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Immediate Post Operative Complications in Arthroscopic ACL Reconstruction and Open Reconstruction with Bone-Tendon-Bone Graft

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ABSTRACT

Background: Arthroscopic autograft ACL restoration increasingly superseded primary open repair of the ACL, which was the conventional surgical procedure. After ACLR, postoperative infection is also rare. **Objective:** To compare the immediate post-operative complication in patient undergoing arthroscopic ACL reconstruction versus open ACL reconstruction with bone-tendon-bone autograft. **Material and Methods:** A total of 304 participants participated in a randomized controlled experiment. After being randomly assigned to one of two groups, Group-A had arthroscopic ACL reconstruction, whereas Group-B had open ACL reconstruction. Every twelve hours, the VAS was used to assess postoperative discomfort. SPSS was used to evaluate all of the data that was gathered. The chi-square test or Fisher's exact test were used to compare the frequencies of complications across groups. To account for possible effect modifiers, stratification was used. A P-value of less than 0.05 is regarded as statistically significant. **Results:** Comparable demographics were displayed by both groups, with identical mean ages (46.82 ± 8.11 vs. 47.34 ± 8.58 years) and somewhat more men (64.5% arthroscopic vs. 61.2% open). Patients who had arthroscopy experienced consistently reduced pain levels at 12, 24, and 36 hours ($p < 0.001$) and a shorter hospital stay (1.56 ± 0.27 vs. 2.00 ± 0.79 days, $p < 0.001$). The open group experienced higher complications, including discomfort (4.6% vs. 12.5%) and infection (2.6% vs. 4.6%). In order to reduce postoperative morbidity, they are all in favor of the arthroscopic method. **Conclusion:** Comparing arthroscopic ACL surgery to open ACL reconstruction, our study revealed a noticeably lower risk of complications.

INTRODUCTION

Maintaining the rotational stability of the knee and preventing anterior displacement of the tibia relative to the femur are two of the most important functions that the anterior cruciate ligament (ACL) performs.[1] The ACL is one of the critical tissues that help to stabilize the knee joint.[2] There is a high incidence of anterior cruciate ligament (ACL) injuries among athletes who participate in sports such as soccer, basketball, and skiing. These injuries are frequently caused by sudden stops, pivots, or changes in direction.[3] If you rupture your anterior cruciate ligament (ACL), it will have repercussions that extend beyond the acute injury itself. It will drastically weaken the stability of your knee, which will result in functional restrictions, recurring episodes of giving way, and an increased risk of subsequent injuries, such as meniscal tears and cartilage damage.[4]

The current gold standard therapy for an anterior cruciate ligament (ACL) rupture is to replace the torn ligament using either autograft or allograft tissue in patients who are unstable and who are returning to pivoting sports. This is the case despite the fact that there has been a significant uptick in the number of ACL repairs that have been performed across the world.[5] Reconstruction of the anterior cruciate ligament (ACL) has seen significant development over the course of many decades, with improvements in surgical procedures, graft selection, and postoperative rehabilitation regimens resulting to enhanced patient outcomes. In spite of these developments, the choice to undertake surgery is a multi-faceted one, taking into account the patient's age, activity level, the occurrence of concurrent injuries, and personal aspirations. Although a significant number of patients are able to obtain favorable results after undergoing surgery, it is not without dangers. It is essential to have a thorough

grasp of the potential consequences in order to make well-informed decisions and effectively manage patients.[6]

Up until the 1980s, the primary open repair of the anterior cruciate ligament (ACL) was the conventional surgical procedure for repairing ACL ruptures. However, after that, unsatisfactory outcomes were documented at longer follow-up and the practice was discontinued.[7,8], Subsequently, arthroscopic autograft ACL reconstruction increasingly took the position of open anterior cruciate ligament (ACL) surgery for the treatment of ACL ruptures. The majority of sports injuries are now treated using arthroscopic operations, and the incidence of arthroscopic treatments has climbed considerably over the past decade. In the United States, almost three out of ten elective orthopedic surgeries are performed using arthroscopy.[9] These surgeries, most notably the restoration of the anterior cruciate ligament (ACL), are considered minimally invasive procedures, and major problems that accompany them are extremely rare. In addition, the advantages of the operation, in general, are of a much greater magnitude than the potential for difficulties.[10] However, because such events are so uncommon, there is a paucity of information on the accompanying problems, including their frequencies and the risk factors that are related with them. The purpose of this study is to shed light on this kind of incident.

Autograft anterior cruciate ligament repair, on the other hand, is associated with a number of drawbacks, including anterior knee discomfort, impaired thigh muscle strength after harvesting, and a lengthy period of rehabilitation.[11] Over the course of the last ten years, there has been a resurgence and a growing interest in anterior cruciate ligament (ACL) repair. As a result, several arthroscopic ACL repair procedures have been developed, particularly for proximal ACL ruptures.[12,13] Suture anchor repair (SAR) of the anterior cruciate ligament (ACL), repair with dynamic intraligamentary stabilization (DIS), reconstruction with internal brace ligament augmentation (IBLA), and bridge-enhanced anterior cruciate ligament repair (BEAR) are the four treatments that have garnered the most attention among these recently discovered surgical procedures.

The occurrence of postoperative infection following anterior cruciate ligament restoration (ACLR) is a potentially catastrophic complication that leads to a lengthy recovery period and poor functional outcomes.[14,15] It is essential to make a timely diagnosis of infection in order to prevent serious consequences such as knee dysfunction, cartilage damage, or arthrofibrosis. Although postoperative infection following ACLR is uncommon, with reported incidence rates ranging from 0.1% to 2%, an infection must be diagnosed as soon as possible.[16–17] In addition, a retrospective research conducted on a wide scale on pediatric and adolescent patients who were receiving ACLR revealed an overall infection incidence of 0.52%, which is comparable to the rate that was found in adults.[18] Patients under the age of 15 had a reduced infection incidence within this group, which suggests that there may be a potential age-related variation in the susceptibility to infection.

In addition, several systematic studies that were published in the past shown encouraging outcomes following ACL replacement. After conducting a comprehensive review of 23 studies pertaining to dynamic intraligamentary stabilization (DIS) in 2017, Ahmad et al.[13] came to the conclusion that ACL restoration has the potential to be a successful method for the treatment of acute proximal ACL injuries. According to the findings of another comprehensive study conducted by van der List et al.[19], several methods of primary anterior cruciate ligament (ACL) repair were shown to be safe, with failure rates ranging from 7 to 11%, and having high functional outcome ratings in 1,101 patients. On the other hand, two later systematic evaluations revealed conflicting results following ACL repair in comparison to ACL reconstruction.[20,21]

According to a study conducted by Andrés-Cano and colleagues,[22] the most common complication that patients who underwent arthroscopic ACL reconstruction experienced was uncontrolled pain, which accounted for 6.7% of the cases. This was followed by hemarthrosis, which necessitated arthrocentesis (4.4%), fever (3.2%), deep vein thrombosis (0.6%), cellulitis (0.6%), septic arthritis, which necessitated arthroscopic debridement (0.3%), and other complications, including issues with immobilization at 1.2%. According to the findings of another study, out of 121 patients, twenty patients (16.5%) suffered complications following arthroscopic posterior cruciate ligament restoration. On the other hand, the most common complication was surgical site infection, which occurred sixty percent of the time (12 out of twenty), followed by effusion fifty-five percent and deep vein thrombosis ten percent.[23] According to the findings of a study conducted by Raab et al,[24] the rate of immediate complications with open ACL restoration was much greater than that with arthroscopic reconstruction (7.31% versus 2.56%).

The purpose of this research is to examine the immediate post-operative complications that occur in patients who have arthroscopic anterior cruciate ligament (ACL) repair as opposed to open ACL restoration combined with bone-tendon-bone autograft. There have been a number of research done on arthroscopic reconstruction of anterior cruciate ligament (ACL) tears, and the results have been improved. Many surgeons, however, continue to use the open anterior cruciate ligament (ACL) restoration approach despite the scant evidence that supports its safety and effectiveness. As a result of the scant data available, there is currently no agreement over the type of reconstruction methodologies to be used. The results of our research will assist the surgeon in selecting an appropriate strategy for the care of an anterior cruciate ligament (ACL) tear, which will in turn serve to reduce the risk of post-operative complications.

MATERIAL AND METHODS

On the basis of approval from the College of Physicians and Surgeons Pakistan (CPSP) and the institutional ethical review committee, a randomized controlled trial was carried out at the Department of Orthopedic Surgery at Liaquat National Hospital in Karachi over the course of a period of six months, beginning in December 2024 and ending in May 2025. Following an in-depth description of

the procedures and aims of the study, informed permission was acquired from each and every participant. Using the World Health Organization's sample size calculator, the sample size was determined. This calculation took into account the previously published complication rates of 7.31 percent[24] for open and 16.51 percent[23] for arthroscopic ACL repair, respectively. The power of the study was 80 percent, and the significance level was five percent.

Through the use of non-probability sequential sampling, a total of 304 patients were recruited for the study, with 152 individuals being assigned to each intervention arm. The patients who were eligible for the study were between the ages of 18 and 65, of either gender, and had been diagnosed with an anterior cruciate ligament injury during the previous three months. A combination of clinical signs, such as knee damage, swelling, pain that was scored higher than three on the Visual Analogue Scale (VAS), and a positive Lachman test, as well as radiological evidence on magnetic resonance imaging (MRI), were used to corroborate the diagnosis. Increased signal intensity on T2 or fat-saturated proton density sequences, rupture of ligament fibers, changed orientation of the anterior cruciate ligament (ACL) relative to the intercondylar (Blumensaat) line, and fluid signals indicating femoral avulsion were some of the criteria that were established by magnetic resonance imaging (MRI). All of the patients who were identified as having ASA physical status I or II were included. Those individuals who had already had knee reconstruction, diabetes mellitus that was not under control, or established bone diseases such as osteoarthritis were not allowed to participate. A standardized questionnaire was used to capture baseline data, which included demographic information, clinical history, comorbidities (such as hypertension), smoking status (defined as daily cigarette usage for a period of at least 28 days), body mass index (BMI), and the duration of symptoms.

For the purpose of ensuring that the allocation was kept a secret, the participants were randomly assigned to one of two groups using an opaque sealed envelope method. In Group A, arthroscopic anterior cruciate ligament (ACL) repair was performed, whereas in Group B, open ACL reconstruction was performed utilizing bone-tendon-bone autografts. In accordance with the recommendations established by the hospital, the intraoperative and postoperative care regimens were harmonized across both groups. In order to identify any potential early postoperative issues, patients were carefully watched from the moment of surgery until they were discharged from the hospital.

Surgical site infection (SSI), wound dehiscence, postoperative discomfort, and deep vein thrombosis (DVT) were among the complications that occurred during the procedure. With the presence of pain, soreness, localized swelling, temperature that was at least 100 degrees Fahrenheit, purulent wound discharge, high white blood cell count (more than 12,000 per millimeter squared), or positive microbiological cultures from wound samples, a diagnosis of surgical site infection (SSI) was made. A clinical evaluation of wound dehiscence was performed by determining whether or not the margins of the surgical incision were completely or partially separated. The VAS was used to assess postoperative pain at regular intervals of twelve hours, and the results were categorized as follows: no pain (zero), mild (1–3), moderate (4–6), or severe (>6). On the basis of characteristics such as non-compressible venous segments, absence of color flow in occluded veins, and irregular flow dynamics during Valsalva maneuvers, deep vein thrombosis (DVT) was discovered by the utilization of duplex ultrasonography methods.

All of the data that was obtained was input into SPSS version 26, and then it was evaluated. Depending on the distribution that was validated using the Shapiro-Wilk test, quantitative variables were described as using either the mean plus or minus the standard deviation or the median with the interquartile range. The frequencies and percentages were used to express the categorical variables and their values. In situations where it was deemed suitable, the chi-square test or Fisher's exact test was utilized in order to make comparisons between groups about the frequencies of complications. In order to account for possible impact modifiers such as age, gender, body mass index (BMI), duration of symptoms, duration of surgery, smoking status, hypertension, and length of hospital stay, stratification was utilized. For post-stratification analyses, either chi-square or Fisher's exact tests were utilized, and a p-value of ≤0.05 was regarded to be associated with statistical significance.

RESULTS

The Table 1 showed a modest male predominance in both groups, with 98 males (64.5%) and 54 females (35.5%) in the arthroscopic cohort, and 93 males (61.2%) and 59 females (38.8%) in the open group. The mean age was statistically comparable at 46.82±8.11 years for the arthroscopic group and 47.34±8.58 years for the open group, reflecting age-matched populations.

Anthropometric measures indicated that patients in the open ACL group were notably taller (88.18±4.31 cm) and heavier (174.20±6.10 kg) than their arthroscopic counterparts (82.75±8.78 cm and 166.71±16.23 kg, respectively), although the mean BMI was slightly higher in the arthroscopic group at 37.44±11.86 kg/m^2 compared to 35.34±3.60 kg/m^2 in the open group. Hypertension was present in 22 patients (14.5%) in the arthroscopic group and 19 patients (12.5%) in the open group, while the remaining patients in both groups were normotensive. Smoking prevalence was nearly equivalent, with 33 smokers (21.7%) and 119 non-smokers (78.3%) in the arthroscopic cohort, versus 30 smokers (19.7%) and 122 non-smokers (80.3%) in the open group.

Preoperative symptom duration was closely matched, with an average of 4.89±1.06 months in the arthroscopic group and 4.86±1.04 months in the open group. Operative time was consistent across both techniques, recorded at 81.30±8.15 minutes and 81.74±8.22 minutes, respectively. However, hospitalization duration differed noticeably, with arthroscopic patients requiring a shorter mean stay of 1.56±0.27 days compared to 2.00±0.79 days for those undergoing open reconstruction, suggesting faster recovery and potentially lower inpatient resource

utilization associated with the minimally invasive approach.

Postoperative pain assessment revealed that patients in the arthroscopic group experienced less pain across most time intervals. At 12 hours post-surgery, the pain score averaged 6.82±0.64 versus 7.44±0.73 in the open group; at 24 hours, it was 6.04±0.63 compared to 6.66±0.74; and at 36 hours, 3.26±0.65 in contrast to 3.93±0.76. Interestingly, at the 48-hour mark, the open group reported a slightly lower mean pain score of 0.82±0.72 compared to 1.18±0.63 in the arthroscopic group, a finding that may warrant further exploration but likely lacks clinical significance given the overall trend.

Figure 1 presents that surgical site infection was reported in 4 out of 152 patients (2.6%) who underwent arthroscopic ACL reconstruction, compared to 7 out of 152 patients (4.6%) in the open group. Pain, as a reported complication, demonstrated more pronounced variation between the groups. In the arthroscopic group, postoperative pain was documented in 7 patients (4.6%), whereas the open reconstruction group had 19 cases (12.5%).

In Table-2, the relationship between immediate postoperative complications and demographic factors were evaluated. A significant association was observed in male patients. Among those who developed complications, 69.2% (18 out of 26) belonged to the open ACL reconstruction group, while only 30.8% (8 out of 26) underwent arthroscopic repair. Conversely, among males without complications, 54.5% (90 out of 165) were arthroscopically treated, and 45.5% (75 out of 165) underwent open repair. The association between gender and complications in males reached statistical significance (p = 0.024). For female patients, although the proportion of complications remained higher in the open group (72.7%, 8 out of 11), the difference was not statistically significant (p = 0.152), suggesting the gender-related variation may predominantly impact male patients.

Regarding hypertensive status, none of the arthroscopic patients with hypertension developed complications, whereas both complication cases among hypertensive individuals occurred in the open group (100%, 2 out of 2). Despite this pattern, the association did not reach statistical significance (p = 0.209). Among non-hypertensive patients, 68.6% (24 out of 35) of those with complications had undergone open surgery, while only 31.4% (11 out of 35) were treated arthroscopically. This contrast yielded a significant p-value (p = 0.022), indicating a stronger association between surgical technique and complications in normotensive individuals.

Smoking status did not demonstrate significant associations in either subgroup. Among smokers with complications, 71.4% (5 out of 7) were in the open repair group, and 28.6% (2 out of 7) underwent arthroscopic reconstruction (p = 0.243). Among non-smokers, however, the pattern was more pronounced: 70% (21 out of 30) of patients with complications had open repair, while only 30% (9 out of 30) underwent arthroscopy. This finding was statistically significant (p = 0.023), suggesting that among non-smokers, the open technique may confer a higher risk of early postoperative complications.

Table 1

Frequency Distribution of Demographics, Durations and Postoperative Findings According to Study Groups

Variables	Arthroscopic ACL Group	Open ACL Group
Gender[a]		
Male	98(64.5)	93(61.2)
Female	54(35.5	59(38.8)
Age(years)[b]	46.82±8.11	47.34±8.58
Height(cm)[b]	82.75±8.78	88.18±4.31
Weight(kg)[b]	166.71±16.23	174.20±6.10
Body mass index (kg/m^2)[b]	37.44±11.86	35.34±3.60
Hypertension[a]		
Yes	22(14.5)	19(12.5)
No	130(85.5)	133(87.5)
Smoking Status[a]		
Smoker	33(21.7)	30(19.7)
Non-Smoker	119(78.3)	122(80.3)
Symptom's duration (months)[b]	4.89±1.06	4.86±1.04
Procedure duration[b]	81.30±8.15	81.74±8.22
Hospital stay(days)[b]	1.56±0.27	2.00±0.79
Pain score[b]		
After 12 hours	6.82±0.64	7.44±0.73
After 24 hours	6.04±0.63	6.66±0.74
After 36 hours	3.26±0.65	3.93±0.76
After 48 hours	1.18±0.63	0.82±0.72

a = n(%) b=Mean± standard deviation

Figure 1

Frequency of Surgical Site Infection and Pain among Study Groups

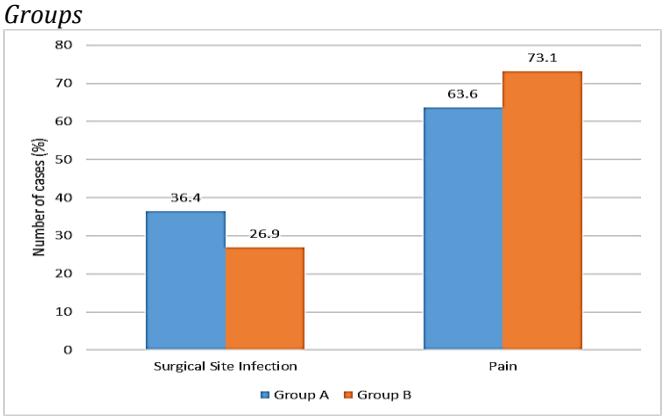

Table 2

Association of Complication with Study Groups

	Complication [a]		P-value
	Yes n(%)	No n(%)	
Arthroscopy ACL Group	11(7.2)	141(92.8)	0.013*
Open ACL Group	26(17.1)	126(82.9)	

Chi-square test was applied *Significant at 0.05 levels.

The Table 3 represents the relationship between immediate postoperative complications and patient demographics revealed statistically significant associations in selected subgroups. Among male patients who developed complications, 69.2% (18 out of 26) had undergone open ACL reconstruction, whereas only 30.8% (8 out of 26) were treated arthroscopically. Conversely, in males without complications, a greater proportion 54.5% (90 out of 165) had received arthroscopic repair compared to 45.5% (75 out of 165) who underwent the open technique. This association reached statistical significance (p = 0.024), indicating that male patients may be more susceptible to early complications following open reconstruction.

In the female subgroup, although 72.7% (8 out of 11) of those who experienced complications belonged to the

open repair group and 27.3% (3 out of 11) to the arthroscopic group, the difference was not statistically significant (p = 0.152). This suggests that gender-based variation in complication rates may be less pronounced among female patients.

Hypertensive status did not yield a significant association overall. Among hypertensive patients who developed complications, both cases occurred in the open repair group (100%, 2 out of 2), while none were observed in the arthroscopic cohort. However, the difference was not statistically significant (p = 0.209). Among non-hypertensive individuals, a significant trend emerged: 68.6% (24 out of 35) of complication cases occurred in the open group, while only 31.4% (11 out of 35) were observed in the arthroscopic group. This association was statistically significant (p = 0.022), suggesting that normotensive patients undergoing open repair are at higher risk for immediate complications.

Smoking status showed no significant association among smokers (p = 0.243), with 71.4% (5 out of 7) of complications occurring in the open group and 28.6% (2 out of 7) in the arthroscopic group. Among non-smokers, however, a significant difference was noted: 70% (21 out of 30) of complications occurred following open ACL reconstruction, whereas only 30% (9 out of 30) were seen in the arthroscopic cohort (p = 0.023).

Table 3

Association of Complication with Demographics According to Study Groups

Variables			Complication		P-value
			Yes n(%)	No n(%)	
Gender	Male	Arthroscopic ACL Repair	8(30.8)	90(54.5)	0.024*
		Open ACL Repair	18(69.2)	75(45.5)	
	Female	Arthroscopic ACL Repair	3(27.3)	51(50)	0.152
		Open ACL Repair	8(72.7)	51(50)	
Hyper-tension	Yes	Arthroscopic ACL Repair	0(0)	22(56.4)	0.209
		Open ACL Repair	2(100)	17(43.6)	
	No	Arthroscopic ACL Repair	11(31.4)	119(52.2)	0.022*
		Open ACL Repair	24(68.6)	109(47.8)	
Smoking Status	Smoker	Arthroscopic ACL Repair	2(28.6)	31(55.4)	0.243
		Open ACL Repair	5(71.4)	25(44.6)	
	Non-Smoker	Arthroscopic ACL Repair	9(30)	110(52.1)	0.023*
		Open ACL Repair	21(70)	101(47.9)	

Chi-square test was applied *Significant at 0.05 levels.

The comparison of quantitative variables between patients with and without immediate postoperative complications is presented in Table 4. Among those who developed complications, the mean age was 43.82±6.05 years for Group A (arthroscopic repair) and 44.42±6.78 years for Group B (open repair), showing no statistically significant difference (p=0.800). Similarly, among patients without complications, age did not differ significantly across groups, with Group A averaging 47.05±8.22 years and Group B 47.94±8.82 years (p=0.396).

Body mass index (BMI), however, revealed differential patterns. In patients without complications, BMI was significantly higher in the arthroscopic group (37.39±11.52 kg/m^2) compared to the open group (35.27±3.73 kg/m^2), with a p-value of 0.040, suggesting that BMI may have a modest association with complication rates in favor of arthroscopic intervention. Among those with complications, the BMI values were 38.1±16.38 in Group A and 35.69±2.92 in Group B, though this difference did not reach significance (p=0.639).

No meaningful differences were found in preoperative symptom duration between those with complications (4.82±0.98 months in Group A vs. 5.15±0.88 months in Group B; p=0.312) or those without complications (4.89±1.07 months vs. 4.8±1.07 months; p=0.485). Likewise, the duration of surgical procedures did not differ significantly regardless of complication status, with mean operative times ranging between 77.18±6.23 and 82.19±8.49 minutes across both groups (all p-values > 0.05).

Hospital stay duration showed a strong association with postoperative outcomes. Patients who developed complications had significantly shorter stays in the arthroscopic group (1.46±0.20 days) compared to the open group (2.12±0.82 days; p<0.001), and this difference was similarly significant among patients without complications (1.57±0.27 vs. 1.98±0.79 days; p<0.001). These results underscore the efficiency of arthroscopic repair in minimizing inpatient recovery time.

Pain scores over the first 48 hours postoperatively consistently favored the arthroscopic approach. Among those with complications, pain was significantly lower in Group A across all measured time intervals: 6.54±0.50 vs. 7.31±0.56 at 12 hours (p<0.001), 5.77±0.49 vs. 6.50±0.63 at 24 hours (p=0.001), and 2.90±0.57 vs. 3.73±0.65 at 36 hours (p<0.001). Only at 48 hours was the difference not statistically significant (0.90±0.48 vs. 0.68±0.56; p=0.264). For patients without complications, pain scores followed a similar trend, with Group A showing consistently lower levels at 12 hours (6.85±0.65 vs. 7.47±0.77; p<0.001), 24 hours (6.07±0.64 vs. 6.70±0.77; p<0.001), 36 hours (3.30±0.65 vs. 3.97±0.78; p<0.001), and 48 hours (1.21±0.64 vs. 0.85±0.75; p<0.001).

Table 4

Mean Compare of Quantitative Variables with Complication According to Study Groups

Variables	Complication (Mean ± Std. Dev)			No Complication (Mean ± Std. Dev)		
	Group A	Group B	p-value	Group A	Group B	p-value
Age (years)	43.82± 6.05	44.42± 6.78	0.800	47.05± 8.22	47.94± 8.82	0.396
BMI (Kg/m2)	38.1± 16.38	35.69± 2.92	0.639	37.39± 11.52	35.27± 3.73	0.040*
Duration of Symptoms (months)	4.82± 0.98	5.15± 0.88	0.312	4.89± 1.07	4.8± 1.07	0.485
Duration of Procedures (min)	77.18± 6.23	79.58± 6.48	0.306	81.62± 8.22	82.19± 8.49	0.581
Length of Hospitals Stay (days)	1.46± 0.2	2.12± 0.82	<0.001*	1.57± 0.27	1.98± 0.79	<0.001*
Pain Score After 12 Hours	6.54± 0.5	7.31± 0.56	<0.001*	6.85± 0.65	7.47± 0.77	<0.001*
Pain Score After 24 Hours	5.77± 0.49	6.5± 0.63	0.001*	6.07± 0.64	6.7± 0.77	<0.001*
Pain Score After 36 Hours	2.9± 0.57	3.73± 0.65	<0.001*	3.3± 0.65	3.97± 0.78	<0.001*
Pain Score After 48 Hours	0.9± 0.48	0.68± 0.56	0.264	1.21± 0.64	0.85± 0.75	<0.001*

Independent t-test was applied *Significant at 0.05 levels.

DISCUSSION

A rupture of the anterior cruciate ligament (ACL) is a frequent injury that happens in today's society as a result of greater participation in sports and a rise in the number of accidents that occur on the roads. Despite the fact that it was a contentious issue whether or not all patients who had suffered an ACL damage required ligament repairs. Surgical reconstruction has emerged as the approach of choice for therapy. The major objective of this treatment is to restore the stability of the knee, which will ultimately enable the patient to return to their usual range of motion, which includes participating in sports after the procedure. Other purposes include the prevention of early arthritic changes and the restoration of normal knee kinematics of the knee. At the moment, the autograft of the hamstring tendon (semitendinosis and gracillis) is the preferred method for anterior cruciate ligament (ACL) repairs. Due to anatomical, physiological, and hormonal reasons, female athletes are more likely to sustain ligament injuries than male athletes. This is a fact that has been extensively established in the scientific literature.[25]

Our study compared arthroscopic and open ACL reconstruction using bone-tendon-bone autografts. The study demonstrated several clinically relevant findings. Both groups were demographically balanced, with a modest male predominance 64.5% in the arthroscopic group and 61.2% in the open group and similar mean ages (46.82 ± 8.11 vs. 47.34 ± 8.58 years). Patients undergoing open surgery were taller and heavier than those treated arthroscopically, although the arthroscopic group had a slightly higher BMI (37.44±11.86 vs. 35.34±3.60 kg/m^2). Procedure duration and symptom onset were similar; however, hospital stay was significantly shorter in the arthroscopic group (1.56 ± 0.27 days vs. 2.00 ± 0.79 days; $p < 0.001$). Pain scores consistently favored the arthroscopic technique across the first 36 hours ($p < 0.001$), with scores at 12, 24, and 36 hours measuring 6.82 ± 0.64, 6.04 ± 0.63, and 3.26 ± 0.65, respectively, compared to 7.44 ± 0.73, 6.66 ± 0.74, and 3.93 ± 0.76 in the open group. At 48 hours, pain scores reversed slightly (1.18 ± 0.63 vs. 0.82 ± 0.72), though the clinical impact was minimal.

Complication rates included surgical site infections in 2.6% of arthroscopic cases versus 4.6% of open repairs, and pain-related complications in 4.6% vs. 12.5%, respectively. Significant associations were noted among male patients ($p = 0.024$), non-hypertensives ($p = 0.022$), and non-smokers ($p = 0.023$), with higher complication rates consistently linked to the open technique. Quantitative comparisons further revealed higher BMI in patients without complications treated arthroscopically (37.39 ± 11.52 vs. 35.27 ± 3.73; $p = 0.040$). Across all pain assessments and hospitalization metrics, arthroscopic ACL repair showed superior outcomes, reinforcing its role as a preferred approach in reducing early postoperative morbidity.

In a research, it was shown that patients who had arthroscopic anterior cruciate ligament (ACL) surgery had statistically equivalent results of problems and satisfaction when compared with autograft ACL reconstruction. The follow-up duration ranged from 12 to 36 months on average.[26]

Since the latter half of the 20th century, the surgical treatment of choice for anterior cruciate ligament (ACL) ruptures has been the repair of the ACL. Van der List et al.,[27] on the other hand, conducted a study of the evolutionary history of ACL surgical treatment methods and argued that the paradigm change away from primary ACL repair was partially attributable to "unfortunate timing." The poor results that occurred after open ACL repair were caused by a combination of factors, including immature arthroscopic technique, a prolonged period of immobilization following surgery,[28,29] and an inappropriate selection of patients [30]. Patients who had proximal rips and had high tissue quality tended to have much better clinical outcomes than those who had other types of tears, according to a major discovery that was published by Sherman et al.,[30] in the year 1991.

Primary arthroscopic anterior cruciate ligament (ACL) repair procedures offer certain benefits over autograft ACL restoration, according to theory. As an illustration, it is recommended that proprioception be preserved,[31] that the procedure be less invasive, that early range of motion (ROM) be regained, that native kinematics be restored,[32] that donor site morbidity be avoided, and that osteoarthritis be avoided.[33]

An additional study was carried out with the purpose of analyzing the problems that arise during surgical procedures and evaluating the clinical results of patients who had undergone anterior cruciate ligament (ACL) repair. It is estimated that the patient is between the ages of 18 and 51 years old, with a mean age of 28.33 years. The vast majority of patients were in the age range of 21 to 34 years old and were active. In this particular study, there were a total of 41 male patients and 4 female patients. One possible explanation for the prevalence of anterior cruciate ligament injuries in men is that they are more likely to participate in sports and activities that take place outside.[25]

On the other hand, Johnson et al.[34] had patients in their series who were between the ages of 17 and 48 years old, with the mean age being 26.3 years and the median age being 25.0 years. The majority of the patients in their study were between the ages of 15 and 25 years old, and there were 23 men (92%) and 2 girls (8%) in their study. In a prior survey, the most prevalent types of injuries were those sustained in sports (31.11%) and those sustained in road traffic accidents (68.89%). From one month to thirty months, the duration of symptoms varied. It took an average of four months for the injuries to heal.[25] The participants in the research were 25 individuals with anterior cruciate ligament (ACL) deficient, ranging in age from 17 to 43 years old, with an average age of 25.8 years.[35] Sixty-eight percent of the patients were caused by sports, twenty-four percent were caused by unintentional falls, and eight percent were caused by road traffic accidents. Three months was the typical amount of time that complaints were presented. A total of 42 individuals participated in this study, with 21 patients (46.67%) having involvement of the right knee joint and 24 patients (53.33%) having involvement of the left knee joint.[35]

According to Brig et al.'s research, sixty percent of the cases had injuries to the right knee.[36] In the study that Kruger-Franke and colleagues conducted on 107 individuals, they found that anterior cruciate ligament

(ACL) ruptures were related with 55% of the lateral meniscus tear and 45% of the medial meniscus rupture.[37]

A prospective research was conducted by Nellaiyappan on patients who had suffered an anterior cruciate ligament (ACL) injury and had undergone arthroscopic ACL restoration utilizing hamstring autograft. There was a 67% recovery to the pre-injury level for patients.[38] In comparison, the results of another research indicated that 44 patients had a good to exceptional prognosis after a year of follow-up evaluation. Therefore, the findings of both of the investigations were equivalent to one another.[25]

Another research found that the most prevalent postoperative problems were knee discomfort, which was experienced by five patients (11.11%), followed by stiff knee, which was experienced by three patients (6.67%), and finally, postoperative infections, which were experienced by one patient (2.22%). After doing a meta-analysis of patients who were treated with hamstring tendon grafts, Ibrahim et al. and Marder et al. reported their findings. Patients who experienced anterior knee discomfort were found to be 24% in both of the investigations. Functional results are impacted by the procedures used for graft fixation, the positioning of the bone tunnel, and postoperative rehabilitation activities.[39,40]

CONCLUSION

When compared to the open procedure that makes use of bone-tendon-bone autografts, the arthroscopic technique for reconstructed anterior cruciate ligaments (ACL) is linked with excellent immediate postoperative results. The period of hospitalization for patients who underwent arthroscopy was shorter, and they experienced less postoperative discomfort. The group that underwent arthroscopic surgery had a decreased overall complication rate, particularly with regard to pain-related events and surgical site infections. The data presented here provide credence to the utilization of arthroscopic reconstruction as a means of reducing the risk of early postoperative morbidity and facilitating the healing process.

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