray films for avulsion of ligamentous attachments, loose bodies, fractures (particularly Segond's fracture), epiphyseal injuries, previous surgery or healed injuries, or signs of degenerative joint disease. In patients with an acute ACL injury, some authors recommend arthrography to evaluate both the integrity of the ACL and the possibility of meniscal injury. Magnetic resonance imaging is noninvasive and provides excellent images but is costly, and its value as a diagnostic aid remains controversial.

Treatment

The ACL is more responsible to provide stability of knee in female athletes than the male counterpart. The female knee may be more cruciate-dependent than the male knee. Thus, non surgical treatment of a female athlete with an ACL tear is less likely to succeed, and a trial of conservative treatment should be considered only in an athlete with mild signs and symptoms and a realistic possibility of returning to full activity. So the discussion of surgery depends on history taking, physical examination, and the findings of other diagnostic aids. Arthroscopic surgical repair of an ACL injury is the best treatment for a female athlete with positive Lachman's and pivot tests. Given the poor reliability of physical exam tests of meniscal status, menisci can be evaluated during surgery and repaired when indicated. Such surgical reconstruction can usually improve stability and performance enough for the athlete to resume a high level of activity (13).

Conclusion

Study on knee injuries in female players during sports in low developing countries indicate that increase in speed and power of the games, the rate of injuries has also increased particularly in basketball, volleyball, gymnastic and other athletic events. Interallia for more ACL injuries in female players in a combination of intrinsic and extrinsic factors. Data indicates that ACL injuries were more common among female athletes. The rate of injuries in female soccer layers was over two times higher than for men/thousand athletes. A close

examination of the data suggest13 of the 24 athletes went to surgical repair and returned to play, 7 were still undergoing rehabilitation and were expected to return in the field. However 4 did not resume competition.

Of the internal factors that originate the injury specifically with knee joint or related to its anatomy, one of them is (lose joint tidness) and the other is the effect of harmone or ligamentous tissue. Results are however not conclusive.

External factors responsible for ACL injuries are "movement performance during sports activity or kinseology of sports, muscle imbalance, body contact, use of braces and playing surface".

In order to prevent injury, a complete and full diagnosis is necessary which includes, precise information and also how the injury occurred and the previous history. A complete examination of the injured part of the body is necessary and a supervision of the injured part is a necessary step. X-ray examination and MRI of the injured part should be done. Treatment of the injuries shall depend on the findings of the diagnostic aids. Surgical treatment of the female athletes on ACL tears is likely to succeed. Therefore conservative treatment should be considered only when there are mild signs and symptoms.

References

1. Nigg BM, Segesser B: The influence of playing surfaces on the load of the locomotor system and on football and tennis injuries. Sports Med 1988;5(6):375-385.

2. Powell JW: Incidence of injuries associated with playing surfaces in the National Football League 1980-1985. Athletic Training 1987; 22(3): 202-206

3. Grace TG, Sweetser ER, Nelson MA, et al: Isokinetic muscle imbalance and knee-joint injuries. J Bone Joint Surg (Am) 1984;66(5):734-740

4. Moore JR, Wade G: Prevention of ACL injuries. Nat Strength Condit Assoc J 1989; 11(3) :35-40.

5. Huston LJ, Wojtys EM: Neuromuscular performance characteristics in elite female athletes. Am J Sports Med 1996;24(4):427-436.

6. Liu SH, AI-Shaikh R, Lane J, et al: The estrogen-collagen interaction in the ACL: a potential explanation for female athletic injury. American Orthopaedic Society for Sports Medicine22nd Annual Meeting, Lake Buena Vista, FL, June 16-20, 1996.

7. De Loes M: Epidemiology of sports injuries in the Swiss organization, Youth and Sports, 1987-1989: injuries, exposure, and risks of main diagnoses. Int J Sports Med 1995;16(2):134-138.

8. Zelisko JA, Noble HB, Porter M: A comparison of men's and women's professional basketball injuries. Am J Sports Med 1982;10(5):297-299

9. Arendt E, Dick R: Knee injury patterns among men and women in collegiate basketball and soccer: NCAA data and review of literature. Am J Sports Med 1995;23(6):694-701.

10. Cox JS, Lenz HW: Women midshipmen in sports. Am J Sports Med 1984;12(3):241-243.

11. Ferretti A, Papandrea P, Conteduca F, et al: Knee ligament injuries in volleyball players. Am J Sports Med 1992;20(2):203-207.

12. Backx FJG, Beijer HJM, Bol E, et al: Injuries in high-risk persons and high-risk sports: a longitudinal study of 1818 school children. Am J Sports Med 1991;19(2):124-130.

13. DeLee JC, Farney WC: Incidence of injury in Texas high school football. Am J Sports Med 1992;20(5) :575-580.

14. Tenvergert EM, Ten Duis HJ, Klasen HJ: Trends in sports injuries, 1982-1988: an in-depth study on four types of sport. J Sports Med Phys Fitness 1992;32(2):214-220.

15. Zebas CJ, Loudon K, Chapman M, et al: Musculoskeletal injuries in a college-age population during a 1-semester term. J Am Coli Health 1995;44(1):32-34.

16. Daniel DM, Stone ML, Dobson BE, et al: Fate of the ACL-injured patient: a prospective outcome study. Am J Sports Med 1994;22(5):632-644.

17. Griffis ND, Nequist SW, et al: Injury prevention of the anterior cruciate ligament, abstracted, in American Orthopaedic Society for Sports Medicine: Meeting Abstracts, Symposia, and Instructional Courses. 15th Annual Meeting, Traverse City, MI, June 19-22, 1989.

18. Noyes FR, Mooar PA, Matthews DS, et al: The symptomatic anterior cruciate-deficient knee. J Bone Joint Surg (Am) 1983;65(2):154-174.

19. Bahr R, Karlsen R, Lian O, et al: Incidence and mechanism of acute ankle inversion injuries in volleyball: a retrospective cohort study. Am J Sports Med 1994; 22(5): 595-600.

20. Ireland ML: Anterior cruciate ligament injuries in young female athletes: high risks call for new approaches. Your Patient & Fitness 1996;10(5):26-30.

21. LaPrade RF, Burnett QM II: Femoral intercondylar notch stenosis and correlation to anterior cruciate ligament injuries: a prospective study. Am J Sports Med 1994;22(2): 198-203.

22. Souryal TO, Freeman TR: Intercondylar notch size and anterior cruciate ligament injuries in athletes: a prospective study. Am J Sports Med 1993;21(4):535-539.

23. Souryal TO, Moore HA, Evans JP: Bilaterality in anterior cruciate ligament injuries: associated intercondylar notch stenosis. Am J Sports Med 1988;16(5):449-454

24. Marshall J, Barbash H: The Sports Doctor's Fitness Book for Women. New York City, Delacorte Press, 1981, pp 15-33.

25. Nicholas JA: Injuries to knee ligaments: relationship to looseness and tightness in football players. JAMA1970;212(13):2236-2239.

26. Grana WA, Moretz JA: Ligamentous laxity in secondary school athletes. JAMA 1978;240(18):1975-1976.

27. Moretz JA, Walters R, Smith L: Flexibility as a predictor of knee injuries in college football players. Phys Sportsmed 1982;10(7):93-97.

28. Woodland LH, Francis RS: Parameters and comparisons of the quadriceps angle of college-aged men and women in the supine and standing positions. Am J Sports Med 1992;20(2): 208-211.

29. Gray J, Taunton JE, McKenzie DC, et al: A survey of injuries to the ACL of the knee in female basketball players. Int J Sports Med 1985;6(6):314-316.

30. Hutchinson MR, Ireland ML: Knee injuries in female athletes. Sports Med 1995;19(4):288- 302 I