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A comparative study of iliotibial band tenodesis for extra-articular augmentation of ACL reconstruction using staple versus interference screw

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***Abstract*---**Background: Rotational laxity has been demonstrated to persist, even in the face of a well-performed Anterior Cruciate Ligament (ACL) reconstruction. The iliotibial band (ITB) has also been shown to have an impact on the control of anterolateral rotational laxity. In particular, recent research would suggest that the capsulo-osseous layer of the ITB, is a major contributor to anterolateral rotational control. Methods: From December 2018 to December 2020, a prospective randomized (simple randomization) analytical clinical study was done to compare the functional outcome of group of patients undergoing ITB for extra articular augmentation of ACL Reconstruction using staple versus group of patients using interference screw. Results: Upon comparing the postoperative, the primary finding is there was significant improvement of pivot shift in both groups with (100 % grade A pivot shift) in group A and (85 % grade A pivot shift) and (15% grade B pivot shift) in group B. So, the primary finding in this study is significant rotational control. The secondary finding is there was statistically significant difference in the postoperative IKDC objective score between the 2 groups (p= 0.004).

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The reason for that is the postoperative lateral sided pain over iliotibial band incisional scar, there was statistically significant difference between the 2 groups (p= 0.001), in group A (60.0%) were graded as (A) and (40.0%) were graded as (C) but in group B (80.0%) were graded as (A) and (20.0%) were graded as (B). And so, after surgery, (35.0%) had removed staple in group (A) and (0.0%) patients had removed interference screw in group B. There was statistically high significant difference on comparing results in favor of postoperative results (p 0.008). Suggesting the use of interference screw rather than staple, when the same point of fixation of ITB tenodesis as described in the technique was used. Conclusions: Using lateral extra-articular tenodesis (LET) of ITB as an augmentation for ACL reconstruction improve rotational stability. Suggesting the use of interference screw rather than staple, when the same point of fixation of ITB tenodesis as described in the technique was used.

***Keywords*---**Anterior cruciate ligament (ACL), lateral extra-articular tenodesis (LET) of iliotibial band (ITB), rotational stability, extra-articular.

Introduction

Rotatory instability has been observed even following successful reconstruction and is among the most critical aspects in patient satisfaction. The failure rate for primary ACL reconstruction is 3–5% and it increases to 15–20% for revision ACL. Residual rotatory laxity is a possible cause for the higher failure rate. (3)

It has been suggested that the persistent rotational instability seen after ACL reconstruction in some patients is caused by injuries to the anterolateral extra-articular structures. In these cases, even optimal ACL reconstruction procedures may fail to control rotational laxity. An alternative approach is to augment ACL reconstruction with an extraarticular anterolateral soft tissue procedure designed to resist internal rotation (IR) of the tibia and compensate for the extra-articular component of the injury. (4,5)

The indications for lateral extra-articular tenodesis (LET) of iliotibial band (ITB) remain a topic of debate; some authors recommend LET only for revision ACLR in the presence of a recurrent pivot shift, whereas others only indicate LET when an anterolateral ligamentous injury or Segond's fracture is detected on imaging. (6, 7)

Persistent anterolateral rotary instability after ACLR can occur for a variety of reasons, meniscal root tears, missed Ramp lesion, total or subtotal meniscectomies and injury of anterolateral soft tissue structures. (13) Additionally, increased posterior tibial slope >12° has been associated with increased graft failure and can result in insufficiency of the ACL graft over time. In such cases, augmentation of ACL reconstruction with LET procedure can be a good option. (14)

Patients and Methods

After approval of the ethical committee of, a prospective randomized controlled trial (RCT) was conducted From December 2018 to December 2020 to compare the functional outcome between two groups of patients undergoing iliotibial band tenodesis for extra articular augmentation of ACL reconstruction using staple versus group of patients using interference screw. The functional knee scores were calculated using The International Knee Documentation Committee (IKDC) subjective score and The Lysholm knee score.

A total of 40 patients with ACL injury were included in the study and randomly into one of two groups. An informed consent was obtained from all patients. Patients were divided into 2 groups, 20 patients each. Group A underwent combined intra-articular anatomic single bundle (ASB) ACLR and iliotibial band tenodesis using staple, while group B underwent ASB ACLR and iliotibial band tenodesis using interference screw. The technique of extra articular tenodesis used in both groups was Modified Lemaire technique.

Inclusion criteria:

- Jerk III.
- Associated meniscal injuries were included.
- Athletic and non-athletic.

Exclusion criteria:

- Associated ligament injury
- Knee O.A, malalignment, chondral injuries and ACL revisions.

Pre-operative evaluation

Clinical evaluation; History taking for the mode and time of trauma, giving way, knee pain, knee swelling, locking, limping and previous interventions. Full knee examination was done in the outpatient clinic. Lysholm knee score and IKDC score were done for all patients. Radiographic evaluation; Plain radiographs in the AP and Lateral views and MRI were the studies used in all cases.

Operative details and procedure

All surgeries were performed in the supine position, under general anesthesia. Routine examination under anesthesia (EUA) was performed as the first step for all patients. The grade of knee jerk was noted and documented to assess the grade of laxity. A tourniquet cuff connected to a digital timer was secured over the proximal thigh.

ACL Graft harvesting:

In both group 'A' and 'B', harvesting of the hamstring tendons, quadrupled semitendinosus and gracilis of at least 8 mm diameter were used for ACL reconstruction.

Ilio-Tibial band Tenodesis:

A 6 cm long skin incision is made laterally centered over the posterior aspect of the ITB and extending from Gerdy's tubercle to the just above the lateral epicondyle. (**Fig** 1). Dissection should be carried down to the ITB, and the central third of the ITB should be prepared for harvest. Avoid dissection to the deep detachment through the Kaplan fibers. The ITB graft will be left attached to Gerdy's tubercle distally and should be measured at least 10 mm wide and be 10 to 12 cm in length to have sufficient length (**Fig** 2).

Fig 1. Side view left knee showing bony landmarks.

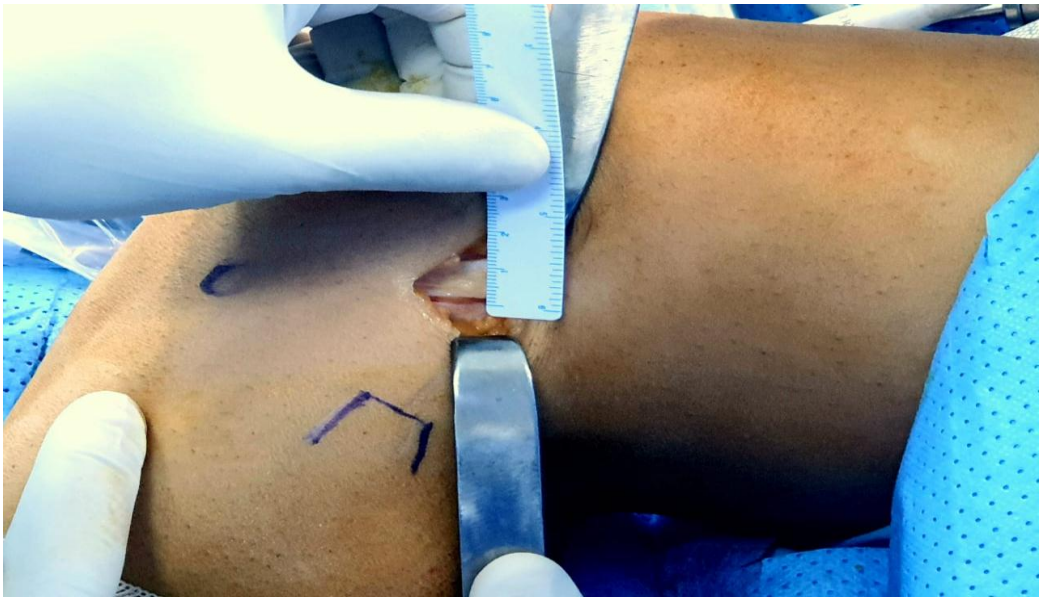


Fig 2. Side view left knee showing central third of the ITB

The tendon was cleaned of underlying fat should be performed before detaching the tendon proximally. A scalpel is used to cut the ITB graft along its anterior, posterior, and proximal margins. The proximal end of the graft should be whip stitched with high-strength suture to aid in passing and fixation of the graft. (**Fig** 3).

Fig 3. Side view left knee showing whip stitching of the ITB graft

In Group B: first a guide wire was drilled in a different direction, postero-superior, away from future tunnel of ACL reconstruction. Then drill bit 4 mm from the point of 5 mm posterior and 10 mm proximal to lateral epicondyle to far

medial cortex of femur then drill bit according to size of iliotibial band graft, usually 7 mm then Passing suture loop in femoral tunnel of iliotibial band tenodesis. It's very important to protect iliotibial band graft from iatrogenic damage during femoral drilling of ACL reconstruction tunnel Then continue ACL reconstruction. (**Fig** 4, 5)

Fig 4: Side view left knee showing direction of iliotibial band tunnel which is postero-superior to avoid tunnel coalition with ACL reconstruction femoral future tunnel.

Fig 5 Side view left knee showing Passing suture loop in femoral tunnel of iliotibial band tenodesis.

Arthroscopic procedure

Diagnostic knee arthroscopy (DKA) was performed as a routine step in all cases. Any meniscal lesions were treated prior to ACL reconstruction, either by performing partial menisctomy or meniscal repair. After tibial tunnel and femoral tunnel preparation for ACL reconstruction, the anteromedial portal was used to make sure there was no suture traversal passed in the femoral tunnel. (**Fig** 6)

Fig 6: Arthroscopic view of left knee through anteromedial portal and no tunnel coalition

After finishing ACL reconstruction procedure as routine procedure and passing the graft.

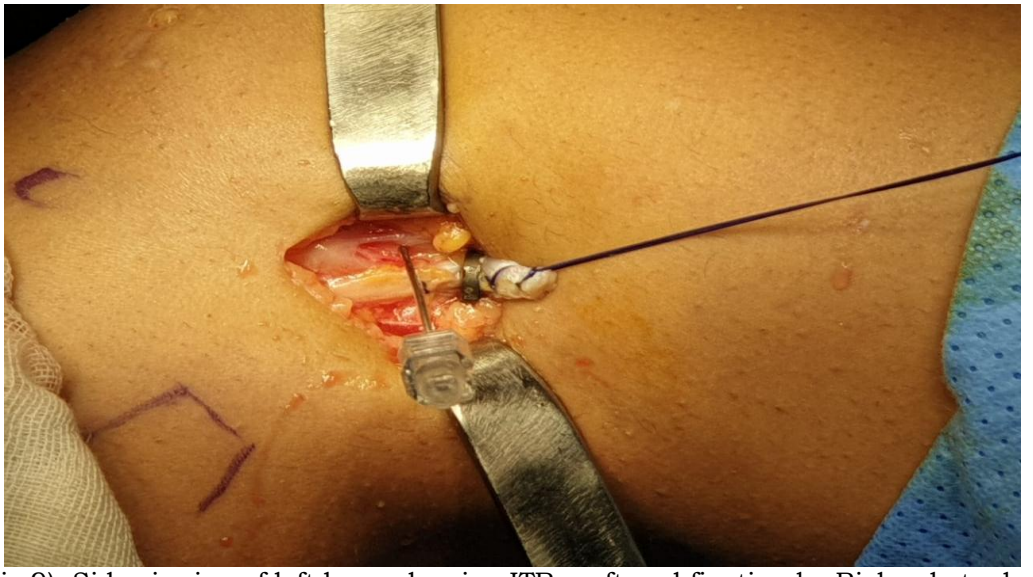
Continue iliotibial band tenodesis

In both groups the prepared ITB graft should be first passed under the fibular collateral ligament (FCL) prior to fixation to the distal femur with care taken not to disrupt the fibular collateral ligament or underlying capsule. (**Fig** 7). The site of fixation of the ITB graft must then be identified and prepared. The ITB graft should be fixed to point of 5 mm posterior and 10 mm proximal to lateral epicondyle.

Fig 7: Side viewing of left knee showing identification of fibular collateral ligament and iliotibial band graft should be passed under FCL.

In group (A), curette was used or osteotome to roughen up the bone surface in preparation for fixation using staple (Richard Staple). The knee was kept in 30 degrees flexion in neural rotation and with gentle traction to avoid tightening of lateral structures. (**Fig** 8,9).

(Fig 8). Side viewing of left knee showing ITB graft after passing under LCL.



(Fig 9). Side viewing of left knee showing ITB graft and fixation by Richard staple.

In Group B, after Retrieving ITB graft and Gentle pull, interference screw was used in 30 degrees knee flexion and neutral rotation. (**Fig** 10, 11).

(Fig 10). Side viewing of the left knee after putting interference screw guide wire in femoral tunnel of iliotibial band.

(Fig 11). Side viewing of the left knee showing the interference screw.

After fixation, ensure that the knee can obtain full extension and flexion. The graft should become taut with internal rotation. The tourniquet was deflated and meticulous haemostasis was done to avoid post-operative hematoma. After haemostasis intraarticular drain and ST graft harvest drain were used. Closure of the ITB and no drain was used in the ITB incision.

Post-operatively

Patients stay in the hospital for one night, in the ward, where they receive intravenous antibiotics, cryotherapy, anti-edematous modalities, anticoagulation and start static quadriceps exercises. Patients were discharged on oral antibiotics, anticoagulation and analgesics for 1 week. Full weight-bearing is allowed aided by 2 crutches for balancing. After 1 week, aspiration was done in cases of moderate or severe effusion. After 2 weeks, one crutch is discarded and at 1month post-operative, weight bearing is allowed without crutches.

Follow-up evaluation

All patients were evaluated after surgery every two weeks up to the second postoperative month, monthly up to 6 months then after 12 months and 18 months.

A- Clinical evaluation: Postoperative clinical evaluation was similar to the preoperative evaluation. In addition, the graft donor site was examined for tenderness, irritation and presence of abnormal sensation of the skin surrounding.

B- Postoperative rating scales: After clinical and radiographic assessment, the postoperative rating scales were calculated. The Lysholm knee score was used for subjective evaluation.

Using the IKDC scoring system for subjective & objective evaluation was done at 18th month postoperatively.

Results

Sports activity

In group (A), (65%) were athletes as compared to (20%) in group (B).

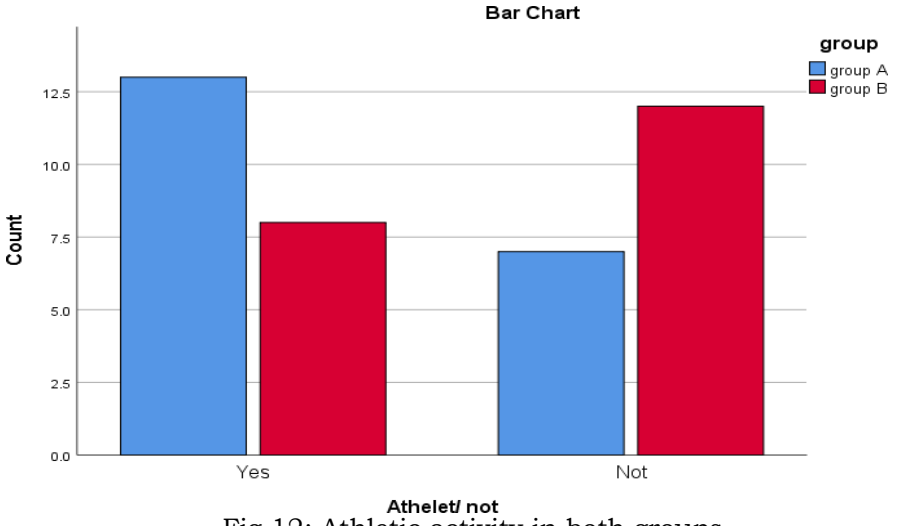
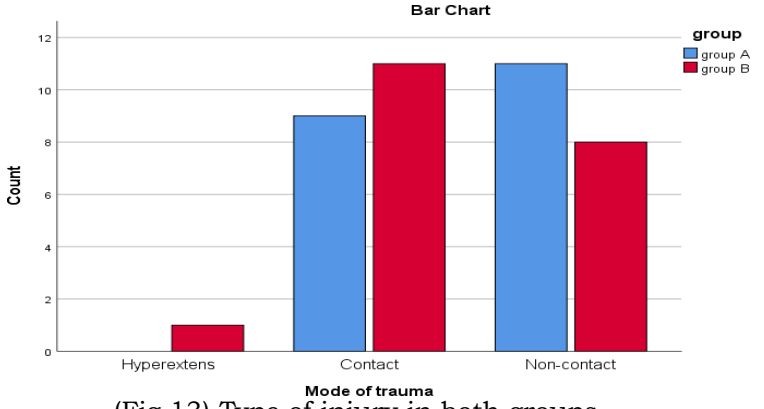


Fig 12: Athletic activity in both groups.

Type of trauma

(45%) in group (A) suffered contact trauma, while (55%) suffered non-contact trauma. (55%) in group (B) suffered contact trauma, while (40%) suffered non-contact trauma, and (5%) Hyperextension injury.



(Fig 13) Type of injury in both groups.

Time to surgery:

The average time from injury to surgery was 2.18 months in group (A) as compared to 2.11 months in group (B).

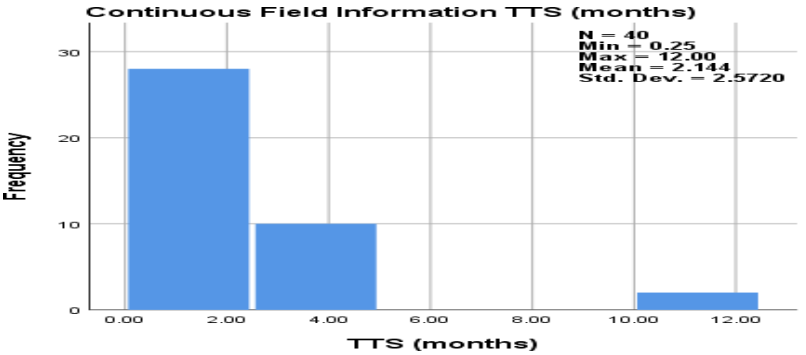


Fig 14: Time from injury to surgery.

Operative time

The mean operative time for group (A) was 45 minutes (SD 7). The mean operative time for group (B) was 47 minutes (SD 8). There was no statistically significant difference between the two groups (P>1).

Subjective evaluation

A-Lysholm score:

Upon comparing the postoperative results, there was statistically insignificant difference between the 2 groups (p=0.904)

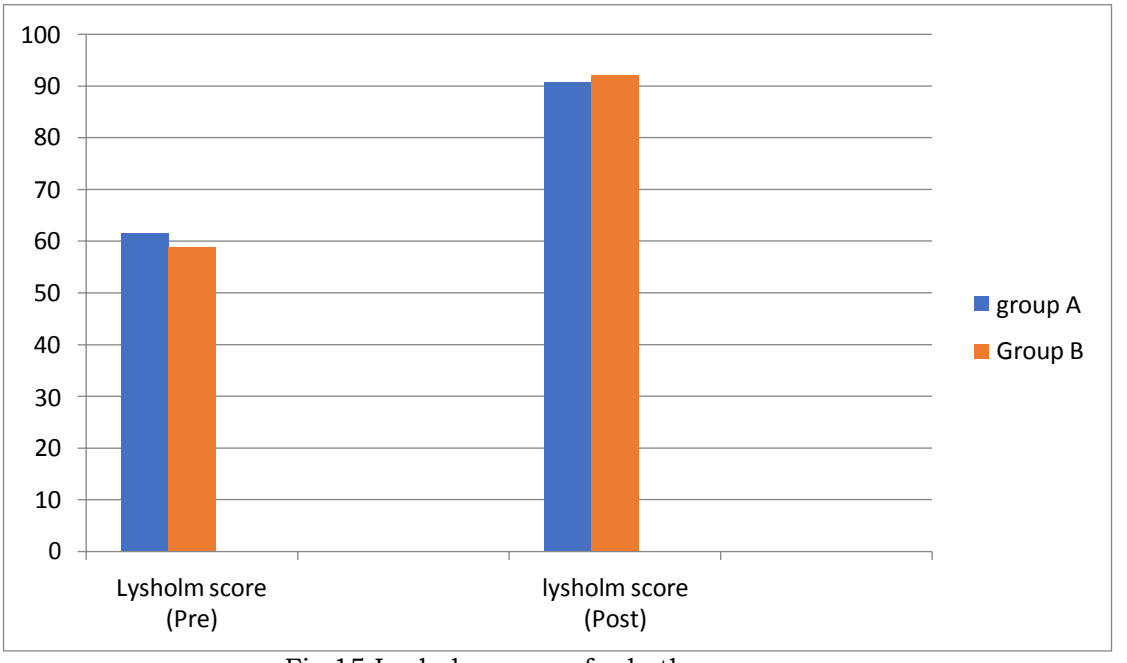


Fig 15 Lysholm scores for both groups.

B-Subjective IKDC score:

• Pivot test:

Group A

There was statistically high significant difference on comparing preoperative and postoperative results in favors of postoperative results ($p<0.001$).

Group B

There was statistically high significant difference on comparing preoperative and postoperative results in favor of postoperative results ($p<0.001$). Upon comparing the results postoperatively, there was statistically insignificant difference between the 2 groups ($p= 0.231$).

Time to return to full sports activity:

The mean time between the index surgery and patient return to full sports activity in athletic patients in group A were 8 months (SD 0.7). While the mean time between the index surgery and patient return to full sports activity in athletic patients in group B was 8.7 months (SD 0.5). Comparing both groups, there was no statistically significant difference between both groups ($P>1$).

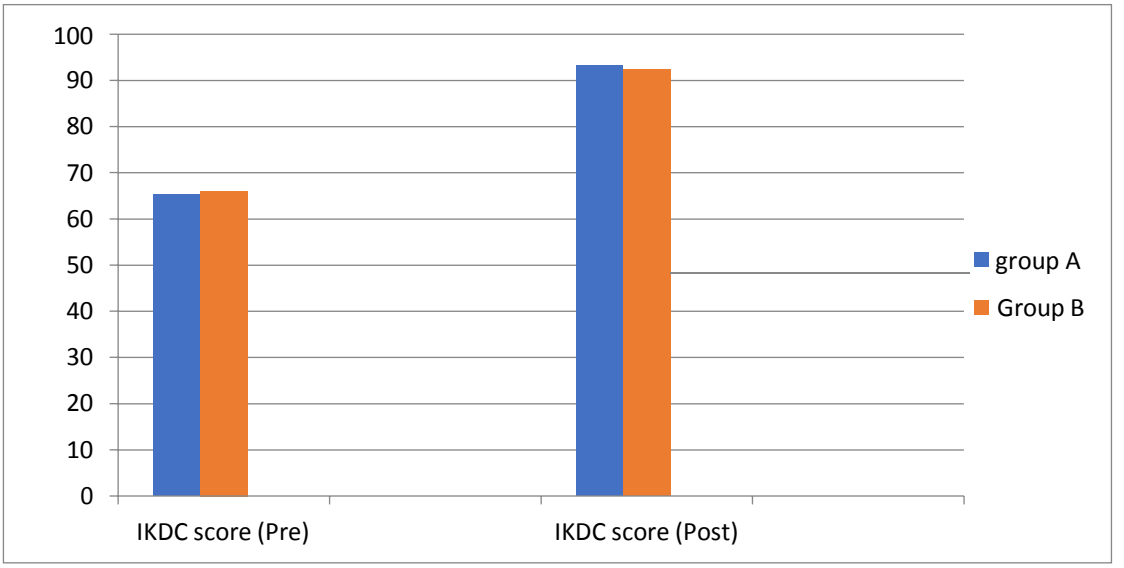


Fig 16: Subjective IKDC for both groups.

Complications
Hemarthrosis:

1 patient (5.0%) in group (A) and 2 patients (10.0%) in group (B) had prolonged Hemarthrosis up to eight weeks postoperatively. This was managed by aspiration under complete aseptic conditions, according to the degree of effusion in addition to anti-inflammatory and anti-edematous drugs. There was no residual effusion by the 12th week postoperative.

Donor site complications:

Persistent numbness, irritation and pain: this had been observed at the site of graft harvesting in 1 patient (5.0%) in group A and (0%) in group (B), with nothing to be done for this unavoidable complication.

Lateral compartmental pain over scar of iliotibial band tenodesis:
Using both IKDC objective (table 15) and simple Upon comparing the results postoperatively, there was statistically significant difference between the 2 groups (p= 0.001). Suggesting the use of interference screw rather than staple, when the same point of fixation of ITB tenodesis as described in the technique was used.

Infection:
(5%) of group (A) had superficial infection at the harvest site wound which was managed by broad spectrum oral antibiotics for one week after which it was completely resolved. No infection (0 %) in group (B).

Need for removal LET fixation method
After surgery, 7 patients (35.0%) had removed staple in group (A) after the staple was pulled out. And no patient had the need for removal of ITB tenodesis fixation method in group (B). There was statistically high significant difference on comparing results (p 0.008). Suggesting the use of interference screw rather than staple, when the same point of fixation of ITB tenodesis as described in the technique was used.

Table 1
Lat compartment findings in both groups

		Group A		Group B	
		Count	%	Count	%
Lateral Compartment pain	A (no pain)	12	60.0%	16	80.0%
	B (can be gnored)	0	0.0%	4	20.0%
	C (cannot begnored)	8	40%	0	0.0%
	D (interferedwith sleep)	0	0.0%	0	0.0%

Discussion

This study describes a comparison study for extra-articular augmentation of ACL Reconstruction using staple versus interference screw. Both groups making up our series were strictly comparable with regard to demographic data, activity level, interval between the injury and the operation and even objective laxity before surgery, allowing a better appreciation of the influence of lateral extra-articular tenodesis.

The primary question was the effect of extra-articular augmentation of ACL reconstruction on control of rotational laxity. Upon comparing the postoperative results, the primary finding is there was improvement of pivot shift test in both groups with (100 % grade A pivot shift test) in group A and (85 % grade A pivot shift test) and (15% grade B pivot shift test) in group B. So, the primary finding in this study was improvement of rotational control.

The secondary question was if there was a difference between staple and interference screw as a fixation method for iliotibial band tenodesis. The secondary finding is there was statistically significant difference in the postoperative IKDC objective score between the 2 groups (p= 0.004). The reason for that is the postoperative lateral sided pain over iliotibial band incisional scar, there was statistically significant difference between the 2 groups (p= 0.001), in group A (60.0%) were graded as (A) and (40.0%) were graded as (C) but in group B (80.0%) were graded as (A) and (20.0%) were graded as (B). And so, after surgery, (35.0%) had removed staple in group (A) and (0.0%) patients had removed interference screw in group B. There was statistically high significant difference on comparing results in favor of postoperative results (p 0.008). Suggesting the use of interference screw rather than staple, when the same point of fixation of ITB tenodesis as described in the technique was used. Historically, ACL ruptures were treated surgically by isolated extra-articular tenodesis, as described by Lemaire. [15]

Neyret et al [16] recommended against an isolated Lemaire procedure in amateur skiers under 35 based on poor subjective satisfactions rates (16/31 satisfied) and high rates of residual instability. In their series 12 of 15 patients had a positive pivot shift at 4.5 years. Ellison procedure [17] was also reported in a long-term follow-up study by Reid et al. [18] of 32 patients, 24 (75%) had a positive pivot shift and 29 (91%) had a positive Lachman at a mean follow-up of 11 years. The authors abandoned the procedure citing poor subjective and objective scores.

The extra-articular tenodesis was largely abandoned when single-bundle intraarticular ACL reconstruction became the gold standard. The original single-bundle reconstruction consisted of a vertical graft position resulting in poor rotational control, with some patients experiencing persistent rotatory laxity. [19] Double-bundle ACL reconstruction was subsequently developed in the early 2000s, with the concept of adding posterolateral bundle to the more standard anteromedial graft, leading to better control of rotation. Because it is technically more difficult and it did not show better clinical outcomes, the double-bundle technique has since lost popularity. [20]

However, even in the face of a well-performed single-bundle or double-bundle ACL reconstruction, rotational laxity has been demonstrated to persist. Two metanalyses by Prodromos and colleagues [21] and Mohtadi [22] showed that up to 34% and 22% of patients, respectively, continue to have a positive pivot shift, the presence of which has been correlated with worsening outcome. This is one reason that has led to greater interest in the anterolateral side of the knee.

The iliotibial band (ITB) has also been shown to have an impact on the control of anterolateral rotation, because it attaches to the Gerdy's tubercle. In particular, recent research would suggest that the capsulo-osseous layer of the ITB, attaching proximally from the posterior Kaplan fibers on the distal femur, to distally on the posterior aspect of the Gerdy's tubercle is a major contributor to anterolateral rotational control. [23]

Anterolateral rotational control is provided by a combination of intra-articular and extra-articular structures, with the ACL, lateral meniscus, ITB, and ALL working

together. Furthermore, ACL injury may therefore result in a combination of injuries to these structures. It is important therefore to look for peripheral injuries in addition to the ACL and address these as appropriate. The new anatomic understanding also implies that lateral extraarticular procedures may be more anatomic than previously believed. [23] In a cadaver model, an LET has been shown to decrease the stress on an ACL graft by 43%. [24]

Similar benefits have been seen in an in vivo model. At the time of surgery, LET added to a single-bundle ACL reconstruction was shown to significantly reduce tibial internal rotation compared with a single-bundle ACL reconstruction. Zaffagnini and colleagues [2] also showed that patients had improved restraint to internal tibial rotation at 90° flexion, in addition to improved varus-valgus laxity in full extension.

Kittl and colleagues [23] found that the ALL played no significant role in internal rotational control. In a similar robotic experiment, they determined the superficial and deep components of the ITB to be the primary restraints to internal rotation from 30° to 90°, with the ACL having a significant contribution at 0° only. Interestingly, the ACL provided no restraint to the pivot shift. The finding of a role for the ITB in the control of internal tibial rotation is important but not new. Fetto [25] and Marshall were able to induce a pivot shift by division of the ITB in an ACL intact knee.

Combined procedures are advantageous for 2 main reasons as stated in the biomechanics section, an added lateral extra-articular procedure has a more beneficial lever arm for rotational control and it has been shown that it offloads the intra-articular graft, possibly preventing it more from failure. Even in case of failure of the intra-articular graft, it functions as a secondary restraint to rotational laxity Results for combined intra-articular AC reconstruction and LET procedures have been more promising.

A recent meta-analysis by Hewison and colleagues [26] of 29 articles revealed a statistically significant reduction in the pivot shift in favour of a combination ACL reconstruction and LET, compared with ACL reconstruction alone. No significant difference was seen in anterior translation as measured by KT1000/2000 arthrometry or in IKDC scores. The meta-analysis also highlights the degree of heterogeneity in the studies, as several factors were different, including type of ACL graft (bone-patellar tendon-bone [BTB] vs hamstring tendon [HT]) and method of LET.

O'Brien and colleagues [27] found no difference in clinical stability for those treated with a central third patella tendon intra-articular graft with or without the addition of a lateral extra-articular sling procedure; however, 40% of the extra-articular group had chronic pain or swelling associated with the additional procedure. Anderson and colleagues.

Regarding Extra-articular augmentation, several studies described different techniques of. In comparing our results with other studies using Combined ACL Reconstruction and iliotibial band Tenodesis with different techniques.

Andrea Ferrretti et al [28], the most important finding of this study (primary finding) was that 2 of the 3 scales adopted indicated a lower incidence of radiologic signs of OA in group II, revealing a trend toward better results in the group with extra-articular so, the previous concept of lateral overtightening causing degenerative changes in the lateral compartment is unlikely to be correct. In group II (extra-articular group) there was no difference between meniscectomized and unmeniscectomized patients according to Fairbank and Kellgren classification. Unfortunately, can't compare our results to the primary findings of this study because of short term follow-up of our study.

The secondary finding of this study is that combined reconstruction seems to improve knee stability, reducing pivot shift phenomenon at follow-up and decreasing the rate of failures with no major effect on subjective functions. In comparing secondary findings of their study, there was improvement of post-operative pivot in both groups of our study.

Dejour et al [29], patellar tendon reconstruction combined with the extra-articular procedure achieved the best lateral compartment Anterior tibial translation (LCATT) correction. There are intrinsic differences between the three procedures. Absolute correction of ATT is not different for the medial compartment between the three groups, but the patellar tendon reconstruction combined with a Lemaire extra-articular procedure achieved the best lateral compartment ATT correction.

Their study also concluded improving of pivot shift 23/25 was grade A and 2/25 was grade B in group B. In comparing their study, there was improvement of post-operative pivot in both groups. Trichine et al [30], this prospective randomized study did not make it possible to highlight a significant difference between the two groups concerning the subjective, sporting, and even total result (overall IKDC score).

Limitations

The scope of the current study is limited by the length of follow-up. Further follow-up is necessary to determine differences between groups in long-term clinical outcomes and complications. The sample size is smaller than other studies approaching the same topic. The lack of blinded follow up of patients might be considered inherent bias although all the objective parameters of the follow up KT 1000 & lateral compartment anterior tibial translation also measuring of Pivot shift which is not completed. Radiological analysis long term follow up is very important to confirm that there is no associated osteoarthritis with extra articular tenodesis. We think all this measure will may be beneficial and should be included in the further studies in this technique.

Recently in our other new study (not finished yet), the point of fixation of staple was changed to be more proximal in the safe zones described by kittl el et al [31] and to be in the metaphysis to avoid lateral epicondyle hump. And was found to be not associated with lateral sided knee pain and also no pull out of staple, at 6 months follow up.

Conclusion

Rotational stability was improved after using lateral extra-articular tenodesis (LET) of ITB as an augmentation for ACL reconstruction. And in comparing both groups, Suggesting the use of interference screw rather than staple, when the same point of fixation of ITB tenodesis as described in the technique was used.

Extra-articular augmentation of ACL Reconstruction is a promising field for further studies that should have a larger sample size and include higher risk patients including revision cases and those with global ligamentous laxity. The principle was valid and can be done in primary cases.

Declaration of interest: none

References

1. Iñaki Mediavilla1, Mikel Aramberri, ACL Reconstruction and Biomechanics Mediavilla, I., Aramberri, M. (2019) ACL Reconstruction and Biomechanics. Int J Orth,2(1): 012-018.
2. Zaffagnini S, Signorelli C, Lopomo N, et al. Anatomic double-bundle and overthetop single-bundle with additional extra-articulartenodesis: an in vivo quantitative assessment of knee laxity in two different ACL reconstructions. Knee Surg Sports Traumatol Arthrosc 2012; 20:153–9.
3. Grassi A, Kim C, Marcheggiani Muccioli GM, Zaffagnini S, Amendola A (2017) What is the mid-term failure rate of revision ACL reconstruction? A systematic review. Clin Orthop Relat Res 475(10):2484–2499
4. Inderhaug E, Stephen J, Williams A, Amis A. Mechanical comparison of anterolateral procedures combined with anterior cruciate ligament reconstruction. Am J Sports Med. 2017;45(2):347-354.
5. Parsons EM, Gee OA, Spiekerman C, Cavanagh PR. The biomechanical function of the anterolateral ligament of the knee. Am J Sports Med. 2015;43(3):669-674.
6. 6.Weber AE, Zuke W, Mayer EN, et al. Lateral augmentation procedures in anterior cruciate ligament reconstruction: Anatomic, biomechanical, imaging, and clinical evidence [published online February 1, 2018]. Am J Sports Med.
7. Porter MD, Shadbolt B, Pomroy S. The augmentation of revision anterior cruciate ligament reconstruction with modified iliotibial band tenodesis to correct the pivot shift: A computer navigation study. Am J Sports Med 2018;46: 839-845.
8. 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; 45:1547-1557.
9. David L. Bernholt, Mitchell I. Kennedy, Matthew D. Crawford., Nicholas N. DePhillipo and Robert F. LaPrade. Combined Anterior Cruciate Ligament Reconstruction and Lateral Extra-Articular Tenodesis. (2019) by the Arthroscopy Association of North America. 2212-6287/19252. References 122

10. 10-Markatos K, Kaseta MK, Lallos SN, Korres DS, Efstathopoulos N. The anatomy of the ACL and its importance in ACL reconstruction. Eur J Orthop Surg Traumatol. 2013; 23(7):747-52.

11. Kraeutler MJ, Wolsky RM, Vidal AF, Bravman JT. Anatomy and Biomechanics of the Native and Reconstructed Anterior Cruciate Ligament: Surgical Implications. J Bone Joint Surg Am. 2017; 99(5):438-445.
12. Jorge Chahla MD and Robert F Laprade PHD. Anatomy of the ACL Insertions: Arthroscopic identification of the Attachments, Steadman Philippon Research institute The Steadman Clinic, Vail, CO, USA © ISAKOS 2017 DOI 10.1007/978-3-662-52742-9_17
13. Sayed-Noor AS, Pedersen E, Sjödèn GO. A new surgical method for treating patients with refractory external snapping hip: Pedersen-Noor operation. J Surg Orthop Adv. 2012 Fall;21(3):132-5.
14. Ilizaliturri VM, Martinez-Escalante FA, Chaidez PA, Camacho-Galindo J. Endoscopic iliotibial band release for external snapping hip syndrome. Arthroscopy. 2006 May;22(5):505-10.
15. Lemaire M. Ruptures a ciennes du ligament croise anterieur du genou. J Chir 1967; 93:311–20.
16. Ellison A. Distal iliotibial-band transfer for anterolateral rotatory instability of the knee. J Bone Joint Surg Am. 1979; 61:330–337
17. Neyret P, Palomo R, Donell S, et al. Extra-articular tenodesis for anterior cruciate ligament rupture in amateur skiers. Br J Sports Med. 1994; 28:31–34.
18. Reid J, Hanks G, Kalenak A, et al. The Ellison iliotibial-band transfer for a torn anterior cruciate ligament of the knee. Long-term follow-up. J Bone Joint Surg Am. 1992; 74:1392–1402.
19. Duthon V, Magnussen R, Servien E, et al. ACL reconstruction and extra-articular tenodesis. Clin Sports Med 2013;32(1):141–53.
20. Yagi M, Wong EK, Kanamori A, et al. Biomechanical analysis of an anatomic anterior cruciate ligament reconstruction. Am J Sports Med 2002; 30:660–6.
21. Prodromos CC, Joyce BT, Shi K, et al. A meta-analysis of stability after anterior cruciate ligament reconstruction as a function of hamstring versus patellar tendon graft and fixation type. Arthroscopy 2005;21(10):120
22. Mohtadi N. Function after ACL reconstruction: a review. Clin J Sport Med 2008; 18(1):105–6
23. Stephen JM, Lumpaopong P, Deehan DJ, Kader D, Amis AA. The medial patellofemoral ligament location of femoral attachment and length change patterns resulting from anatomic and nonanatomic attachments. Am J Sports Med. 2012; 40:1871-1879.
24. Cristoph Kittl, Camilla Halewood, Joanna M. Stephen, Chinmay M. Gupte, Andreas Weiler, Andy Williams and Andrew A. Amis. Length Change Patterns in the Lateral Extra-articular Structures of the Knee and Related Reconstructions*Am J Sports Med* 2015 43: 354 originally published online December 24, 2014 DOI: 10.1177/0363546514560993
25. Fetto JF, Marshall JL. Injury to the anterior cruciate ligament producing the pivot shift sign. J Bone Joint Surg Am 1979;61(5):710–4.
26. Hewison CE, Tran MN, Kaniki N, et al. Lateral extra-articular tenodesis reduces rotational laxity when combined with anterior cruciate ligament

reconstruction: a systematic review of the literature. Arthroscopy 2015;31(10):2022–34
27. O'Brien SJ, Warren RF, Wickiewicz TL, et al. The iliotibial band lateral sling procedure and its effect on the results of anterior cruciate ligament reconstruction Am J Sports Med 1991;19(1):21–4 [discussion: 24–5]
28. Ferretti A, Monaco E, Ponzo A, Basiglini L, Iorio R, Caperna L, Conteduca F (2016) Combined intra-articular and extra-articular reconstruction in anterior cruciate ligament-deficient knee: 25 years later. Arthroscopy 32(10):2039–204
29. Dejour D, Vanconcelos W, Bonin N, Saggin PRF (2013) Comparative study between mono-bundle bone-patellar tendonbone, double-bundle hamstring and mono-bundle bonepatellar tendon-bone combined with a modified Lemaire extra-articular procedure in anterior cruciate ligament reconstruction. Int Orthop 37:193–19.
30. Trichine F, Alsaati M, Chouteau J, Moyen B, Bouzitouna M, Maza R (2014) Patellar tendon autograft reconstruction of the anterior cruciate ligament with and without lateral plasty in advanced-stage chronic laxity. A clinical, prospective, randomized, single-blind study using passive dynamic X-rays. Knee 21:58–65.