ORIGINAL ARTICLE

Minimally Invasive Intramedullary Fixation of Middle third clavicular Fractures Through the Medial Entry by Titanium Elastic Nailing System (TENS)

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Abstract

Background: ***It is routine practice in sports medicine to treat injuries to the anterior cruciate ligament(ACL). Athletes and regular people alike are prone to this form of damage when they engage in incorrect fitness or workout routines.***

Aim and objectives: ***To determine the long-term success rate of anterior cruciate ligament repair(ACLR) using various graft types.***

Subjects and methods: ***Between 2010-2023, we used the following keywords to search the MEDLINE database through PubMed, EMBASE, and the Cochrane Library:ACL restoration, quadriceps tendon grafts, hamstring-tendon autografts, bone patellar tendon(BPT) autografts, peroneus longus autografts, semitendinosus tendon, and gracilis tendon autografts are all examples of tendon transplants.***

Results: ***Peroneus longus tendon(PLT) grafts were harvested from various sites, while HT grafts typically included semitendinosus and occasionally gracilis tendons. Various methods were employed, including single-bundle(anatomic and primary) and double-bundle techniques, with attention to fixation methods(e.g., press-fit fixation for HT and interference screw fixation for quadrupled HT). Complications varied, with knee stiffness reported in 20% of HT vs. 5% of PLT patients in one study. Graft ruptures occurred more frequently in the HT group(four instances) than in the PLT group(two instances). Other complications included minor wound issues and infections.***

Conclusion: ***Both HT and PLT grafts resulted in significant improvements in knee function as measured by International Knee Documentation Committee(IKDC), Lysholm, and modified Cincinnati scores, with no significant difference in outcomes between graft types. Complications such as graft rupture, knee stiffness, infections, and graft failure were reported across studies, but the overall rate of complications did not differ significantly between the graft types.***

Keywords: Grafts; ACL reconstructions; Systematic review

1. Introduction

Anterior cruciate ligament reconstruction(ACLR) relies heavily on graft selection. Here in the modern day, the most popular clinical grafts include patellar tendon autografts, single-bundle hamstring autografts, allogeneic tendon grafts, artificial grafts, and augmentations. Some doctors will recommend a particular type of graft over another. The topic of which graft would work best for ACLR is still up for discussion. When it comes to actual surgical procedures, every graft has its own set of pros and cons.[1]

When doing ACLR surgery, one of the most typical graft types is the patellar tendon autograft, which typically takes the shape of bone-patellar tendon-bone. Due to the bone plugs on both sides of the graft, it may facilitate quick healing and serve as a secure screw fixation point(if used).[2]

In order to complete ACLR, physicians now often use a single-bundle multi-strand(usually four strands) hamstring tendon autograft. Autografts from the semitendinosus and gracilis tendons are common in the hamstrings.

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Hamstring tendon autograft has been associated with fewer problems, according to several studies. But because bone plugs are usually absent on either side of a hamstring tendon autograft, the graft's stiffness might be diminished. Clinical trials comparing the two autografts are numerous, but the findings are mixed.[3]

When it comes to primary ACL reconstruction, using the peroneus longus autograft is a safe and effective treatment. As an alternate graft option, the peroneus longus tendon autograft can be suggested for single-bundle ACL restoration.[4]

Also, many ACLR doctors prefer allograft tendons over autograft tendons since the former helps patients avoid further stress during the procedure and the latter lessens the likelihood of problems or morbidities at the donor site. Certified tissue banks provide the majority of the allograft tendons utilized in ACLR. Two types of tendon allografts are utilized in ACLR: patellar and hamstring.[5]

Claims of the usage of artificial grafts or augmentations like the Leeds-Keio ligament have surfaced. While there are a few pertinent meta-analyses, research on the effects of synthetic grafts or augmentations is still lacking.[6]

The purpose of this research was to evaluate the relative long-term success of different graft types used in ACLR.

2. Patients and methods

Search strategy for identification of studies:

Between 2010-2023, we used the following keywords to search the MEDLINE database through PubMed, EMBASE, and the Cochrane Library:The following procedures are examples of tendon autografts: ACL restoration, quadriceps graft, hamstring-tendon, bone patellar tendon, peroneus longus, semitendinosus, and gracilis tendon.

Inclusion criteria:

Studies comparing the effectiveness of quadriceps tendon autograft with that of hamstring autograft(especially femoral biceps, semitendinosus, and semimembranosus) were conducted on humans. The subjects were adults(16 and up) who had never had surgery to repair their anterior cruciate ligament(ACL). The procedures in question were primary ligament reconstructions performed for either acute symptoms or chronic ACL deficiency, with or without meniscus injury. The studies were conducted between 2010-2023, and the languages used were English.

Exclusion criteria:

Research that needs to be updated ACL reconstruction for patients whose injuries, are not related to medical conditions(e.g., caused by RTAs or interpersonal fights), studies that discuss the causes of ACL reconstructive surgery failure(e.g., in the form of reviews), studies that were missing results, duplicates, or studies that followed patients for less than a year and those that looked at the effects of reconstructing other ligaments, articles published in languages other than English, studies that included knee injuries, studies that used allografts or artificial grafts in ACL reconstructions, and lastly, studies that used allografts or artificial grafts.

Outcomes measures:

IKDC scores, Lysholm scores, modified Cincinnati, Lachman test, infections, and complications.

Methods of the review:

Locating and selecting studies:

A two-step process was used to screen for eligibility: first, title/abstract screening; and second, full-text screening.

Data extraction:

Using the Rayyan software, the papers were screened in phases. Two researchers worked separately to analyze the titles and abstracts as well as the complete reading; where their findings differed, they discussed and resolved the differences between themselves. The following data was gathered following the articles' readings: publication information(author, year, and place), study design, intervention duration and follow-up, specifics regarding ACL damage, intervention(PLT vs. HT, QT vs. HT, and QT vs. BPTP), and outcome measures.

Statistical considerations:

The systematic review manager software was used to integrate the outcomes of the included studies after they were manually checked for eligibility. Based on the search results and inclusion/exclusion criteria, a PRISMA flowchart was created to help assess the potential risk of bias for each study. Data was collected using the COCHRANE Collaboration Tool for Assessing the Risk of Bias.

Evidence of publication bias:

In order to help evaluate the potential risk of bias for each study, data were gathered using the(Cochrane Collaboration tool for assessing the risk of bias), and a PRISMA flowchart was created using the search results and inclusion/exclusion criteria.

Statistical Analysis:

The method of meta-analysis was carried out utilizing the latest version of Review Manager(RevMan) [Copenhagen: The Cochrane Collaboration, 2020].

One method for determining if a randomised controlled trial was biased is the Cochrane Risk of Bias Assessment Tool. It takes a comprehensive

look at six important areas where bias might creep in: creating random sequences, hiding allocations, blinding participants and staff, blinding outcome evaluation, insufficient data on outcomes, and biased reporting. An 'other bias' category accounts for hypothetical biases not covered by the domains, such as confounding or misclassification bias. Due to its extensive and robust examination of research validity, which considers bias at both the study and outcome levels, this instrument improves the reliability and credibility of synthesis data.

The random-effects model estimated pooled effect sizes and 95% CIs for each outcome, accounting for study variability.

The I2 statistic indicates the fraction of impact estimate variance due to heterogeneity rather than chance. I2 values of 25%, 50%, and 75% indicated minimal, moderate, and high heterogeneity.

Summaries of study characteristics and conclusions were created using descriptive statistics. While percentages and frequencies were utilized for categorical variables, means and standard deviations were computed for continuous data.

3. Results

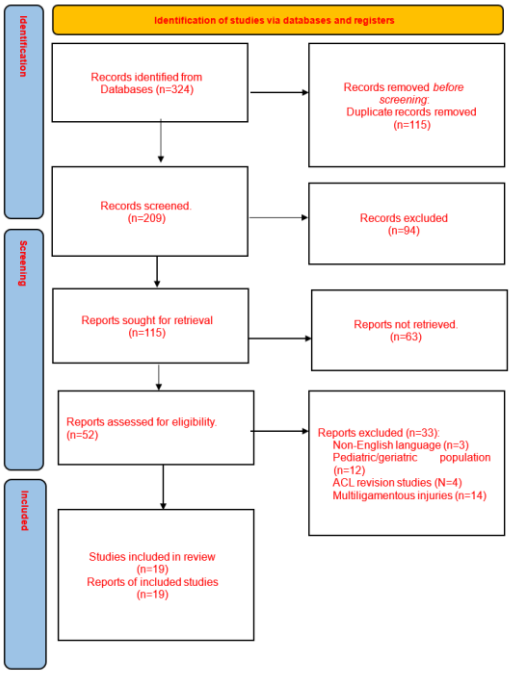

Figure 1. Study flow chart.

Regarding comparison of HT vs. PLT, a total of 8-studies focusing on ACL injuries, with research spans between 2010-2023. The studies predominantly enrolled adults with ACL deficiencies or tears, excluding those with significant comorbidities or previous knee surgeries. The age range for participants was generally 16-65-years, inclusive of both genders. All of the included cohort studies employed a prospective design(N=4), two studies were cross-sectional, and single randomized controlled trial(RCT). Study durations ranged from short-term(1-year) to long-term(10-years). The exclusion criteria across studies were consistent, focusing on excluding individuals with additional significant injuries, previous knee surgeries, systemic diseases affecting surgery or recovery, and severe chondral lesions, (Table 1).

Table 1. Features of the included research contrasting PLT and HT grafts(N=8).

STUDY	JOURNAL	POPULATION CHARACTERISTICS	DURATION OF STUDY	STUDY DESIGN	LOE
AGARWAL [7]	Cureus	Adults aged 16-50-years, both genders, with symptomatic ACL deficiency. Exclusion: joint stiffness, multi ligamentous injury, associated fractures.	June 2020-December 2021	Prospective cohort study	II
CHOUDHARI [8]	International Journal of Advanced Research (IJAR)	Patients with ACL tear. Included symptomatic individuals with ACL insufficiency, aged 18-60 years, no previous knee surgery, and a normal contralateral knee. Excluded asymptomatic individuals, systemic diseases compromising pre-anesthetic fitness, associated Grade-III MCL and LCL injuries, osteoarthritic knee/cartilage injury, patients with associated fracture of tibial plateau, patients with local skin infections, and patients unwilling to give consent	April 2021-September 2022	Cross-sectional study	III
JAIN [9]	International Journal of Medical and Biomedical Studies	Patients undergoing isolated single bundle ACL reconstruction. Inclusion criteria: Patients aged 18-45-years with ACL tear, willing to participate, and able to undergo surgery. Exclusion criteria:Previous knee surgery, peripheral vascular disease, ACL tear with other significant injuries, knee joint abnormalities, and unwillingness to give	November 2018 to October 2020	Prospective observational study	II

		consent.			
KEYHANI [10]	The Archives of Bone and Joint Surgery	Patients undergoing ACL reconstruction. Inclusion criteria:Age 18–50-years, ACL rupture. Exclusion criteria: Chondral lesions greater than grade-III, previous surgery on the affected knee, revision cases, joint hypermobility syndrome, ankle joint problems.	Hamstring group (2017-2018), Peroneus Longus group (2018-2019)	Comparative cross-sectional study	IV
RHATOMY [11]	Knee Surgery, Sports Traumatology, Arthroscopy	Patients with isolated ACL injury undergoing single-bundle ACL reconstruction, aged 16–45 years. Excluded if had associated ligament injury, chondral damage, meniscal injury, fracture around the knee, or abnormal contralateral knee.	2015-2017	Prospective observational study	II
SAEED [12]	JBJS Open Access	Patients with isolated primary ACL injury. Inclusion criteria:Age 18-51 years with isolated primary ACL injury. Exclusion criteria:Patients with meniscal injury(if not suspected on MRI), fractures of the knee and ankle, previous surgery for ACL tear, or multiligamentous knee injury.	February 23, 2017, to February 23, 2021	Prospective cohort study	II
SHI [13]	The Journal of Knee Surgery	Patients with acute ACL rupture and grade III medial collateral ligament(MCL) injury. Age range:19–65-years. Both males and females were included.	December 2002-October 2012	Prospective cohort study	II
VIJAY [14]	Journal of Orthopaedic, Trauma and Rehabilitation	Patients undergoing ACL reconstruction. Inclusion Criteria:Patients aged more than 18-years of both sexes with ACL injury. Exclusion Criteria:Previous fractures, ligament injuries or surgeries, osteoarthritic changes in the knee or ankle, neuromuscular disorders.	September 2019-May 2020	RCT	I

ACL:Anterior Cruciate Ligament; LOE:Level of Evidence; MCL:Medial Collateral Ligament; LCL:Lateral Collateral Ligament; MRI:Magnetic Resonance Imaging; RCT:Randomized Controlled Trial.

All studies employed arthroscopic single-bundle ACL reconstruction. One study specified anatomic tunnel positioning[15] and one included medial collateral ligament repair with specific suture devices.16 The diameter of hamstring autografts ranged from 7.65±0.6mm to 8.3±0.47mm across studies, with one study using quadrupled HT grafts for reconstruction. Peroneus longus autograft diameters were slightly larger on average, ranging from 8.4±0.35mm to 8.81mm. The PLT grafts were harvested from various locations, with some studies doubling the graft for reconstruction.[16] Rehabilitation protocols varied but were generally standardized within each study for both groups. Beginning on the day after surgery, patients were instructed to engage in both active and passive ROM exercises(POD)[17] as they work their way up to fully supporting their own weight and strengthening exercises. The duration of rehabilitation protocols extended beyond 10-months in one study[18] with full physical activity resumption by 1-year in another.16 Suture removal was typically performed around POD 13, and the use of a brace for walking continued up to 3-weeks post-operatively in several studies, Table2).

Table 2. Details of surgical intervention in the included studies comparing HT vs. PLT grafts(N=8).

STUDY	SURGICAL TECHNIQUE	GRAFT DETAILS	REHABILITATION
AGARWAL [7]	Arthroscopic single-bundle ACLR	PLT and HT(semitendinosus and gracilis) used for ACLR	Standardized protocol for both groups from Day 1 post-surgery to beyond 10-months
CHOUDHARI [8]	Arthroscopic ACL reconstruction	Hamstring autograft diameter:8.3±0.47mm; Peroneus longus autograft diameter: 8.4±0.35mm	Active assisted knee ROM from POD-1, full weight bearing with brace from next day, static and dynamic quadriceps strengthening exercises, suture removal on POD 13, brace continued for walking till 3-weeks post-op.
JAIN [9]	Arthroscopic single-bundle ACL reconstruction by single senior surgeon	Peroneus longus graft diameter:8.8±0.8 mm, Hamstring graft diameter:8.1±0.9 mm	Standard rehabilitation protocol for all patients
KEYHANI [10]	Arthroscopic single-bundle ACL reconstruction by single senior surgeon. Anatomic tunnel positioning.	Peroneus Longus diameter:8.71±0.4 mm, Hamstring diameter:7.65±0.6 mm	Standard post-op rehab protocol-brace, gradual weight-bearing and ROM progression.
RHATOMY [11]	Arthroscopic single-bundle ACL reconstruction	Peroneus longus graft diameter: 8.8±0.7mm, Hamstring graft diameter:8.2±0.8mm	Same rehabilitation programme for both groups, including partial weight bearing for 3-weeks post-surgery, followed by full weight bearing and knee flexion exercises.
SAEED [19]	ACL reconstruction using doubled PLT autograft; quadrupled HT(Semitendinosus and gracilis) autografts	PLT mean diameter:8.81mm.HT mean diameter:8.17mm	Same for both groups - guided physio, ROM, strength training
SHI[13]	Arthroscopic-assisted single-bundle ACL reconstruction with Endobutton fixation. MCL repaired with TWINFIX suture	PLT graft was harvested 1-1.5cm proximal from its distal insertion, used doubled. HT(semitendinosus and gracilis) graft was harvested	Started on postoperative day 2 with active knee extension and quadriceps contraction exercises, and ankle plantar and dorsiflexion exercises. Gradual increase in knee flexion over weeks. Full physical

	devices.	via standard medial approach, used quadrupled.	activity resumed by 1 year.
VIJAY [14]	ACL reconstruction. Hamstring group:Ipsilateral hamstring tendon autograft Peroneus longus group:Ipsilateral peroneus longus tendon autograft, harvested using an incision posterior to the lateral malleolus, tenodesis of PL to peroneus brevis tendon, graft prepared by separating muscle fibers and whipstitches placed at both ends.	Peroneus longus autograft:Average length 8.5-9.0cm, diameter 8.5cm	Standard physiotherapy protocol post-surgery for both groups

ACLR:Anterior Cruciate Ligament Reconstruction; PLT:Peroneus Longus Tendon; HT:Hamstring Tendon; ROM:Range of Motion; POD:Post-Operative Day

The American Orthopaedic Foot and Ankle Society(AOFAS) score, thigh circumference, Modified Cincinnati score, graft diameter, donor site morbidity, knee range of motion, IKDC score, Lysholm score, anterior drawer test, Lachman test, pivot shift test, and Tegner-Lysholm scores were among the important outcome measures used to compare HT vs. PLT grafts across eight studies. Studies found different complications; in one, only 5% of people in the PLT group and 20% of people in the HT group reported knee stiffness[1] and infections requiring arthroscopic debridement reported in both groups at a rate of 5%. Graft ruptures were more common in the HT-group with four instances compared to two in the PLT-group. Minor wound complications and one case of graft resorption at 6-months were reported in the PLT-group.[16] Additionally, one study[20] reported kneeling pain and higher infection rates in the HT-group, Table 3.

Table 3. Outcome measures and complications reported in the included studies comparing HT vs. PLT grafts(N=8).

STUDY	OUTCOME MEASURES	COMPLICATIONS
AGARWAL [7]	IKDC, Lysholm score, anterior drawer test, Lachman test, pivot shift test, AOFAS score, thigh circumference.	--
CHOUDHARI[8]	Lysholm knee score and IKDC score	Knee stiffness[Group H:4(20%), Group P:1(5%)], Infection requiring arthroscopic debridement(Group-H:1(5%), Group-P:1(5%)].
JAIN [9]	Graft diameter, IKDC score, Modified Cincinnati score, and donor site morbidity evaluated by measuring thigh circumference and ankle scoring (MRC grading and FADI Score).	No graft failures or revisions reported. One case each of mild knee effusion in both groups at 1-year.
KEYHANI [10]	IKDC score, Lysholm score, knee ROM, thigh circumference, AOFAS, FADI, ankle ROM	Some minor wound complications in PL group.
RHATOMY[11]	IKDC, Lysholm scores, graft diameter, modified Cincinnati, donor site morbidity measured by thigh circumference, and ankle scoring (AOFAS and FADI).	NR
SHI [13]	Knee stability and function assessed clinically(Lachman test, KT-2000 arthrometer) and subjectively(Tegner–Lysholm Knee Scoring Scale, IKDC Subjective Knee Form). Donor site morbidity and ankle function were also evaluated.	One patient in PLT group had graft resorption at 6-months. No other complications reported.
VIJAY[14]	Functional Outcome Measures: American Orthopedics Lysholm score, knee Modified Cincinnati scores Ankle and Foot Ankle Donor Site Morbidity Scoring:determined by utilizing a handheld dynamometer to measure the plantar flexion and eversion strength of the ankle and the flexion and extension strength of the knee	Kneeling pain in HST group; Infection rates: HST group(3-patients), PL group(1-patient), kneeling pain(6-patients in hamstring group)

IKDC:International Knee Documentation Committee;AOFAS score:American Orthopaedic Foot and Ankle Society score; MRC:Medical Research Council; FADI:Foot and Ankle Disability Index; HST group:hamstring tendon group; PL group:patellar ligament group; PLT:patellar ligament; NR:Not Reported.

4. Discussion

The results of our present study can be summarized as follows:

Gender Distribution: Most studies showed a male predominance in sample populations, with varying percentages favoring males.

Age Range: Participants were predominantly in their late 20s to early 30s across studies, with little variation between groups(Hamstring Tendon(HT) vs. Peroneus Longus Tendon(PLT) and Quadriceps Tendon(QT) vs. HT).

Body Mass Index(BMI): Reported BMI indicated slight differences between QT and HT groups, but both averages remained within the normal range.

Graft Characteristics:

Diameter: HT autograft diameters ranged between 7.65±0.6mm-8.3±0.47mm, while PLT autografts averaged slightly larger, between 8.4±0.35mm-8.81mm.

Graft Harvesting Locations:

PLT grafts were harvested from various sites, while HT grafts typically included semitendinosus and occasionally gracilis tendons. Various methods were employed, including single-bundle(anatomic and primary) and double-bundle techniques, with attention to fixation methods(e.g., press-fit fixation for HT and interference screw fixation for quadrupled HT). Complications varied, with knee stiffness reported in 20% of HT vs. 5% of PLT patients in one study. Graft ruptures occurred more frequently in the HT group(four instances) than in the PLT

group(two instances). Other complications included minor wound issues and infections.

Rehabilitation Protocols: Standardized protocols were used across studies, emphasizing early range of motion exercises and gradual progression to full weight-bearing activities.

Surgical Techniques and Complications:

ACLR Techniques: Various methods were employed, including single-bundle(anatomic and primary) and double-bundle techniques, with attention to fixation methods(e.g., press-fit fixation for HT and interference screw fixation for quadrupled HT).

Postoperative Complications:Complications varied, with knee stiffness reported in 20% of HT vs. 5% of PLT patients in one study. Graft ruptures occurred more frequently in the HT group(four instances) compared to the PLT group(two instances). Other complications included minor wound issues and infections.

Outcome Measures

IKDC Scores: Six studies, including 628 patients, showed significant postoperative improvements in IKDC scores for both graft types:

PLT Grafts: Postoperative scores ranged between 68.84±1.44-94.66±2.80.

HT Grafts. Postoperative scores ranged between 68.43±1.59-95.1±0.73.

Pooled Mean Difference: No significant difference in postoperative IKDC improvements between graft types(P=0.86).

Lysholm Scores: Similar findings were noted:

PLT Grafts: Postoperative scores ranged between 81.20±2.85-99.15±2.89.

HT Grafts: Postoperative scores ranged between 80.80±2.91-99.85±0.37.

Pooled Mean Difference: No significant difference between groups(P=0.71).

Modified Cincinnati Scores: Postoperative MCS also showed similar trends, with significant improvements for both graft types and high heterogeneity within studies.

Complications and Events:

Lachman Test Results: Minimal events for PLT grafts(1.02% for one study) compared to 10% for HT grafts. Overall, no significant difference in ACL laxity post-surgery.

Infection Rates: The pooled infection rate was 6.86% across all studies, with no significant difference between graft types(P=0.77).

Composite Complications:Rates for postoperative complications were 7.73% for PLT grafts and 6.41% for HT grafts, with no significant difference in event rates.

In a study by Agarwal et al.,[7] evaluating the functional outcomes, knee stability, donor site morbidity, and thigh muscle atrophy in patients who underwent arthroscopic single-bundle repair using PLT or HT for ACL injuries. Additionally, there was no substantial difference in the AOFAS scores between the groups; the HT group averaged 99.80±0.70 and the PLT group 99.05±3.56. However, the PLT group had a significant reduction in thigh muscle wasting at the most recent follow-up($p<0.001$). Although both graft types generated similar knee stability and functional results, and there was no obvious donor site morbidity, the PLT group recovered from thigh muscle wasting more quickly, suggesting that PL grafts are a good, safe, and effective substitute for ACL replacement.

A retrospective cohort study by Akoto et al.,[21] examined 92 patients over a 12-month period to determine the efficacy of primary ACLR with a press-fit fixation approach for quadriceps tendon(QT) grafts as opposed to conventional quadrupled HT grafts with interference screw fixation. Out of the total number of patients, 46 got HT grafts and 46 got QT grafts. Tests for knee stability(Lachman and Pivot-Shift), side-to-side difference, one-leg hop, thigh circumference, and donor site morbidity were not significantly different between the two groups in the study. A total of 85% of the QT group and 83% of the HT group tested negative using the Lachman test; 80% and 85% of the QT and HT groups, respectively, tested negative using the Pivot-Shift tests. Graft failure rates in the QT group were 7.3% lower than in the HT group, which had a rate of 9.8%.

Lee et al.,[22] evaluated the functional and joint stability results of anatomic ACL restoration using bone-quadriceps tendon(BQT) and double-bundle hamstring tendon(DBHT) autografts. Comparisons using the KT-2000 arthrometer and manual laxity tests revealed that both transplant types significantly improved the range of motion. There was a parallel improvement in both groups' subjective ratings on the International Knee Documentation Committee and the modified Lysholm. There were no changes in Tegner activity scores after surgery, and neither group differed in terms of anterior knee pain nor tunnel positioning. On the other hand, the BQT group restored flexor muscle strength more quickly. In terms of knee stability and functional results, the BQT autograft was just as effective as the DBHT autograft, and it even outperformed it when it came to recovering the strength of the flexor muscles.

In a study by Barié et al.,[23] In a prospective randomized controlled trial, 60 athletes were evaluated to compare the long-term outcomes of ACL restoration utilizing bone-patellar tendon-bone(BPTB) autografts using a hardware-free press-fit fixation approach to those of ACL reconstruction using BQT. The functional results of both graft types were excellent, with low rates of radiological degeneration, limited anterior

translation(<3mm), and high Lysholm and IKDC scores. There were no discernible variations in radiological results, stability, or function across the various graft types, and patients reported high levels of satisfaction with the procedure. In contrast to the QTB group, the BPTB group suffered from donor site morbidity, which included problems with kneeling and crouching, to a far greater extent.

Perez et al.,[24] evaluated the effectiveness of BPTB autografts over QT autografts in the treatment of primary ACL tears. There was no statistically significant difference between the BPTB and QT groups with respect to median IKDC, Tegner, or Lysholm scores. Furthermore, there was just one graft failure recorded in the QT group, and the rates of follow-up arthroscopy for arthrolysis and graft failure were identical in both groups.

Limitations: The small sample size, the availability of obtaining the full data for each study, and the short period were considered the limitations of the current study. further studies with long period of the study, and large sample size, were recommended.

4. Conclusion

Both HT and PLT grafts resulted in significant improvements in knee function as measured by IKDC, Lysholm, and modified Cincinnati scores, with no significant difference in outcomes between graft types. Complications such as graft rupture, knee stiffness, infections, and graft failure were reported across studies, but the overall rate of complications did not differ significantly between the graft types.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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Conflicts of interest

There are no conflicts of interest.

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