

Outcome of Arthroscopic Reconstruction of Anterior Cruciate Ligament Injury: A Comparison of Peroneus Longus Tendon and Semitendinosus-Gracilis Tendon Autograft

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Abstract:

Background: Outcome studies on ACL reconstruction have assessed and compared different surgical techniques.

Aim of the study: This study aimed to compare the outcomes of anterior cruciate ligament restoration with semitendinosus-gracilis tendon autograft and peroneus longus tendon autograft at 2 years post-surgery. **Methods:** This study was conducted in Department of Orthopaedics & Traumatology, TMSS Medical College & Rafatullah Community Hospital (TMC & RCH), Bogura, Bangladesh, Uttara Adhunik Medical College and Hospital, Uttara, Dhaka., Bangladesh & Enam Medical College Hospital, Savar, Dhaka, Bangladesh. A prospective examination was conducted on 50 patients with isolated anterior cruciate ligament damage who had peroneus longus tendon autograft reconstruction. Out of these, 42 patients were followed up. The semitendinosus-gracilis tendon autograft group consisted of 50 consecutive patients who met the same criteria, with 45 accessible for follow-up. All data was gathered, documented in a Microsoft Excel spreadsheet, and analyzed with descriptive statistics in SPSS 16.0. All data was collected, documented in a Microsoft Excel work sheet, and analyzed using descriptive statistics in SPSS 16.0. **Results:** Ninety percent of patients with peroneus longus tendon had good or excellent results, while 91% had good or excellent results with semitendinosus-gracilis tendon. 86% of patients in the peroneus longus tendon group were assessed as normal or if patients with ruptures or atraumatic failures were assumed to have scored grade D, then there were 82% in the peroneus longus group and 89% in the semitendinosus-gracilis tendon group scoring grade A or B. There was no significant difference between the peroneus longus and semitendinosus-gracilis tendon groups in any of the other IKDC subcategories at 2 years. In the hamstring tendon group anterior kneeling pain was present in 6% at both 1 and 2 years ($P < 0.0002$). **Conclusion:** In terms of clinical stability, range of motion, and general symptoms, patients undergoing ACL restoration with a semitendinosus-gracilis tendon graft had the same outcome as those receiving a peroneus longus tendon graft. There was no difference in the return to level I or II sports, while more peroneus longus tendon patients reached level I.

Keywords: Arthroscopic anterior cruciate ligament reconstruction, outcome, semitendinosus-gracilis tendon autograft, techniques.

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I. Introduction

Rupture of the ACL reduces knee stability, leading to trouble with sports performance, increased risk of meniscal injury [1, 2], and early degenerative joint disease [3, 4]. Repair alone produces inferior results compared to reconstruction or repair plus augmentation [4]. Anterior cruciate ligament reconstruction may enhance knee stability and lower the risk of meniscal tears, however this has not been scientifically proven. At our center, ACL reconstruction in the meniscus-retained knee was found to be more effective than ACL reconstruction with meniscectomy in terms of reducing radiologic deterioration after 7 years [5]. Various procedures for ACL replacement have been proposed and tested, such as prosthetic ligament, allograft, autograft, graft with prosthetic augmentation, and extraarticular reconstruction. Most surgeons currently favor autografts of peroneus longus or semitendinosus-gracilis tendon, with extraarticular repair being infrequently employed [6]. Furthermore, studies have shown no difference in results when an extraarticular augmentation was added to an intraarticular peroneus longus tendon graft [7]. Open and arthroscopic techniques of graft substitution have been compared but have not shown significant differences in outcome, although open and arthroscopic reconstruction with semitendinosus-gracilis tendons has not been compared [8]. Outcome studies on ACL restoration have focused on assessing and comparing surgical techniques. Similarly, studies have compared groups with peroneus longus or semitendinosus-gracilis tendon grafts [9]. Aglietti et al. [4] Otero and Hutcheson [10] used interference screw aperture fixation for peroneus longus tendon grafts and outside suspensory fixation for semitendinosus-gracilis tendon grafts. We compared peroneus tendon and single-strand semitendinosus-gracilis tendon in "over the top" posture with different extraarticular reconstructions. Marder et al. [11] found no significant difference in outcome between groups using matched fixation for both transplant types. This study, along with others, included patients with meniscal tears, chondral lesions, and other ligament injuries, as well as those who underwent revision ACL surgery. To properly evaluate these research, it's important to consider various fixation systems, surgical approaches, intraarticular lesions, and transplant sources. Our study analyzes the clinical outcomes of ACL restoration using the four-strand semitendinosus-gracilis tendon autograft and peroneus longus tendon autograft at 2 years post-surgery. The study aimed to demonstrate that arthroscopic repair with either graft can achieve satisfactory results when placed anatomically and anchored with an interference screw.

II. Methodology

This study was a prospective study conducted in Department of Orthopaedics & Traumatology, TMSS Medical College & Rafatullah Community Hospital (TMC & RCH), Bogura, Bangladesh, Uttara Adhunik Medical College and Hospital, Uttara, Dhaka., Bangladesh & Enam Medical College Hospital, Savar, Dhaka, Bangladesh. From 2022 to 2024, our center's recommended ACL restoration procedure was arthroscopic implantation of a central-third peroneus longus tendon autograft with interference screws for femur aperture fixation and tibia near-aperture fixation. After 2023, semitendinosus-gracilis tendon autografts were employed, which involved extracting and doubling the ipsilateral gracilis and semitendinosus tendons. The graft was inserted using the arthroscopic approach and secured with interference screws. After both methods, we performed accelerated early rehabilitation without bracing. After 2022, outcome assessment became standardized and prospective for auditing results. Patients with an isolated anterior cruciate ligament damage underwent identical arthroscopic surgery, with the exception of the grafts. A prospective examination was conducted on 50 patients with isolated anterior cruciate ligament damage who had peroneus longus tendon autograft reconstruction. Out of these, 42 patients were followed up. The semitendinosus-gracilis tendon autograft group had 50 consecutive patients who matched the same criteria, with 45 available for follow-up. All data was gathered, documented in a Microsoft Excel spreadsheet, and analyzed with descriptive statistics in SPSS 16.0.

III. Result

Patients with isolated ACL injuries were separated from bigger groups. There were 50 patients in the peroneus longus tendon group (27% of 185) and 50 in the semitendinosus-gracilis tendon group (24% of 208) who underwent peroneus longus tendon graft reconstruction. Thus, ACL injuries that were not isolated accounted for approximately 73% to 76% of cases. Ninety percent of patients with peroneus longus tendon had good or excellent results, while 91% had good or excellent results with semitendinosus-gracilis tendon (Table-1). The IKDC assessment combines symptoms and signs. Overall, 86% of patients in the peroneus longus tendon group were assessed as normal or if patients with ruptures or atraumatic failures were assumed to have scored grade D, then there were 82% in the peroneus longus tendon group and 89% in the semitendinosus-gracilis tendon group scoring grade A or B. Further analysis of the subcategories is given below with IKDC grades in parentheses (Table-2). The activity level category is shown in Table-3. At the time of first examination the patients reported their preinjury activity level; there was no difference between groups, with over 90% involved in strenuous activities. Before surgery, 70% of the peroneus longus tendon group and 82% of the semitendinosus-gracilis group

could participate only at the light or sedentary level of activity, that is, levels III or IV. At 1 year 73% in the peroneus longus tendon group and 70% in the semitendinosus-gracilis tendon group were already participating at activity level I or II, that is, moderate to strenuous activity, with about 50% in each group back to strenuous activity. Within two years, 84% of the peroneus longus tendon group and 74% of the semitendinosus-gracilis tendon group achieved level I or II (chi-square, $P=0.1$, not significant). However, if the focus of analysis is applied to attainment of level I sport versus attainment of levels II, III, or IV, a chi-square analysis of these numbers yields a significance of $P=0.01$, indicating that significantly more of the peroneus longus tendon group achieved level I. There was no significant difference between the peroneus longus tendon and semitendinosus-gracilis tendon groups in any of the other IKDC subcategories at 2 years. Table-4 shows there was significantly greater thigh atrophy in the peroneus longus tendon group than in the semitendinosus-gracilis tendon group at 1 year, although, with a high percentage in each group at 10 mm or less, the actual difference is small. By 2 years the difference between groups was no longer significant, with 81% of the peroneus longus tendon group and 75% of the semitendinosus-gracilis tendon group having less than 10-mm difference in thigh circumference. The KT-1000 arthrometer data at 49 N were available for 21 patients in the peroneus longus tendon group and for 35 patients in the semitendinosus-gracilis tendon group (Table-5). Table-6 shows the most unambiguous difference between the two groups. The percentage of patients with anterior kneeling pain in the peroneus longus tendon group decreased from 55% at 1 year to 31% at 2 years. In the semitendinosus-gracilis tendon group anterior kneeling pain was present in 6% at both 1 and 2 years ($P < 0.0002$).

Table-1: Lysholm knee scores for patients with peroneus longus or semitendinosus-gracilis tendon autografts

Score (points)	Peroneus longus tendon				Semitendinosus-gracilis tendon			
	Tested		Total		Tested		Total	
	N	(%)	N	(%)	N	(%)	N	(%)
Excellent (95–100)	26	(65)	26	(62)	24	(62)	24	(59)
Good (84–94)	9	(25)	9	(24)	12	(29)	12	(27)
Fair (65–83)	4	(9)	4	(9)	3	(6)	3	(6)
Poor (<65)	1	(2)	2	(5)	2	(3)	6	(7)
Median Lysholm score	95				95			
Interquartile range	10				10			

Table-2: Overall IKDC grades for patients with peroneus longus or semitendinosus-gracilis tendon autografts

Rating	Peroneus longus tendon				Semitendinosus-gracilis tendon			
	Tested		Total		Tested		Total	
	N	(%)	N	(%)	N	(%)	N	(%)
A (normal)	37	(48)	37	(46)	31	(40)	31	(38)
B (nearly normal)	29	(38)	29	(36)	41	(53)	41	(51)
C (abnormal)	7	(9)	7	(9)	4	(5)	4	(5)
D (severely abnormal)	4	(5)	7	(9)	1	(2)	5	(6)

Table-3: Activity Levels in 37 Patients with Peroneus longus Tendon (PT) or semitendinosus-gracilis Tendon (ST) Autografts and 2-Year Follow-up Results

Level	Preinjury N (%)		Presurgery N (%)		1-year follow-up N (%)		2-year follow-up N (%)	
	PT	ST	PT	ST	PT	ST	PT	ST
I. Strenuous	32 (94)	30 (91)	10 (22)	14 (10)	15 (55)	19 (49)	24 (70)	21 (51)
II. Moderate	4 (5)	5 (6)	3 (8)	3 (8)	7 (18)	8 (21)	7 (14)	7 (23)
III. Light	0 (0)	0 (0)	2 (6)	3 (8)	9 (22)	8 (21)	4 (9)	4 (14)
IV. Sedentary	1 (1)	2 (3)	22 (64)	17 (74)	6 (5)	2 (9)	2 (7)	5 (12)

Table-4: Thigh Atrophy Difference at 1-Year Follow-up for Patients with Peroneus longus and semitendinosus-gracilis tendon grafts

Difference	Peroneus longus tendon		Semitendinosus-gracilis tendon	
	N	(%)	N	(%)
<10 mm	41	(53)	47	(73)
10–20 mm	35	(46)	18	(23)

>20 mm	1	(1)	3	(4)
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Table-5: Mean and 95% Confidence Limits for KT-1000 Arthrometer Results (Side-to-Side Difference in Millimeters) at 49 N of Force

Patients	Peroneus longus tendon	Semitendinosus-gracilis tendon
Overall	1 (0.8–1.2)	1.7 (1.5–1.9)
Male	0.9 (0.6–1.2)	0.9 (0.7–1.1)
Female	1.0 (0.7–1.3)	2.5 (2.2–2.8)

Table-6: The percentage of patients experiencing knee pain in the peroneus longus and semitendinosus-gracilis tendon groups at 1- and 2-year follow-up

Location of Pain	Peroneus longus tendon group		Semitendinosus-gracilis tendon group	
	1 year	2 year	1 year	2 year
Anterior	55	31	6	6
Other	1	1	1	0
None	44	68	93	94

IV. Discussion

In orthopaedic clinical research, four types of bias are commonly observed: susceptibility, performance, detection, and transfer [12]. This study reduces susceptibility bias by matching groups, performance bias by matching surgeons, graft placement, fixation, rehabilitation, and follow-up, detection bias by utilizing similar outcome evaluation, and transfer bias by having a high follow-up rate. The outcome comparison accurately assesses the differences between the graft and harvest. The percentage of patients with ACL reconstruction who sustained an isolated ACL injury (27% in the peroneus longus tendon group and 24% in the semitendinosus-gracilis tendon group) is slightly lower than the 30.6% (22 of 72) reported by Sgaglione et al. [13], despite the fact that their patients all underwent acute reconstructions. The IKDC and Lysholm scores indicated adequate recovery and patient subjective assessment. Despite graft failures, 86% of patients had good or exceptional Lysholm scores. Additionally, 82% of peroneus longus tendon and 89% of semitendinosus-gracilis tendon patients had normal or nearly normal IKDC scores. The activity level scores were promising. After surgery, almost 50% of patients who had previously engaged in rigorous activity were able to resume it within a year. A limited fraction of "poor" Lysholm score findings did not indicate objective graft loosening. Otero and Hutcheson [10] discovered that the semitendinosus-gracilis tendon graft was less effective than the peroneus longus tendon graft in terms of laxity, as measured by Lachman and KT-1000 arthrometer tests. The peroneus longus tendon graft was anatomically attached with an interference screw, whereas the semitendinosus-gracilis tendon graft was held by suspensory fixation with a femoral post, suture, and tibial screw and washer outside the tunnel. This highlights the limitations of different grafts and anchoring procedures. Despite laxity in the study, Lysholm ratings did not differ significantly. Our investigation found a slight increase in KT-1000 arthrometer readings, even after controlling for fixation technique variance. Lysholm scores indicate that laxity of a minor magnitude is not directly related to clinical result (92% peroneus longus tendon patients and 94% semitendinosus-gracilis tendon patients with 5 mm or less side-to-side difference). The significance of slight changes in KT-1000 arthrometer scores is questionable, as they associated poorly with activity level, IKDC score, and Lysholm score. The KT-1000 arthrometer revealed a mean difference of 1.2 mm for patients at level I, 1.8 mm for level II, 1.2 mm for level III, and 1.3 mm for level IV, depending on their sports level. Marder et al. [11] compared patients undergoing peroneus longus tendon or four-strand semitendinosus-gracilis tendon reconstruction. The study involved individuals with persistent ACL injuries, meniscectomy, and chondral injury. Suspensory fixation was utilized for both types of graft. After an average follow-up of 29 months, both groups showed similar benefits. Marder et al. [11] predicted that semitendinosus-gracilis tendon grafts, 14-mm peroneus longus tendon grafts, and normal ACLs should have equivalent tensile strengths when tension is applied evenly throughout each arm of the semitendinosus-gracilis tendon graft. In cadaver experiments, Steiner et al. [14] discovered that semitendinosus-gracilis tendon grafts, 10-mm peroneus longus tendon grafts, and natural ACLs all had equivalent strength levels. An evenly tensioned semitendinosus-gracilis tendon transplant can fail at a strain of around 4500 N [15]. This exceeds the stated values for a 10-mm peroneus longus tendon graft (2646 N) [16] and an undamaged ACL (1725 N) [17]. At one year, semitendinosus-gracilis tendon restoration resulted in much less thigh atrophy than peroneus longus tendon reconstruction, indicating that quadriceps muscle regeneration may progress more quickly. McDaniel and Dameron found that untreated ACL injuries had the greatest results when the thigh circumference was equal or bigger [16]. Brown et al. suggested earlier quadriceps muscle recovery after semitendinosus-gracilis tendon replacement, and other studies have found no reduction in semitendinosus-gracilis muscle strength after rehabilitation [15, 18]. Yasuda et al. [18] found that 3 months following graft harvest from the uninjured leg,

isometric semitendinosus-gracilis muscle strength recovered to 100% on average. The difference between endon groups was not statistically significant. Marder et al. [11] found no significant difference in knee pain as a symptom between peroneus longus tendon and semitendinosus-gracilis tendon groups, despite the fact that 11% of peroneus longus tendon patients had lower-pole peroneus longus tenderness compared to none in the semitendinosus-gracilis tendon group. Our groups were also similar in this regard. However, the subject of kneeling pain showed a significant difference. Our peroneus longus tendon study found that 56% of patients experienced anterior knee discomfort at one year following surgery and 31% experienced kneeling pain at two years. This finding validates the unresolved issue described by O'Brien et al. [7].

Limitations of the study

The study featured a single focus point and minimal sample sizes. As a result, the study's conclusions may not completely reflect the entire situation.

V. Conclusion & Recommendation

In terms of clinical stability, range of motion, and general symptoms, patients undergoing ACL restoration with a semitendinosus-gracilis tendon graft had the same outcome as those receiving a peroneus longus tendon graft. There was no difference in the return to level I or II sports, while more peroneus longus tendon patients reached level I. Female patients in the semitendinosus-gracilis tendon group showed higher laxity, as measured by KT-1000 arthrometer and Lachman tests. The semitendinosus-gracilis tendon group showed decreased thigh atrophy in the first year, indicating faster quadriceps muscle recovery. However, this difference was not significant after two years. The semitendinosus-gracilis tendon group experienced decreased graft harvest site morbidity, as evidenced by less kneeling pain after 1 and 2 years.

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