Original Article

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Bilateral Anterior Cruciate Ligament (ACL) Tears Treated with Single Stage Arthroscopic ACL Reconstruction: A Retrospective Study

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Abstract

Background: Bilateral Anterior Cruciate Ligament (ACL) tears occur rarely because they create special difficulties when doctors need to perform surgery and patients must recover and get back to their activities. The current research on single-stage bilateral arthroscopic ACL reconstruction does not provide enough data about its treatment results. The research investigates patient outcomes following single-stage bilateral arthroscopic ACL reconstruction which uses hamstring autografts for grafting.

Materials and methods: Twenty-four male patients with bilateral grade III ACL tears underwent single-stage bilateral arthroscopic ACL reconstruction by a single surgeon. The mean age was 24.1 years (Range, 17–41 years). The diagnosis became evident through both clinical evaluation and MRI results which led to the assessment of functional results using Lysholm and Tegner scores before surgery and after the last follow-up visit (At least 2 years).

Results: The mean follow-up duration was 3.16 years (Range, 2–5 years). The mean Lysholm score improved from 46.75 preoperatively to 97.04 at final follow-up, while the mean Tegner activity score increased from 5.45 to 8.79. Two patients developed superficial graft-harvest site infections in one knee, which resolved with conservative management. No other early or late postoperative complications were observed. At final follow-up, all 48 reconstructed knees were clinically stable, with no evidence of graft failure.

Conclusion: The single-stage bilateral arthroscopic ACL reconstruction using hamstring autografts enables young active patients who have bilateral ACL injuries to achieve outstanding functional outcomes and stable knees with minimal complications.

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Introduction

The Anterior Cruciate Ligament (ACL) is vital for knee stability and its main function is to prevent anterior tibial translation. It also acts as a secondary restraint to the internal tibial rotation particularly during activities which involves pivoting and sudden cutting action of the knee.[1,2] Instability of the knee occur after an ACL tear in most of the cases and consequently can lead to damage to the meniscus, cartilage and other soft tissues of the knee. According to current studies, between 100,000 and 200,000 ACL injuries occur each year in the US, but athletes involved in multidirectional sports have a higher incidence (1.5%–1.7%).[3,4,5]

Bilateral ACL tear is a rare injury, individuals with bilateral ACL-deficient knees are occasionally seen in a sports medicine practice with an incidence of 2–4%.[6,7] The majority of bilateral ACL ruptures happen at two different occasions, however there have also been a few documented instances of single-stage bilateral ACL ruptures.[8-13]

Arthroscopic ACL reconstruction (ACLR) of the damaged ligament with autograft or allograft is a common procedure that usually restore knee stability effectively, prevent further knee injury. It also allows predictable and timely return to pre-injury full activities and high-level sporting activities for the patient.[14,15]

In patients with of bilateral ACL tear, single staged or two staged arthroscopic ACLR can be done. Bilateral simultaneous ACL reconstruction refers to a surgical procedure performed on patients presenting with concurrent anterior cruciate ligament tears in both knees, wherein both ligaments are reconstructed during a single operative session.

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Surgeons can choose to perform simultaneous single setting or staged surgeries when ACL reconstruction is recommended for both knees. Regarding outcomes of one-stage bilateral ACL reconstruction, there are very few previous studies on the literature. When compared to unilateral surgery, single-setting bilateral ACL restoration using different grafts has been documented to be successful with no increase in complications. [16,17,18] The goals of single setting bilateral ACL reconstructions are to decrease symptoms, improve knee function and stability. In addition, bilateral simultaneous ACLR require single stage rehabilitation, lower cost, and single anaesthesia.[19] Cost of two separate surgery and rehabilitation is a big disadvantage in a developing country like ours.

This study presents twenty-four cases with bilateral ACL tear who underwent single stage sequential ACLR surgery with Hamstring autograft by a single surgical team. The purpose of this retrospective observational study was to present our experience and clinical outcome after one-stage bilateral ACL reconstruction and review of the literature regarding this procedure.

Materials and methods

This retrospective study was conducted in twenty-four patients with bilateral ACL injury (Grade-III) who underwent single staged bilateral arthroscopic ACLR performed by the same experienced surgeon. All the participants were male with an (Mean age of 24.1 years, ranging from 17 to 41 years) In this study, three patients sustained simultaneous bilateral knee injuries in one occasion, while others incurred injuries on separate occasions. The mean time between the two injuries was 4.45 months (Range:1-12 months) in our study. Regarding simultaneous bilateral knee injuries, one patient suffered the injury during playing football and other two due to motor cycle accidents Out of twenty-four patients, two patients exhibited generalized joint laxity with significant knee hyperextension.

The preoperative diagnosis was established through clinical evaluation and MR imaging (Figure 1 and 2). At the time of admission, functional outcome assessments were done according to Tegner Lysholm scores, documentation for all bilateral arthroscopic ACL reconstruction patients was obtained from medical records. Charts were screened and demographic, preoperative and intraoperative data were recorded in Excel. Preoperative functional outcomes were included and the operating surgeon examined patients regularly in post-operative periods during follow up. Functional outcomes according to Tegner Lysholm scores were assessed and entered the spreadsheet.

After receiving the institutional approval patients were informed about the procedure and consent was obtained. After informed consent and a pre-anesthesia checkup, patients underwent surgery performed by the same senior surgeon under spinal anesthesia. Once anesthetized and positioned supine, tourniquet cuffs were placed on both thighs and connected to separate machines. An Esmarch bandage was applied to exsanguinate the operative knee, followed by tourniquet inflation to 300 mm Hg. Both legs were disinfected with 10% Betadine™ and draped (Figure 3). Then knees were flexed to 90° by hanging the operated leg by the side of the operating table, which remained in this position during the procedure (Figure 3).

Standard anterolateral, anteromedial and accessory medial portals were established and ACL tear with status of the meniscus, cartilage and other injuries were assessed diagnostically. Hamstring autograft (Semitendinosus and Gracilis tendons) were harvested with a stripper. While the assistant prepares the harvested hamstring tendons, the femoral tunnel was created utilizing the transportal technique, ensuring adequate preservation of the posterior wall. Subsequently, the tibial tunnel is constructed with the aid of an aiming jig, followed by assessment for potential impingement. Graft fixation was performed using an Endobutton device on the femur and bioabsorbable interference screws on the tibia. Same procedure was done on the other knee after the completion of ACLR on the first knee (Figure 4).

Upon completion of bilateral procedures, long knee braces were applied to both knees, and the patient was carefully transferred to the ward for postoperative monitoring and care. Postoperative pain was managed by administering multimodal analgesics.

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All patients were discharged after one day, showing satisfactory postoperative control of pain. Wheelchair mobilization was advised for two weeks in patients who underwent partial meniscectomy in addition to ACLR and full weight bearing was allowed to other patients. Range-of-motion exercises were introduced gradually using a knee brace and quadriceps strengthening exercises commenced from first postoperative day.

Results

All 24 patients who underwent single-stage bilateral ACL reconstruction were male, with a mean age of 24.1 years (Range, 17–41 years). Twenty-one patients (87.5%) sustained bilateral ACL injuries during separate injury events, whereas 3 patients (12.5%) presented with simultaneous bilateral ACL tears. The mechanisms of injury are shown in Figure 2. Patient Demographics and Injury Characteristics Table I and the surgical technique is illustrated in Figure 3.

The mean follow-up duration was 3.2 years (Range, 2–5 years) with 6 patients available for a minimum 5-year follow-up. Functional outcomes improved significantly following surgery. The mean Lysholm score increased from 46.8 preoperatively (range, 44–51) to 97.0 at final follow-up (Range, 95–98). Similarly, the mean Tegner activity score improved from 5.5 preoperatively to 8.8 postoperatively (Table II).

Two patients experienced superficial surgical-site infections at the graft-harvest site in one knee, which resolved with nonoperative management. No additional early or late postoperative complications were observed. At final follow-up, all 48 reconstructed knees were clinically stable, with no evidence of graft failure.

Table I Patient Demographics and Injury Characteristics

Patient	Age (Yrs)	Gender	Timing of Injury	Mechanism
1	23	M	Separate	Football
2	31	M	Simultaneous	RTA
3	19	M	Separate	Cricket
4	25	M	Separate	Football
5	33	M	Separate	Football
6	24	M	Separate	RTA
7	41	M	Separate	Badminton
8	21	M	Separate	Football
9	18	M	Separate	Cricket
10	30	M	Separate	Football
11	27	M	Separate	Cricket
12	23	M	Separate	Football
13	31	M	Separate	RTA
14	19	M	Separate	Cricket
15	25	M	Separate	Football
16	18	M	Separate	Football
17	24	M	Simultaneous	RTA
18	23	M	Separate	Badminton
19	21	M	Simultaneous	Football
20	18	M	Separate	Cricket
21	20	M	Separate	Football
22	27	M	Separate	RTA
23	17	M	Separate	RTA
24	21	M	Separate	Football
Mean	24.1	—	—	—

Table II Preoperative and Follow-Up Lysholm and Tegner Scores

Patient No.	Lysholm Preop	Lysholm FU	Tegner Preop	Tegner FU
1	45	96	6	9
2	47	98	5	8
3	44	97	6	8
4	48	95	5	9
5	46	97	6	9
6	45	98	5	9
7	49	96	5	8
8	51	98	5	9
9	45	96	5	9
10	48	95	6	9
11	50	98	6	8
12	45	96	6	9
13	44	97	5	9
14	46	98	5	9
15	45	97	6	9
16	49	98	6	9
17	45	96	5	9
18	49	98	6	9
19	51	98	5	9
20	44	97	6	9
21	46	98	5	9
22	47	97	5	9
23	45	97	6	9
24	48	98	5	8
Mean	**46.75**	**97.04**	**5.45**	**8.79**

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Figure 1 Figure showing MRI of right knee with torn ACL

Figure 2 Figure showing MRI of left knee with torn ACL

Figure 3 Both legs were disinfected with 10% Betadine™ and draped. Then knees were flexed to 90° by hanging the operated leg by the side of the operating table

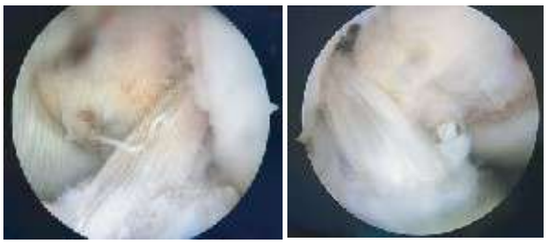

Figure 4 Arthroscopic view of bilateral ACL reconstruction with hamstring autograft

Discussion

There are very few studies of bilateral ACL injuries reported in the orthopaedic literature, making them extremely uncommon.[6,7] The best course of treatment is still up for debate because there is a lack of consensus in the literature. Treatment strategies for individuals with bilateral ACL-deficient knees are scarcely covered in the literature. According to all reported cases in the literature, every documented case had either simultaneous single staged or phased ACL reconstruction. According to the present study's most important finding, all patients exhibiting symptoms of bilateral ACL insufficiency are best treated clinically and cost-effectively with simultaneous bilateral ACLR. There was not a single patient who experienced a major adverse event throughout this research.

The Anterior Cruciate Ligament is one of the most ruptured knee ligaments due to increase involvement of individuals of all ages and genders in sports. Approximately 70-84% of these injuries occur during athletic activity, particularly in non-contact sporting scenarios. The largest prevalence of ACL rupture occurs in individuals aged 15 to 25 years who engage in sports.[20-22] In this study, patients age ranges from 17- 41 years (Average-24.1 years) and most of the cases (n=18) got injured during participation of sports. However, road traffic accidents (Motor cycle accidents) contribute to a substantial number of cases (n=6).

The risk of non-contact Anterior Cruciate Ligament (ACL) injuries is influenced by multiple factors, which can be categorised as environmental, anatomical, hormonal, neuromuscular and biomechanical factors. Environmental determinants include extrinsic elements such as type of sport, playing surface, weather conditions, and the interaction between footwear and surface. [23,24] In our patient group, most of them got injured while participating in sports. Anatomical risk factors associated with non-contact ACL injury comprise knee geometry—such as femoral intercondylar notch width and tibial slope—joint laxity, body mass index and static alignment of the lower limbs. Joint laxity combines hypermobility and musculotendinous flexibility and is observed more frequently in females than males. Several studies have demonstrated a positive correlation between

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increased joint laxity, increased knee extension and elevated risk of non-contact ACL injury.[25,26]In this study, two patients had hyper laxity with increased knee extension.

Bilateral Anterior Cruciate Ligament (ACL) injury is relatively rare, with reported incidence rates ranging from 2% to 4%.[6] Most of these Bilateral ACL 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 majority of these cases occur at different points in time. Simultaneous bilateral ACL tears are exceedingly uncommon and are predominantly documented as isolated cases in the literature.[27,28] We had three patients with history of simultaneous bilateral ACL tears and rest of the cases got injured in two different occasion, which is comparable to the other studies. The mean time between the two injuries was 4.45 months (Range:1-12 months) in our study.

Currently, the risk factors, etiology and mechanisms underlying contralateral ACL injuries are not as thoroughly defined or conclusive as those related to unilateral ACL injuries. Notably, individuals who continue participation in the same activities after an initial ACL injury face a higher risk of sustaining a contralateral ACL injury than those experiencing a first-time ACL injury. This finding has been substantiated by studies comparing the incidence of contralateral ACL injury among those with previous unilateral ACL injuries to the rate of first-time ACL injuries in both affected and unaffected individuals. Across all relevant studies, the incidence of contralateral ACL rupture surpassed that of first-time ACL injuries. A review of the existing literature indicates that returning to the same or a higher level of activity following a unilateral ACL injury is the most significant risk factor for contralateral injury.[28-31] This paper revealed that, eight patients (33,33%) had bilateral ACL tears due to participation in same level of sporting activity following a unilateral ACL injury. In our observation, sixteen patients had ACL injuries on the contralateral knee while trying to participate the same sports after the first incident.

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 is well outlined in the literature.[32-33]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. In our paper, most of the patients were young (Average-24.1 years) and all of them underwent single staged ACL reconstruction. The decisions to do single-stage or 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. Thus, the choice of surgical management remains a subject of debate. In our perspective, cost of the two procedures was one of the consideration factors to do single stage bilateral Arthroscopic ACLR.

Various grafts—including hamstrings, patella tendon, quadriceps autografts, and allografts—are used in single-stage bilateral ACL reconstructions, similar to unilateral procedures. Jari and Shelbourne found that patients receiving patella tendon autografts had anterior knee pain, but functional outcomes was comparable to those with unilateral ACL reconstruction.[16] Studies using hamstring grafts reported no significant differences versus unilateral cases, and most patients were satisfied at follow-up.[7-8] In one study, quadruple strand hamstring auto-grafts were used for all patients and there were no graft failures. This article presents a single-stage successive bilateral ACL reconstruction, rather than a genuine simultaneous bilateral ACL restoration as described by Saithna et al., which employed two arthroscopy towers and involved two teams of surgeons and nurses. In our instance, we utilized a single arthroscopy tower and a change of instruments and gloves was executed after surgery was done in one knee.[19]

Several studies have shown that single-staged single-stage bilateral ACL reconstruction gives reproducible, safe, cost-effective results without compromising rehabilitation and functional results.[16,18] Although there are no prospective randomized clinical studies in the literature to compare the single-staged verses two-stage

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bilateral ACL reconstruction. Our findings are consistent with those previously reported in the literature.

In this study, postoperative functional outcomes were assessed utilizing Lysholm and Tegner scoring systems. At an average follow-up of 3.16 years (Range: 2–5 years) with 6 patients reaching the 5-year follow-up at the time of data collection. The mean preoperative Lysholm score improved from a mean of 46.75 (Range: 44–51) to a mean of 97.04 (Range:95-98) at the final postoperative assessment. Similarly, Tegner scores increased from a preoperative mean of 5.45 to a postoperative mean of 8.79. According to Lysholm knee grading, all patients achieved excellent outcomes (Range 95–98) which is quite remarkable. Throughout the final follow-up period, no patients had graft failure or unstable knees.

Some of the concerns expressed against single-staged bilateral ACL reconstruction included the prolonged duration of surgery and perceived rehabilitation disabilities. In addition, there are some scenarios in which simultaneous bilateral reconstruction may not be suitable. For instance, some patients with bilateral ACL deficiency report instability in only one knee, with satisfactory function in the contralateral limb; in these cases, intervention may be limited to the more symptomatic knee. Additionally, patients exhibiting inadequate quadriceps muscle strength are not considered ideal candidates for simultaneous bilateral ACL reconstruction.

Economic considerations play a significant role in providing healthcare, especially within developing nations. Hospital and surgical expenses, along with hidden costs like lost work time for patients and caregivers, significantly influence decisions made by patients, doctors, insurers, and governments. We observed that a single simultaneous bilateral procedure typically results in single hospital stay, lower hospital bills compared to two separate unilateral operations. Additionally, we also found that choosing a simultaneous operation reduces overall surgeon fees and physical therapy costs. Conversely, those undergoing staged bilateral ACL reconstructions must endure two distinct absences from work and two rounds of rehabilitation, leading to greater interruptions in daily life for everyone involved.

Limitation

A key limitation of our study is the small sample size, largely due to the rarity of this type of injury. Additionally, our group did not include any female patients. This could reflect a biased sample seeking treatment at our hospital or may be influenced by cultural differences between Western countries and the Indian subcontinent.

Conclusion

Bilateral ACL injuries occur rarely because they stem from two separate accidents instead of happening during one incident. The experienced surgeon performed single-stage bilateral ACL reconstruction on our patients who then followed an individualized rehabilitation plan which produced excellent functional results at their last follow-up appointment. The research demonstrates that bilateral simultaneous Anterior Cruciate Ligament (ACL) reconstruction serves as an effective treatment method which delivers affordable solutions for patients who need to undergo dual ACL reconstruction. However, this procedure should be done by an experience arthroscopic surgeon from Bangladesh.

Recommendation

Further studies should be done this type of injury in multicentre and sample size should be large. Followup study should be done for identifying better strategics for this type of injury.

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Contribution of authors

CIM-Conception, acquisition of data, data analysis, drafting & final approval.

AZMS-Design, interpretation of data, critical revision & final approval.

MAN-Conception, acquisition of data, data analysis, drafting & final approval.

MYAC-Design, interpretation of data, critical revision & final approval.

AR-Data analysis, drafting & final approval.

MAI-Conception, acquisition of data, data analysis, drafting & final approval.

Disclosure

All the authors declared no conflict of interest.

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