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Original Research Article

To distinguish between the results of early and delayed arthroscopic reconstruction of anterior cruciate ligament tears

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Abstract

Objective of the Study: This study's main goal is to evaluate the functionality of early and delayed arthroscopically reconstructed ACLs using the IKDC score, Lysholm-Tegner score, KOOS scoring, as well as clinical testing such as the pivot shift test, anterior drawer test, Lachmann test, and range of motion both before and after surgery.

Need for the Study: Reconstructing the anterior cruciate ligament (ACLR) increases the stability and functionality of the knee. Numerous contentious concerns, including graft selection, surgical technique, and scheduling of operation, are present and the surgical approach is still evolving. The best moment for reconstructive surgery following injuries is a topic of debate. Few authors have advocated for reconstruction within 12 weeks. Early surgical intervention may reduce the likelihood of meniscal and chondral damage and prevent the knee from becoming more unstable. Other studies concluded that early repair would have unexpected results because of discomfort, arthrofibrosis, and patellar contracture syndrome and advised waiting until 12 weeks had passed before having surgery. This research will assist the surgeon in arthroscopically reconstructing the anterior cruciate ligament at the ideal time.

Methods: After receiving informed consent, 60 patients with ACL injuries who were admitted to Govt. Medical College & Hospital were enrolled in this study. There was a thorough clinical examination and history taken. Magnetic Resonance Imaging (MRI) and routine clinical tests were used to confirm the diagnosis (Sigma HDxT-GE 1.5 Tesla). Depending on the time of hospital presentation, patients with total or partial ACL Tears having ACL reconstruction were randomly assigned to early 12-week groups x. These patients had arthroscopic ACL reconstruction using semitendinosis and gracilis triple grafts in order to repair their established ACL tears, either partial or total. IKDC score, Lysholm-tegner score, and KOOS scoring were used to evaluate the functional performance of the rebuilt ACL over a period of 6 to 1 year.

Results: Clinical and functional scores post-operatively improved statistically significantly in both the Early and Delayed groups. In both groups, the score improvement was comparable. The improvement in pain ratings, range of motion, anteroposterior stability, and functional scores between the early and delayed groups did not vary statistically. There were no notable variations between the two groups' improvements.

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Keywords: Arthroscopic reconstruction, anterior cruciate ligament tears, surgery

Introduction

The anterior cruciate ligament (ACL) has gained popularity over the past ten years. The majority of athletes has either heard of it or knows someone who has suffered an ACL injury. The anterior cruciate ligament is widely known for playing a crucial part in the kinematics of the knee and contributes significantly to the stability of the knee joint [1]. Therefore, the regular day-to-day activities of the average person are significantly impacted by the restoration of the anterior cruciate ligament (ACL). Nowadays, one of the most common knee surgical operations is the reconstruction of the anterior cruciate ligament (ACL). The knee's stability and functionality are improved with anterior cruciate ligament restoration (ACLR) [2]. Numerous contentious problems still surround the surgical procedure, including the choice of the graft (patellar tendon, hamstring, quadriceps, or allograft), surgical technique (double versus single bundle), femoral tunnel drilling, and the precise timing of the procedure. Young athletes frequently suffer from anterior cruciate ligament (ACL) tears, which put the knee at risk for further damage and possibly for the earlier start of osteoarthritis (OA) [3]. The preferred course of treatment for young patients who want to continue playing sports is ACL reconstruction. Reduced post-surgical morbidity and shorter absences from work and leisure activities are the results of arthroscopic methods. In the beginning, patients were frequently rebuilt within the first week following the accident, which occasionally led to a stiff joint [4]. Therefore, it was indicated that postponing the procedure might reduce the chance of developing arthrofibrosis. The benefits of early reconstruction, on the other hand, have been emphasised; they include a shorter period of aberrant knee kinematics and instability and, consequently, less meniscal and cartilage damage due to recurring pivoting trauma while waiting for surgery. Currently, the majority of surgeons concurs that before to reconstruction, the patient should have restored complete range of motion (ROM) and exhibits no symptoms of arthrofibrosis or quadriceps atrophy. There is still no agreement on the best time to have an ACL reconstruction [5]. The study's objective was to compare the outcomes six months after anterior cruciate ligament (ACL) reconstruction using a hamstring tendon (HT) autograft in patients who underwent surgery within 12 weeks of the injury (Group A) and patients who underwent surgery more than 12 weeks later (Group B) [6].

Anatomy: During the eighth week of the human embryo, a gap forms between the mesenchymal rudiments of the femur and tibia, forming the knee joint [7]. Vascular mesenchyme is segregated within the joint as the mesenchyme in the area of the future knee joint condenses to produce the pre-cartilage and the joint capsule. The cruciate ligaments and the menisci develop from this tissue. The long axes of the many immature fibroblasts that make up the cruciate ligaments at 9 weeks are parallel to the direction of the ligaments. ACL and PCL are separated from one another at 10 weeks, and over the following 4 weeks, the cruciate ligaments continue to distinguish from the surrounding tissues and the insertion sites become more clearly defined. By 18 weeks, the cruciate ligaments are virtually completely by themselves, and some vascular components can be seen within their structure. The ACL continues to grow and become more vascular during the following weeks, eventually resembling the adult ACL. The remaining development is characterised by significant expansion but little shape change. The mature ACL links the femur and tibia with a band of dense connective tissue that is consistently orientated. The anterior and posterior cruciate ligaments are entirely encircled by a fold of synovium that comes from the posterior intercondylar region of the knee. The cruciate ligaments are hence extrasynovial and intraarticular [8]. The medial surface of the lateral femoral condyle's posterior aspect has a fossa where the ACL is attached. The attachment has a semilunate shape, with a convex posterior border and a straight anterior border. The femoral attachment's long axis measures around 23 mm in length and is angled just slightly forward of vertical [9]. The ACL is joined

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to a fossa on the tibia that is lateral and anterior to the anterior tibial spine. The transverse meniscal ligament is underneath the anterior portion of the tibial attachment, and some ACL fascicles may converge with the lateral meniscus' anterior attachment. The ACL's tibial attachment is a little bit wider than its femoral attachment. It is around 30 mm long. The ACL is fan-shaped as a result of the tibial attachment being a little larger than the femoral. From the femur to the tibia, the ACL travels anteriorly, medially, and distally over the joint. The bony attachments give it a small outward (lateral) spiral shape as well. The ACL's cross-sectional area fluctuates along its length, being bigger at its insertion sites than in the mid-region, although having an average thickness of 11 mm. The range of the typical length is between 31 and 38 mm [10]. Current reconstruction techniques cannot replicate the intricate geometry of the ACL. The ACL's front border has the longest fibres, while its posterior margin has the smallest. As the ACL is stressed, its distinctive crimp pattern straightens. The anteromedial (AMB) and posterolateral (PLB) bundles have been split into the ACL, which has no anatomically distinct bundles but has been functionally divided into at least two bundles that cooperate to maximise its restraining function throughout the range of knee motion [11]. The direction of the ACL's femoral connection in flexion and extension is what keeps the ligament taut throughout its range of motion. The ACL is connected to the femur and tibia by a network of distinct fascicles that spread out over a sizable, flattened region. The entire ligament is taut when the knee is extended, with the PLB bearing the majority of the strain. The AMB tightens and the PLB relaxes during flexion because the femoral connection of the ACL acquires a more horizontal orientation [12]. Additionally, a middle bundle is described. This is thought to be the cause of the knee's straight anterior stability. These macroscopic bundles in the ACL's content do not, however, have a comparable substructure. The fact that groups of fascicles cooperate across the range of joint motion gives the ACL's fascicles their functional relevance [14]. The extracellular matrix that surrounds the fibroblasts that make up the ACL is made of a solid, meticulously arranged mixture of macromolecules, mostly type I collagen and water. The matrix's make-up, the macromolecules' arrangement, and their interactions with water all affect the ligament's mechanical characteristics. As with ageing, minor modifications to this composition could result in modifications to its mechanical properties [15]. The ACL is made up of collagen fibrils that range in size from 30 to 175 nm and are organised in parallel microscopically [16]. These fibrils are then gathered into fibres, which range in diameter from 1 to 20 micrometres. They virtually parallel the ligament's long axis. These fibre bundles combine to create subfascicular units, which have a diameter between 100 and 250 micrometres. A collagen fasciculus with a diameter of several millimetres is made up of 3 to 20 subfasciculi. The ligament's bands could not be anatomically distinguished by Clark and Sidles. The ACL differs from other ligaments surrounding the knee in this regard [17]. The ACL has a matrix comprised of a network of proteins, glycoproteins, elastic systems, and glycosaminoglycans with complex functional relationships, as well as a microstructure made of collagen bundles of various types (mainly type I). The ACL can sustain multiaxial stresses and different tensile strains due to its extensive elastic system and sophisticated ultrastructural organisation [18]. The medial and lateral inferior genicular arteries, as well as a few of their terminal branches, provide portion of the medial and lateral ACL's blood supply [19]. The synovial fold that encloses the ACL is reached by these vessels. They grow into a web-like network of periligamentous vessels in this synovium, which anastomoses with a network of endo ligamentous vessels to generate smaller connecting branches that transversely puncture the ligament. These are longitudinally oriented and parallel to the collagen bundles in the ligament, along with the connective tissue that supports them [20]. Both experimental and clinical research have shown the importance of the vascular tissues in ACL healing and regeneration. According to Bray *et al*., the medial collateral ligament's (MCL) greater ability to enhance its blood supply through angiogenesis and increased flow is crucial for ligament healing and may account for the majority of the

healing potential differential between the MCL and ACL. Revascularization of ligaments that have been healed may occur from the synovium or the fat pad, respectively [21]. In dogs without bone tunnels, revascularization starts at 6 weeks and is finished 20 weeks after surgery. During the first two years following reconstruction, Howell et colleagues used MRI and an intravenous contrast agent (gadolinium diethylenetriamine pentacetic acid) to assess the blood supply to hamstring autografts and periligamentous tissues [22]. They discovered that the grafts did not develop any discernible blood supply within the first two years, and they continued to seem hypovascular like a typical PCL. By one month after surgery, the periligamentous soft tissues had a rich vascularization and were covering the transplant. They came to the conclusion that synovial diffusion may be more important to the grafts' viability than revascularization. Branches of the tibial nerve that enter the joint posteriorly send nerve fibres to the ACL. Neurovascular bundles made up of nerve fibres and sensory receptors enter the ligament from the synovium and follow the vessels [23]. The ligament also houses a number of sensory end organs and some nerve fibres that are separate from the vessels. There are two types of nerve fibres, unmyelinated and myelinated, and four different types of sensory endings have been identified based on their morphology. Pacinian corpuscles and free nerve endings are the two different categories of Ruffini end organs. These nerve terminals are thought to play a significant proprioceptive role in the knee [24]. The number of mechanoreceptors and the precision of the joint position sensation were found to be positively correlated by Adachi *et al*. (20), indicating that the quantity of mechanoreceptors affects the proprioceptive function of the ACL [25].

Materials and Methods

Design of the study

In this study, which was conducted between September 2019 and September 2021 [26], 60 patients between the ages of 18 and 60 who had symptomatic ACL tears that required arthroscopic restoration were admitted to Govt Medical College & Hospital.

Sample size

Sixty patients diagnosed to have acute and chronic ACL injury will be included using purposive sampling technique.

Design of the study

Prospective cohort study.

Method of collection of data

After receiving informed consent, 60 ACL damage patients who were admitted to Govt Medical College & Hospital, Siddipet were enrolled in this study. There was a thorough clinical examination and history taken. Standard clinical tests and radiograph Magnetic Resonance Imaging (MRI) were used to confirm the diagnosis (Sigma HDxT-GE 1.5 Tesla). Depending on the time of hospital presentation, patients with total or partial ACL Tears having ACL repair will be randomly assigned to early 12-week groups. These individuals will have arthroscopic ACL restoration using semitendinosis and gracilis quadraple grafts if they have an established ACL injury (partial or total). At the department of orthopaedics at Govt Medical College & Hospital, functional evaluation of the repaired ACL will be done using the IKDC score, Lysholm-tegner, and KOOS scoring between a period of 6 months and 1 year once post-operatively. Additionally, the grading will be compared to results from the

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anterior drawer test, Lachmann test and knee range of motion [27, 28].

Inclusion criteria

1. Patients with complete or partial ACL Tear who are undergoing
2. ACL reconstruction.
3. Patients belonging to the age group of 18-60 years with ACL injury
4. either isolated or
5. Acute or Chronic
6. Associated Meniscal injury
7. Medial collateral ligament injuries (Grade 1, 2)
8. Lateral collateral ligament injury (Grade 1, 2)
9. Chondral injury (Grade 1, 2)

Exclusion criteria

1. Patients with associated Posterior Cruciate Ligament (PCL) injury.
2. Patients with ACL re-injury.
3. Patients with associated per articular fracture.
4. Patients with associated ipsilateral lower limb fracture.
5. Grade 3 & 4 chondral injuries (detec ted intraoperatively)
6. Medial and Lateral Collateral li gament injury (Grade 3 and 4).

Procedure

All the patients diagnosed to have an ACL injury clinically underwent a MRI of the affected limb. Once the diagnosis was established, in acute stage long knee brace, anti-inflammatory medications, started on quadriceps strengthening exercises and once the tissue swelling subsided and no extension lag patient was taken up for surgery. Patient was admitted one day prior to surgery and preoperative blood tests were done. The patient underwent a pre anaesthetic checkup for fitness. Parts were prepared and a written and informed consent for the surgery was taken [29].

Surgery

Patient was shifted to the operation theatre and was given a spinal/ epidural anaesthesia.

Examination under anaesthesia

Under spinal and epidural anaesthesia the knee join t was assessed clinically for Lachman test, Anterior Drawer test, Pivot shift was graded accordingly. In cases where clinical examination and MRI was inconclusive, but patient was symptomatic, decision to do ACL was taken based EUA and arthroscopic findings [30].

Surgical steps

- Under anesthesia, pneumatic tourniquet was applied over the thigh as it has advantage of increased visibility and shorter duration of surgery.
- Patient was positioned supine
- Parts drapped by standard method to allow manipulation of the limb and cleaned.
- Standard anterolateral and anteromedial portal made.

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- With 25-and 30-degree arthroscope diagnostic arthroscopy done and looked for

1. Suprapatellar pouch and patellofemoral joint
2. Medial gutter
3. Medial compartment
4. Intercondylar notch
5. Posteromedial compartment
6. Lateral compartment
7. Lateral gutter and posterolateral compartment

Results

Preoperative data analysis included clinical test evaluations of the Lachman's test, Anterior Drawer test, Pivot shift, X-ray and MRI of the knee, IKDC score, Lysholm-Tegner scoring, and KOOS scoring. The functional analysis of post-operational data used the IKDC, Lysholm-Tegner score, and KOOS scoring. Post-operative pivot shift tests, anterior drawer tests, and Lachman's tests. Mean + or - SD was used to express the scores at both time points. The data's normalcy was investigated. Using a paired student t-test, the scores, which had a normal distribution, were compared between the pre- and post-operative time points. At P 30 kg/m2, every statistical analyses was deemed significant. Graft failure was possible.

Table 1: Groups

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
1	30	50	50	50
2	30	50	50	100
Total	60	100	100	

Table 2: Age

Age	Years (Average)
Early	32
Delayed	29
Total	30

Table 3: Sex

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
Male	56	93.3	93.3	93.3
Female	04	6.7	6.7	100
Total	60	100	100	

Table 4: Body Mass Index kg/m2

Group	kg/m2
Early	24.73
Delayed	25.056
Average	24.893

Table 5: Mode of injury

Valid	Frequency	Percent	Valid Percent	Cumulative Percent
RTA	14	23.3	23.3	23.3
Self-fall	18	30.0	30.0	53.3
Sports	28	46.7	46.7	100.0
Total	60	100.0	100.0	

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Table 6: Isolated ACL tear

Diagnosis					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	ACL+	60	100.0	100.0	100.0
	ACL	25	41.7	41.7	41.7

Table 7: ACL with medial meniscus tear

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	49	81.7	81.7	81.7
MM	11	18.3	18.3	100.0
Total	60	100.0	100.0	

Table 8: ACL + Lateral meniscus tear

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	46	76.7	76.7	76.7
LM	14	23.3	23.3	100.0
Total	60	100.0	100.0	

Table 9: ACL + both meniscal tears

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	50	83.3	83.3	83.3
Both	10	16.7	16.7	100.0
Total	60	100.0	100.0	

Table 10: Intraoperative chondral changes

	Frequency	Percent	Valid percent	Cumulative percent
Early	04	13.33	22.22	22.22
Delayed	14	46.66	77.78	77.78
Total	60	30		100

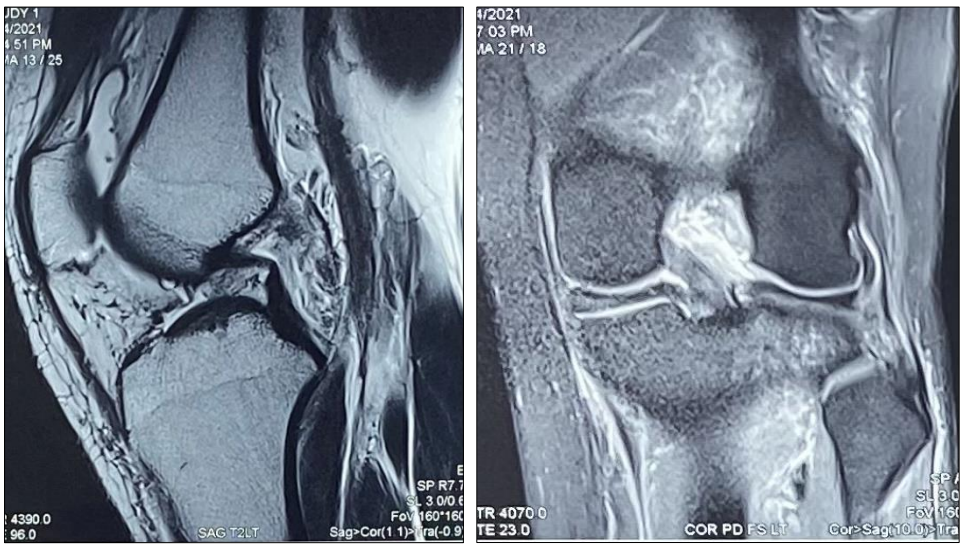

Fig 1: MRI Images of Knee

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Fig 2: Graft Harvesting

Fig 3: Graft Preparation & Tensioning

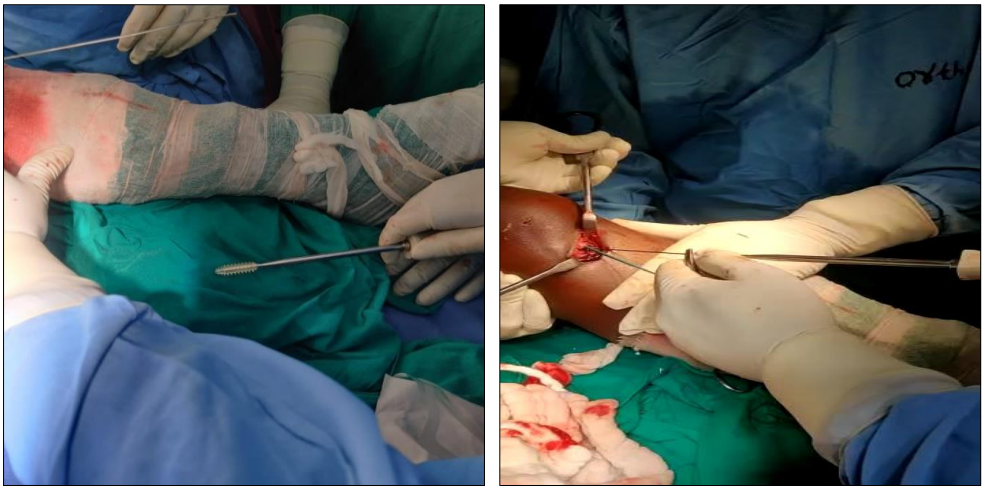

Fig 4: Graft Fixation

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Fig 5: Post-operative Stability check

Discussion

In our study, there were 60 total patients, 30 of them were in the early group and 30 in the delayed group. There is no statistically significant difference in patient ages between the two groups. Patients in groups 1 and 2 were on average 32 and 29 years old, respectively. In terms of patient sex distribution, there is no statistically significant difference between the two groups. In our investigation, the patients were mainly men. The body mass indices of the two groups are statistically identical. Group 1's BMI is 24.73, while Group 2's is 25.056. No statistically significant difference existed between the parties involved in the knee injury.

There was a noticeable difference in the two groups' injury modes. Sports injuries were the most frequent type of injury in both groups, accounting for 46% of patient injuries, followed by domestic occurrences like self-falls and traffic accidents. Meniscal damage was significantly different between groups, with group 2 demonstrating more damage than group

1. Comparatively speaking, Group 2 had more medial meniscus injuries than did Group 1. The functional scoring, however, did not show a statistically significant difference. 25 patients had an independent ACL rupture, 12 in Group 1 and 13 in Group 2, while 11 patients had an accompanying medial meniscus tear, of which 4 were in Group 1 and 7 were in Group
2. Along with ACL tears, lateral meniscus tears were observed in 14 patients; 8 of these patients were in group 1 and 4 were in group 2.

Ten individuals had combined meniscal tears on both sides. One patient had a minor tear of the medial collateral ligament. During the trial period, there were no complications including infection, haemorrhage, stiffness, or graft failure. When compared to pre-operative scores and clinically, there was a statistically significant improvement in the subjective IKDC, Tegner & Lysholm, KOOS ratings, clinically improved knee range of motion, and no indication of instability post-operatively in both groups. But there were no appreciable variations in the functional outcome. However, although group 1 had a larger score difference, statistical significance is not apparent.

Eight patients had grade 1 Lachmann and grade 1 anterior drawer’s tests at more than six months of follow-up. They received no complaints about instability, though.

IKDC score for Group 1 was 38.67 at admission and 81 at the end of six months.

IKDC score for Group 2 was 41.72 at admission and 84 at the end of six months. The T & L

score for Group 1 was 49.78 upon admission and 93.5 after six months. The T & L score for Group 2 was 48.32 upon admission and 91.54 after six months. The KOOS Symptoms score for Group 1 was 59.15 upon admission and 90.34 after six months. The admissions KOOS symptoms score was 61.03 and was 88.23 after six months for Group 2. The KOOS pain score for Group 1 was 60.04 upon admission and 92.67 after six months. The KOOS pain score for Group 2 was 59.80 upon admission and 92.88 after six months. At the time of admission, Group 1's KOOS activity of daily living score was 61.40, and it was 91.67 at the end of six months. At the time of admission, Group 2's KOOS activity of daily living score was 59.80, and it was 95.21 at the end of six months. For Group 1, the KOOS sports score was 43.93 at admission and 79.27 after six months. The KOOS sports score for Group 2 was 30.32 upon admission and 80.25 after six months. At the time of admission, Group 1's KOOS quality score was 36.21, and it was 70.34 after six months. At the time of admission, Group 2's KOOS quality score was 36.60, and it was 73.16 after six months. The KOOS total score for Group 1 was 53.70 at admission and 88.43 after six months. The KOOS total score for Group 2 was 55.06 upon admission and 89.49 after six months.

In our study, there was equivalent activity level, age, BMI, sex, and injury mode between the groups. There were no discernible differences in related injuries across the groups. 95 to 100 is considered to be an exceptional Lysholm activity score, 84 to 94 acceptable, 65 to 83 medium, and 65 poor [31]. The Lysholm score was so favourable for both Groups A and B. At the follow-up, there were no discernible differences between the groups in terms of ROM or the one-leg hopping test while kneeling. Both groups could engage in recreational sports activity, but the patients in Group A could do so at a higher degree. Lysholm score and Tegner activity level did not differ between early (within 3 weeks) and delayed reconstruction (after 6 weeks) in a 2009 Smith *et al*. review [32] comparing the outcomes of early versus delayed surgery for ACL reconstruction generally. Their groups were separated by a different amount of time than in the current study, though. In subacute and delayed reconstructions employing the bone-patellar tendon-bone (BPTB) autograft, Karlsson *et al*. [33] compared the results. Their investigation found higher levels of Tegner activity in the group who received subacute reconstructions, which was consistent with our findings at the two-year follow-up. The time period for the subacute and delayed groups in their study was comparable to ours before 12 weeks and after 12 weeks. Additionally, Karlsson *et al*. [34] reported that the delayed group suffered greater meniscal injuries, a finding that was also documented by other authors. [35] Meniscal injury enhances the chance of developing OA in the knee, as does a meniscal injury coupled with an ACL injury, as was also observed in our study. Meniscectomy and chondral injury were found to be the two most important predictors of the onset of OA, according to Keays *et al*. They also discovered that employing BPTB autografts compared to HT autografts resulted in a lower risk of developing OA, a conclusion that is also agreed upon by others. There are studies that, however, do not differentiate between the various grafts and the development of OA [36].

In a research by Levy and Meier, patients with conservatively treated ACL injuries had a 40% incidence of meniscal tears at year 1, a 60% incidence at five years, and an 80% incidence at ten years following the index injury. Similar trends were observed in the current investigation, where the incidence of medial meniscal tears at the index procedure was 33% in Group A and 60% in Group B. However, the difference was not statistically significant, which may have been caused by the inadequate patient population (type 2 errors). According to Jomha *et al*., meniscectomy rates were greater in chronically injured knees than in acutely injured knees at the time of ACL repair. These authors assert that meniscectomy is more frequently necessary in ACL-deficient knees that experience recurring trauma, such as small translations and significant instances of giving way. Other authors have also reported on this. An isolated ACL injury without accompanying meniscal damage appears to have a low incidence (0–13%) of radio graphically evident knee OA, according to seven prospective and

24 retrospective studies assessing the prevalence of OA more than 10 years after an ACL injury. ACL and meniscal injuries together were associated with a greater reported prevalence of knee OA (21–100%) in the participants. The same study also revealed that long-term prevention of knee OA cannot be achieved by ACL restoration alone. When employing the BPTB autograft, Seon *et al*. discovered that a delay of more than 6 months between the injury and reconstruction was a strong independent predictor of future OA. The condition of the knee at the time of reconstruction and the patient's willingness to endure surgery and recovery are likely to be individual factors that affect each patient's recovery at different times. The patients in the two groups were equivalent in terms of age, gender, graft type, surgical method, and rehabilitation regimen, which was one of the study's strengths. The quantity of patients hurt while playing a contact sport or the amount of pre-injury activity did not differ significantly. The length of the current study is one of its weaknesses since a long-term follow-up would have made it possible to determine whether group performed better in terms of clinical and functional result [37].

Conclusion

Anterior cruciate ligament tears in 60 patients were investigated, together with medial and lateral meniscal tears. At the time of their presentation to our hospital, they underwent arthroscopic surgery and were split into an early and a delayed group. According to our research, there is no discernible difference between the functional outcomes of the early surgery group and the delayed surgery group. Patients who received delayed surgery had greater medial meniscal tears and chondral injuries, although their functional scores eventually caught up to those of the early surgical group. In contrast, those who underwent early surgery had better stability and a quicker return to pre-injury activity levels. Finally, we would add that the patient's soft tissue condition, quadriceps strength, and strength are all factors that influence when the AACL Reconstruction should be performed. Additionally, a lengthy investigation is necessary for a more thorough evaluation.

Conflict of Interest: None.

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