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Bilateral simultaneous anterior cruciate ligament reconstruction: A case series and review of the literature

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ABSTRACT

Bilateral ACL rupture is a relatively uncommon injury with an incidence of 2–4%. Most bilateral ACL rupture occurs at two different times, but few cases of single-staged bilateral ACL ruptures have also been reported. There have been reports of both single-staged, and two-staged reconstruction of bilateral ACL ruptures in the literature but without a clear consensus. We present a series of five bilateral ACL rupture cases managed by single-staged arthroscopic ACL reconstruction, using quadrupled hamstring grafts. All of them were young males, with an average age of 26.8 years (Range: 19–39 years). Three out of five of these cases (60%) had sustained the injury to both the knees simultaneously while playing sports. All the five patients had generalized joint laxity with significant hyperextension of their knees. All the ten knees (in five patients) were clinically stable, at their last follow-ups. None of the knees had any early or late complications. A single-staged bilateral ACL reconstruction is a safe, reproducible, and cost-effective procedure for patients with a bilateral ACL deficient knee, in experienced hands.

1. Introduction

Anterior cruciate ligament (ACL) provides primary restraints to anterior tibial translation and secondary restraints to the internal tibial rotation.[1] An ACL rupture can lead to knee instability with consequent damage to the meniscus, degeneration of the articular cartilage and increased stress on other soft tissues.

Injury to the ACL occurs most often in sporting activities but may also be ruptured in work injuries and non-athletic activities. The reported annual incidence of ACL injury in general population ranges from 0.01% to 0.08%, but it is much higher (1.5%–1.7%) among athletes involved in multidirectional sports.[2,3] Bilateral ACL rupture is relatively uncommon condition with an incidence of 2–4%.[4,5] Most bilateral ACL rupture occurs at two different times,[6–10] but few cases of single-staged bilateral ACL ruptures have also been reported.[11–14]

Non-operative treatment of ACL rupture may enhance the sense of 'stability' to the injured knee but not on objective outcome assessment and rate of return to sports.[15,16] Arthroscopic reconstruction of the damaged ACL has been shown to effectively restore knee stability, prevent further knee damage and enhance the return to pre-injury full activities and return to high-level sporting activities.

There have been reports of both single-staged and two-staged reconstruction of bilateral ACL ruptures in the literature but without a clear consensus. This paper presents five cases of single staged arthroscopic reconstruction of bilateral ACL rupture and critical review of the literature.

2. Case series

We present a series of five cases, who had undergone bilateral ACL reconstruction as a single stage procedure, by the senior author, with 30 years of experience of doing ACL reconstruction surgery. All of them were young males, with an average age of 26.8 years (Range: 19–39 years). Three out of five of these cases (60%) had sustained the injury to both the knees single-stagedly while playing sports. However, two cases (40%) had sustained these injuries on separate occasions, during the sporting activities (Figs. 1 and 2). One of them sustained the other knee injury after 3 months while the second patient sustained it after 5 months. All of these five patients had generalized joint laxity with significant hyperextension of their knees (Fig. 3). We did all of our cases with both knees in 90° flexion, after breaking the table and keeping it in

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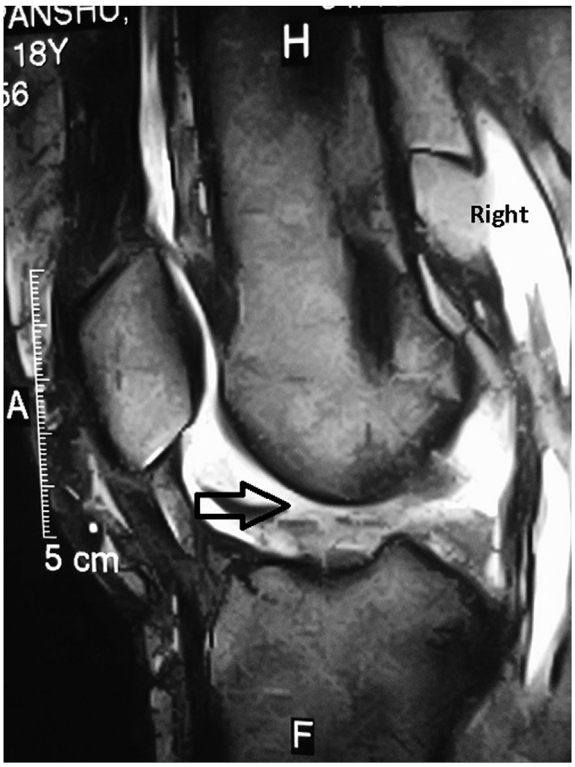

Fig. 1. Figure showing MRI of right knee with absent ACL.

Fig. 2. Figure showing MRI of left knee with absent ACL.

a flexed position while doing the surgery (Fig. 4). We preferred Hamstring grafts as they were easy to harvest and have lower morbidity than the other grafts like patella bone tendon bone

Fig. 3. Figure showing hyperextension of both the knee signifying the hyperlaxity of the joints.

(PBTB) and quadriceps tendon grafts. The grafts were fixed using bioabsorbable interference screws on the tibial side and on the femoral side, using an Endobutton devise (Smith and Nephew). All of our patients were discharged in two days with satisfactory outcomes. Wheel chair mobilisation for 3 weeks, and then full weight bearing after 3 weeks in cases of simultaneous ACLR. Gradual ROM using knee brace and quadriceps exercise from one week onwards.

At a minimum of two years follow-up (average 3.2 years), these patients had excellent outcomes in both the knees (Table 1) with an average Lysholm's core of 95.6 postoperatively (v/s an average score of 47.6 pre-operatively) and an average Tegner score of 8.4 post-operatively (v/s 5.4 pre-operatively). There was no significant difference between the outcomes of patients with simultaneous vs two staged ACL injury. All the ten knees in five patients were clinically stable, at their last follow-ups. None of the knees had any early or late complications.

3. Discussion

Anterior Cruciate Ligament is one of the most frequently ruptured ligament, perhaps due to the increased participation of people of all age and gender in sports. An ACL rupture occurs most commonly during sporting activities, and about 70–84% of the rupture occurs in non-contact situations.[17–21] The highest incidence of ACL rupture is found among the individuals aged 15–25 years old who participate in contact sports.

Multiple variables influence the risk of non-contact ACL injuries. They can be grouped into environmental, anatomical, hormonal, neuromuscular and biomechanical factors. Environmental factors are extrinsic factors such as the type of sports, playing surface, weather characteristics, and footwear to surface interaction.[22,23] Some anatomical factors considered as risk factor for non-contact ACL injuries include knee geometry (Femoral intercondylar notch width, tibial slope), joint laxity, body mass index and static alignment of lower limbs. Laxity is a combination of joint hypermobility and musculotendinous flexibility, and it is more prevalent in the females compared to males. Several studies have found a positive correlation between increased joint laxity, increased knee extension and increased risk of non-contact ACL injury.[24–26] While several studies with a high number of participants showed a positive correlation between the small intercondylar notch and risk of ACL rupture,[27–32] fewer studies disputed the relationship between femoral notch width size and non-contact ACL injury.[33–35] A case-control study compared axial-plane tibia and femoral anatomy, as well as the posterior slope of the medial and lateral tibial plateau in sagittal plane using MRI, showed that men and women with non-contact ACL injury have increased posterior slope of the lateral tibia plateau compared to the matched group with intact ACL.[36,37]

Fig. 4. Figure showing the position of both the knee in flexion on the operative table.

This finding was further corroborated by several other studies.[38–41] Oestrogen and progesterone receptor sites have been identified in human ACL, suggesting that female sex hormone may play a role in ACL structures. However, there is no consensus among researchers on the specific role of sex-specific hormones in the risk of non-contact ACL injuries in females. While some studies have reported an increased risk of ACL tear during preovulatory phase,[42] others showed increased risk during follicular phase[43] and menstrual phase.[44]

Bilateral ACL injury is relatively uncommon with a reported incidence of 2%–4%. Most of these injuries occurs at different times. Single-staged bilateral ACL tear is very rare and is mostly reported in the literature as isolated and individual cases. The risk factors, etiology, and mechanisms of contralateral ACL injury are not as clearly defined and conclusive in the literature as it is for unilateral ACL injury. The risk of contralateral ACL injury has been reported to be higher than the risk of first time ACL injury for individuals engaged in the same activity.[45] It is further evident in studies that included both individuals with a unilateral ACL injury and those without ACL injury that compared the incidence of contralateral ACL injury to that of first time ACL injuries.[46–48] The incidence of contralateral ACL rupture was higher than the incidence of first time ACL injuries in all the studies. A review of the literature on risk factors for a contralateral ACL injury showed that the most critical risk factor was a return to same or higher activity level after unilateral ACL injury. Other risk factors for contralateral ACL injury include altered biomechanics and neuromuscular function from the initial ACL injury, narrow intercondylar notch width, family history, gender, laxity, and age at first ACL injury.

The studies in the literature that described the anatomic risk factor for bilateral ACL injury showed significant notch stenosis in subjects with bilateral ACL tear than individuals with unilateral ACL tear and uninjured ACL.[49–52] Some studies strongly advocate positive correlation between contralateral ACL injury and having an immediate family member with a history of ACL injury[53] while other studies found no correlation.

ACL reconstruction is the treatment of choice for ACL injury especially in the young athletic patients who are most vulnerable to this injury. The goal of the reconstruction is the early return to pre-injury level of activities. Management protocol of unilateral ACL injury including optimal reconstructive techniques and rehabilitation are well outlined in the literature.[54,55] However, at present, there is no consensus on the management of patients with bilateral ACL rupture which can be managed with either a single-staged or two-staged ACL reconstruction. Both single-staged and two stage ACL reconstruction have specific advantages and disadvantages (Table 2). Thus the choice of surgical management remains a subject of debate. Four case reports of two-stage bilateral ACL reconstruction have been found in the literature.[56] Three of these were due to spontaneous bilateral ACL injury and one due to non-spontaneous injury. The decisions to do two-stage procedures in these papers were due to surgeon's and patient 's preference after discussion of the two possible options with the patient. Some of the concerns expressed against single-staged single stage reconstruction included the prolonged duration of surgery and perceived rehabilitation disabilities. Several studies have shown that single-staged single-stage bilateral ACL reconstruction gives reproducible, safe, cost-effective results without compromising rehabilitation and functional results.[57,58] Although there are no prospective randomized clinical studies in the literature to compare the single-staged single-stage verses two-stage bilateral ACL reconstruction, two matched paired studies were found. Sajovic et al. compared the outcome of 7 patients (14 knees) who had one stage bilateral ACL reconstruction with patients having unilateral ACL reconstruction (21 patients). The median hospital stay was 4 (3–5) nights for the bilateral group and 2 (1–4) nights for the unilateral group. There was no significant difference in their duration of rehabilitation. The median time to return to full-time work and full-time sports was nine week and seven months respectively for the bilateral group; eight weeks and six months for the unilateral (control) group respectively. Jari et al. in their match paired study of 25 bilateral single stage ACL reconstructions, and 24 unilateral ACL reconstructions (control) showed no difference in the Modified Noyes Subjective Questionnaire Scores which evaluates pain, stability and activity level as recorded by the patients. Objective evaluation regarding the range of motion, quadriceps strength and mean KT-1000 arthrometer were similar between the two groups. The total cost of surgery, hospital stay and physical therapy was significantly

Table 1
Table showing the demography, Beighton score, mechanism of injury, a procedure performed, graft used, Lysholms score and Tegner scores of all the five cases included in the series.

SN	Age/ Sex	Beighton score	Knee	Timing of injury	Mechanism of injury	Procedure	Graft used	Lysholm's Score (Pre-op/ Post-op)	Tegner Score (Pre-op/ Post-op)
1.	19/M	6	Bilateral	Simultaneously	Soccer	Bilateral simultaneous ACLR	Semitendinosus and Gracilis tendons	47/98	5/9
2.	27/M	7	Bilateral	On separate occasions	Cricket	Bilateral simultaneous ACLR	Semitendinosus and Gracilis tendons	45/97	6/9
3	23/M	7	Bilateral	Simultaneously	Cricket	Bilateral simultaneous ACLR	Semitendinosus and Gracilis tendons	46/95	5/8
4.	26/M	8	Bilateral	On separate occasions	Soccer	Bilateral simultaneous ACLR	Semitendinosus and Gracilis tendons	49/93	6/8
5.	39/M	7	Bilateral	Simultaneously	Road Traffic Accident	Bilateral simultaneous ACLR	Semitendinosus and Gracilis tendons	51/95	5/8

Table 2
Table showing Pros and cons of single-staged v/s two-staged bilateral ACL Reconstruction.

	Pros	Cons
A) Single-staged bilateral ACL Reconstruction	• Single hospital admission required • One time rehabilitation • Single anesthesia • Total hospital stay and expenses less • Time to recovery and off work less	• More demanding surgery • Longer duration of surgery • Requires extensive experience of the surgeon
B) Two-staged bilateral ACL Reconstruction	• Less demanding surgery • Shorter duration of surgery • Can be performed by a lesser experienced surgeon	• Two separate hospital admission required • Two-time rehabilitation • Two anesthesia required • Time to recovery and off work more • Total hospital stay and expenses more

less in the single-staged bilateral group compared to two unilateral operations. Also, one period of off work and one period of rehabilitation is required for one stage bilateral ACL reconstruction which results in less disruption of the lives of the patients and caregivers.

4. Conclusion

Bilateral ACL injuries are relatively rare and more often occur due to two separate injuries, rather than in a single accident. Single-staged bilateral ACL reconstruction is a safe, reproducible, and cost-effective procedure for patients with symptomatic bilateral ACL deficient knee with an excellent clinical outcome. However, it needs to be done by experience arthroscopic surgeons, who have significant experience of performing ACL reconstruction surgeries.

Conflicts of interest

Nil.

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