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Anterior Cruciate Ligament Reconstruction: Isolated All-Inside ST4 vs All-Inside ST4 + Complementary Lateral Tenodesis with Fascia Lata Preliminary Results from 41 Cases

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Abstract

Introduction: Residual rotational instability after anterior cruciate ligament (ACL) reconstruction remains a challenge for orthopedic surgeons, particularly in high-demand populations. This study aims to evaluate the benefit of an additional anterolateral tenodesis alongside ACL reconstruction using quadrupled semitendinosus.

Methods: A retrospective study comparing two groups (group 1: isolated ACL ligamentoplasty with DT4; group 2: ACL ligamentoplasty with anterolateral tenodesis using fascia lata) with a minimum follow-up of 12 months. The primary outcome measure was rotational stability, assessed by the pivot-shift test.

Results: Demographic data were comparable between groups. At 12 months, group 2 showed better rotational stability, with 94% of pivot-shift tests negative compared to 68.2% in group 1 (p = 0.033), representing an 83.9% relative risk reduction (95% CI [25.6% - 97.7%]). No significant difference was observed for the Lachman test. Functional scores favored group 2 but were not

significant (IKDC: 85.9 ± 7.2 vs 82.6 ± 8.1, p = 0.179; Lysholm: 91.7 ± 6.0 vs 88.9 ± 7.1, p = 0.195). Complete return to activities was higher in group 2 (73.7% vs 54.5%, p = 0.219). We observed two recurrent ruptures in group 1, with no ruptures in group 2 (p = 0.177), which remained non-significant. Subgroup analysis revealed more pronounced benefits in patients under 30 and those with a high pre-injury activity level.

Conclusion: Despite a slight increase in operative time and a risk of pain at the lateral graft site, the benefit/risk ratio of adding an anterolateral tenodesis appears favorable for military personnel and high-level athletes.

Keywords: anterior crucial ligament- lateral tenodesis- semitendinous tendon- facia lata tendon -pivot-shift

Introduction

Residual rotatory instability after anterior cruciate ligament (ACL) reconstruction remains a challenge for orthopedic surgeons. Indeed, the rate of this instability is 17-25% in military patients and 10-15% in civilians [1-2]. This residual pivot shift, when it persists, compromises optimal functional recovery, particularly during high-intensity activities.

Although reconstruction of the anterior cruciate ligament using quadrupled semitendinosus remains a modern technique, the rate of residual rotatory instability is not negligible, especially in the high-demand athletic population. This necessitates perfect ligament reconstruction to optimize functional outcomes. The aim of our study is to evaluate the benefit of adding a complementary anterolateral tenodesis in ACL reconstruction by comparing the short-term clinical and functional results of two techniques.

Materials and Methods

This is a single-center retrospective study comparing two groups (1 and 2) between March 2023 and October 2024, with a minimum follow-up of 12 months. Sample size calculation required at least 38 patients.

Inclusion criteria

- Age between 18 and 45 years
- Active military personnel or high-level athletes
- ACL rupture
- Unilateral
- Reconstruction technique using DT4 with or without fascia lata
- 12-month follow-up

Exclusion criteria

- Other ligament ruptures
- History of knee surgery
- Advanced cartilage damage (stage 3-4)
- Other reconstruction techniques
- Incomplete records

41 patients were ultimately included in the analysis.

All consents were given.

Group 1: 22 patients operated using the DT4 technique

Group 2: 19 patients operated using the DT4 technique with anterolateral tenodesis using fascia lata.

The distribution was non-randomized since the choice of technique was adopted according to the chronological evolution of reconstruction practice.

Surgical technique

Arthroscopic anterior cruciate ligament reconstruction - All-Inside using quadrupled semitendinosus with femoral and tibial fixation using endobuttons (fig 1). Anterolateral tenodesis was performed using fascia lata left pedicled on Gerdy's tubercle and fixed behind the lateral epicondyle with an interference screw (fig2). The meniscal tears were treated by suturing (fig3) , smoothing (fig4) , or capsular reinsertion (fig5)

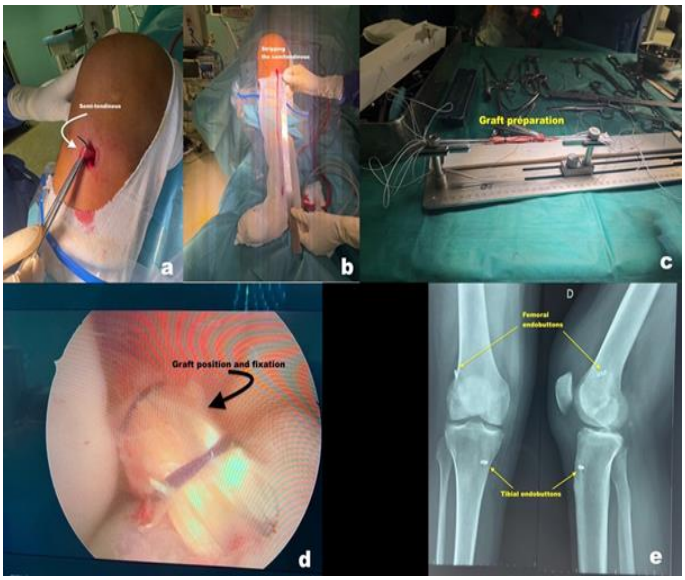

Figure 1: A patient operated on for anterior crucial ligament reconstruction using a folded semi tendinous: (a) Identification of the semi tendinous tendon (b) stripping of the tendon (c) preparation of the graft € postoperative fixation control.

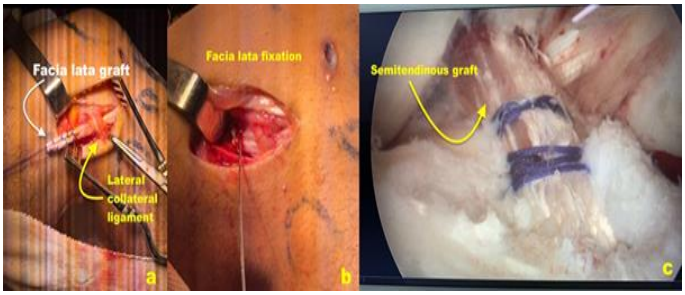

Figure 2: Procedure for anterolateral tenodesis using fascia lata tendon: (a) preparation of the tendon and passage beneath the lateral collateral ligament (b) fixation proximally and posteriorly relative to the lateral femoral epicondyle (c) associated semi tendinous graft.

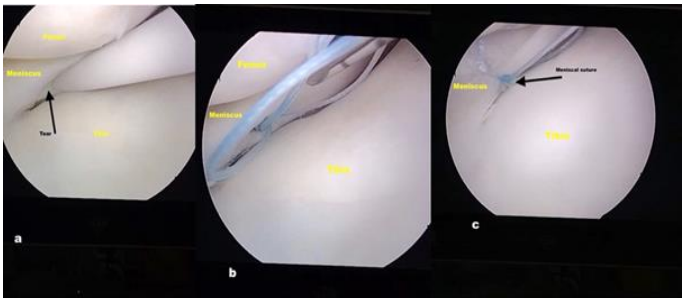

Figure 3: Meniscal suture.

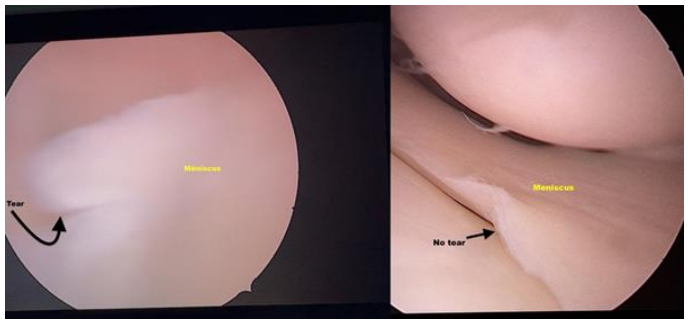

Figure 4: Meniscal smoothing.

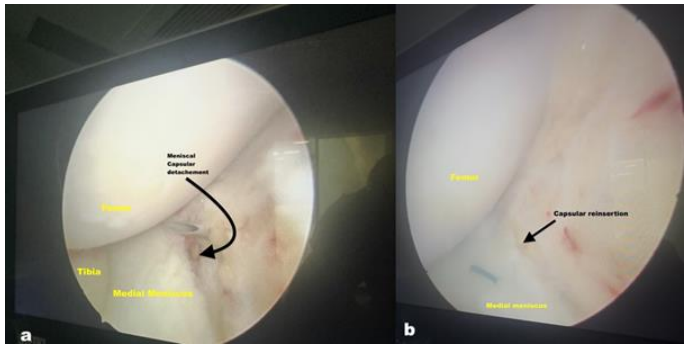

Figure 5: Capsular reinsertion of a medial meniscus detachment.

Rehabilitation protocol

The postoperative functional rehabilitation protocol was the same in both groups.

Patient evaluation

Patients were evaluated by the same evaluator preoperatively and at 6 and 12 months after surgery:

- Clinical: Lachman, pivot-shift, range of motion, muscle strength
- Functional: subjective IKDC, Lysholm, Tegner, return to activities, time to return
- Complications

Statistical analysis

- SPSS software [21].
- Tests used: Shapiro-Wilk test, Student's t-test, Mann-Whitney test, Chi-square test, logistic regression test, ANOVA test, post-hoc test
- Significance = $p< 0.05$; CI = 95% For statistical analyses: they were performed with intention-to-treat.

For missing data: the last observation carried forward method was adopted (although rare)

Demographic and preoperative data: Demographic and preoperative characteristics were collected. All parameters were statistically evaluated and no significant difference was found.

Table 1: Demographic and preoperative data

Parametres		Group 1	Group 2	P value
Age		28,4 ± 3,4	29,1 ± 7	0,653
Sex (M/F)		20/2	18/1	0,625
BMI(kg/m$^{2)}$		24,3 ± 2,1	21,8 ± 2,4	0,473
Side (R/L)		13/9	11/8	0,672
Trauma delay-surgery		4,8 ± 2,3	5,2 ± 2,1	0,568
Mechanism	Sport	16	15	0,758
	Military activity	5	4	
	Road traffic accident	1	0	
Meniscal lesions :	Medial	5	6	0,71
	Lateral	4	1	
	Both	0	2	
Pivot-shift	G0	5	1	0,137
	G1	13	11	
	G2	4	7	
Lachman	G0	2	1	0,546
	G1	15	11	
	G2	5	7	
Joint mobility		0-132 ± 7,2	0-130 ± 7,8	0,385
Quadriceps strength		72,8 ± 8,3	71,5 ± 8,6	0,612
Hamstring strength		78,4 ± 7,2	77,9 ± 7,5	0,825
Preoperative Tegner		3,1± 0,9	2,9 ± 1,0	0,504
Pre-injury Tegner		6,8±0,7	6,9±0,6	

The proportion of men was high in both groups, as men engage more in intense physical activities than women. The average time between trauma and surgery was approximately 5 months. Meniscal lesions were relatively similar in both groups without significance. Preoperative pivot-shift tended to be higher in group B. Sensitivity analysis taking this factor into account returned without significance

Operative data:

Table 2: Operative data

Paramètres		Group 1	Group 2	P value
Operative duration		71,8 ± 12,9	93,6 ± 13,5	<0,001
Graft diametre		8,2 ± 0,6	8,1 ± 0,5	0,491
Meniscal procedure	none	13	8	0,813
	Partial Menisectomy	6	7	
	Meniscal suture	3	4	
complications		2	1	0,915

The operative duration was longer in group 2, which is statistically significant. This additional time is explained by the addition of complementary anterolateral tenodesis. Graft diameters were comparable between the two groups. No statistically significant difference regarding meniscal procedures. Intraoperative complications were relatively rare and without statistical significance.

Results & Discussion

Clinical and functional results were collected at 6 months and 12 months postoperatively.

Table 3: Clinical and functional results at 6 months and 12 months:

Paramètres		Group 1	Group 2	P value	IC=95% de la difference
6 mois					
Pivot-shift	G0	17(77,2%)	18(94%)	0,043	
	G1	4	1		
	G2	1	0		
Lachman	G0	16	15	0,526	
	G1	5	4		
	G2	1	0		
IKDC		74,2 ± 8,3	76,5 ± 7,9	0,362	[-7,3 ; 2,7]
Lysholm		83,6 ± 7,4	85,2 ± 6,8	0,473	[-6,1 ; 2,9]
Tegner		5,7 ± 1,0	4,3 ± 0,8	0,707	[-0,6 ; 0,4]
Joint mobility		0-125 ± 8,2	0-128 ± 7,5	0,211	[-7,8 ; 1,8]
Quadriceps Strength		76,3 ± 8,4	78,1 ± 7,9	0,468	[-6,7 ; 3,1]
Hamstring strength		82,5 ± 6,8	84,2 ± 6,4		0,405
12 mois					
Pivot shift	G0	15(68%)	18(94%)	0,033	
	G1	6	1		
	G2	1	0		
Lachman	G0	17	16	0,428	

	G1	4	3		
	G2	1	0		
IKDC		82,6 ± 8,1	85,9 ± 7,2	0,179	[-8,1 ; 1,5]
Lysholm		88,9 ± 7,1	91,7 ± 6,0	0,195	[-7,1 ; 1,5]
Tegner		5,7 ± 1,0	6,1 ± 0,9	0,186	[-1,0 ; 0,2]
Joint mobility		0-132 ± 6,1	0-135 ± 5,4	0,092	[-6,5 ; 0,5]
Quadriceps strength		76,3 ± 8,4	89,3 ± 6,8	0,183	[-7,2 ; 1,4]
Hamstring strength		91,6 ± 5,3	93,8 ± 4,9	0,165	[-5,3 ; 0,9]
Resumption of activities	complete	12	14	0,219	
	partial	9	5		
	Not resumed	1	0		
Resumption delay		9,8 ± 2,1	9,2 ± 1,9	0,327	[-0,6 ; 1,8]

Pivot shift

At 6-month follow-up, a statistically significant difference (p=0.043) was noted regarding the pivot shift test between the two groups: 94% negative in group 2 compared to 77.2% in group 1. At 12-month follow-up, this significant difference persisted (94% in group 2 vs 68% in group 1, p=0.033). The relative risk of having a positive pivot shift was reduced by 83.9% in the second group (RR=0.16; CI=95% [0.023-0.744]). For the Lachman test, an improvement was noted in the second group but remained non-significant. Multivariate analysis adjusting for potential confounding factors, such as age, preoperative pivot-shift grade, and presence of meniscal lesions, confirms the effect of adding complementary anterolateral tenodesis on improving rotatory stability (adjusted OR=8.10; 95% CI [1.15-57.05]; p=0.036). A Subgroup analysis taking into account age showed that in patients under 30 years (n=24), the difference in negative pivot-shift rate between the two techniques was clearer (100% for group 2 vs 61.5% for group 1, p=0.023). Also, for high pre-injury Tegner level (≥7, n=18), the advantage of anterolateral tenodesis was more visible in terms of return to previous activity level but without significant threshold (77.8% for group 2 vs 44.4%, p=0.097). Analysis, taking into account meniscal status, confirms that the superiority of group 2 in terms of rotatory stability is independent of the presence or absence of associated meniscal lesions. The result is compatible with data from recent studies that have proven the effectiveness of complementary anterolateral tenodesis to ACL ligamentoplasty for controlling residual rotatory instability[3] found that adding a complementary lateral tenodesis allowed better control of internal tibial rotation, particularly at significant degrees of flexion. Sonnery-Cottet et al. [2] also found a reduction in the rate of positive pivot-shift in patients with combined reconstruction, which was statistically significant with 90.2% negative tests compared to 77.8% in the isolated ligamentoplasty group, similar figures to our study. We note an interesting fact in our study, which is the deterioration of the pivot shift in the isolated ligamentoplasty group between 6 months and 12 months postoperatively (from 77.3% to 68.2% grade 0) without deterioration in group 2 (94.7%). This phenomenon could be explained by the fact that the graft undergoes remodeling and progressive elongation subjected to

significant rotational constraints in these patients when resuming activities. The improvement in rotatory stability is relevant for the athletic or military population, whose activities frequently impose pivot movements, abrupt changes in direction, and activities on unstable terrain. Similarly, Belk et al.[4] emphasized that rotatory stability is a determining factor for returning to operational activities in the military.

Complications

Table 4: Complication rates

Parametres	Group 1	Group 2	P value
Recurrent rupture	2	0	0,177
Infection	0	0	-
hematoma	1	2	0,915
arthrofibrosis	0	1	0,277
Persistent anterior pain	2	1	0,347
Pain at the harvest site	2	3	0,631
Lateral pain	0	2	-
Reoperation	3	1	0,39

Two iterative ruptures were found in group 1, occurring at 8 and 11 months after ligamentoplasty concomitant with resumption of sports activities, compared to none in group B (p=0.177) but without statistical significance. The absence of iterative rupture in group 2 compared to group 1 deserves to be highlighted. Although the result is not significant, this difference shows an absolute risk reduction of 9.1% (95% CI [-0.3% to 21.1%]) and a number needed to treat of 11 for the prevention of one iterative rupture. Post-hoc power analysis shows that a sample size of 70 patients is needed to reach significance threshold with 80% power. A meta-analysis by Grassi et al.[5] with a considerable sample, showed that anterior cruciate ligament reconstruction associated with anterolateral tenodesis significantly reduces the risk of iterative rupture (OR = 0.38, 95% CI [0.21-0.64], p<0.01). Similarly, the STABILITY multicenter randomized study by Getgood et al. [6] found an iterative rupture rate of 11% for isolated ACL reconstructions compared to 4% for ACL reconstructions with anterolateral tenodesis (p=0.03).

Joint moblity and muscle strength

The results showed improved mobility with almost complete recovery at 12 months. For muscle strength, a favorable trend was noted for group 2, but without statistical significance.

IKDC, Lysholm scores and activity level (Tegner)

Their values were relatively higher in the second group at 6 and 12 months, without reaching significant threshold.

Two patients in group 2 presented persistent pain at the fascia lata harvest site. This complication is found in several studies [7-9]. A multivariate logistic regression analysis, including covariates such as age, activity level, and associated lesions, proved the absence of significant increased risk of complications in group 2 (adjusted OR=0.82; 95% CI [0.17-3.95]; p=0.804). Our study had Strengths and limitations as follows:

Strengths

- Power calculation for the primary judgment criterion: pivot-shift
- Multimodal evaluation

- Complete follow-up of all patients with minimum 12-month follow-up
- Rigorous statistical analyses including multivariate analyses with adjustment and subgroup analyses
- Results consistent with current literature

Limitations

- Retrospective nature
- Absence of randomization with potential selection bias, although reduced by chronological evolution of practice
- Small sample size
- Evaluator not blinded to the technique used
- Need for laximeter data for objective measurement of laxity
- Relatively short average follow-up

We acknowledge these methodological limitations, which is why we have presented these results as preliminary. However, these results have allowed us to formulate hypotheses, guide, and direct a multicenter randomized prospective study.

Conclusion

The originality of our approach lies in the combination of all-inside DT4 ACL reconstruction with complementary lateral tenodesis, allowing to benefit from the advantages of the All-Inside technique while improving rotatory stability in a statistically significant way.

In total, the benefit/risk ratio of adding external rotation therefore appears favorable in the military or high-level athletic population, in terms of significant improvement in rotatory stability with a tendency to reduce iterative ruptures.

References

1. Cameron KL, Owens BD. The burden and management of sports-related musculoskeletal injuries and conditions within the US military. Clin Sports Med. 2018;33(4):573-589.
2. Sonnery-Cottet B, Saithna A, Cavalier M, et al. Anterolateral Ligament Reconstruction Is Associated With Significantly Reduced ACL Graft Rupture Rates at a Minimum Follow-up of 2 Years: A Prospective Comparative Study of 502 Patients From the SANTI Study Group. Am J Sports Med. 2017;45(7):1547-1557.
3. Inderhaug E, Stephen JM, Williams A, Amis AA. Biomechanical Comparison of Anterolateral Procedures Combined With Anterior Cruciate Ligament Reconstruction. Am J Sports Med. 2017;45(2):347-354.
4. Belk JW, Kraeutler MJ, Purcell JM, McCarty EC. Anterior Cruciate Ligament Reconstruction in the Military Population. J Knee Surg. 2020;33(2):134-138.
5. Grassi A, Macchiarola L, Filippini M, et al. Anterolateral Ligament Reconstruction Versus Extra-articular Tenodesis in Combination With Anterior Cruciate Ligament Reconstruction: A Systematic Review. Am J Sports Med. 2022;50(1):274-281.
6. Getgood AMJ, Bryant DM, Litchfield R, et al. Lateral Extra-articular Tenodesis Reduces Failure of Hamstring Tendon Autograft Anterior Cruciate Ligament Reconstruction: 2-Year Outcomes From the STABILITY Study Randomized Clinical Trial. Am J Sports Med. 2020;48(2):285-297.
7. Helito CP, Sobrado MF, Giglio PN, et al. Combined Reconstruction of the Anterolateral Ligament in Patients With Anterior Cruciate Ligament Injury and Ligamentous Hyperlaxity Leads to Better Clinical Stability and a Lower Failure Rate Than Isolated Anterior Cruciate Ligament Reconstruction. Arthroscopy. 2019;35(9):2648-2654.
8. Ibrahim SA, Shohdy EM, Marwan Y, et al. Anatomic Reconstruction of the Anterior Cruciate Ligament of

the Knee With or Without Reconstruction of the Anterolateral Ligament: A Randomized Clinical Trial. Am J Sports Med. 2017;45(7):1558-1566.

9. Thaunat M, Clowez G, Saithna A, et al. Reoperation Rates After Combined Anterior Cruciate Ligament and Anterolateral Ligament Reconstruction: A Series of 548 Patients From the SANTI Study Group With a Minimum Follow-up of 2 Years. Am J Sports Med. 2017;45(11):2569-2577.