

Review Article

How to avoid knee tunnel convergence when performing a combined anterior cruciate ligament reconstruction and lateral extraarticular tenodesis utilizing the antero medial window

Wesson Pious A. Espiritu*, Melissa Mae R. Sanchez

Department of Orthopaedics, Jose R. Reyes Memorial Medical Center, Manila, Philippines

Received: 21 August 2023

Accepted: 02 October 2023

*Correspondence:

Dr. Wesson Pious A. Espiritu,

E-mail: wessonespirtu@yahoo.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

The anterolateral structures of the knee have been demonstrated to have a significant impact on reducing rotational instability and the forces applied to the anterior cruciate ligament reconstruction (ACL) graft after surgical reconstruction. Combined ACL reconstruction and lateral extraarticular tenodesis are being performed at an increasing number due to its promising outcome in properly indicated patients. However, tunnel convergence in combined ACLR and lateral extraarticular tenodesis can lead to graft damage and possible failure defeating the purpose of this very effective technique. This technical note describes how to avoid knee tunnel convergence when performing a combined ACL reconstruction with lateral extraarticular tenodesis utilizing the “Antero medial window”.

Keywords: Lateral extraarticular tenodesis, ACLR, Antero medial window, Tunnel convergence

INTRODUCTION

Anterior cruciate ligament reconstruction (ACL) tear can create rotational and sagittal instability of the knee, and intraarticular reconstruction technique of the ligament represent the gold standard in its management.¹ The main goal in ACLR is to restore normal knee biomechanics and prevent early degenerative arthritis of the knee.²

An article written by Claes in 2013 brought back to the forefront an anatomic structure previously described by Paul Segond in the 19th century. This structure was described as the anterolateral ligament (ALL) (Figure 1), which is a discrete structure unifying the anterolateral part of the tibia and the femur.³ The anterolateral structures of the knee have been shown to play a major role in decreasing rotatory knee instability and forces across the ACL graft following reconstruction.⁴ Recent biomechanical cadaveric studies have shown that sectioning of this lateral complex associated with a section of the ACL resulted in an increase in sagittal and rotational laxity.⁵

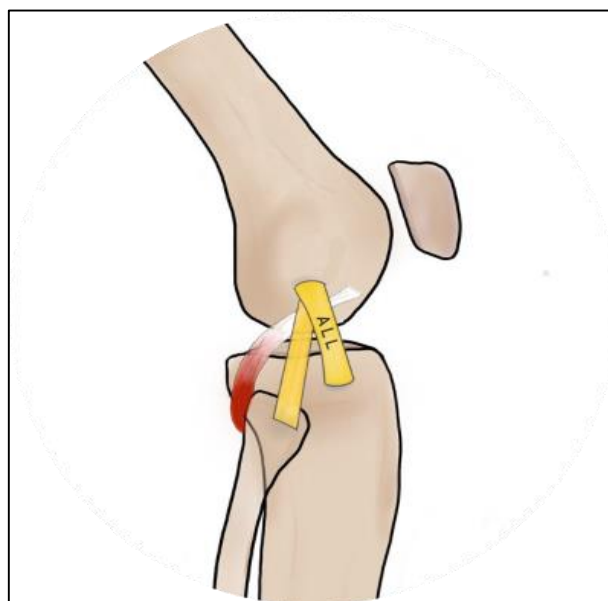


Figure 1: Anterolateral ligament.

The anterolateral complex (ALC), as it has been called since the consensus of 2019, led to an increasing popularity of lateral extraarticular tenodesis (LET) as an adjunctive procedure to ACLR. Recent studies have demonstrated significant reductions in ACL graft rupture rates in high-risk adult populations when a lateral extraarticular procedure is performed. Combined ACLR and LET was associated with a significantly lower graft rupture rate and no difference in non-graft rupture related reoperations or complications compared with isolated ACLR.⁶

A modified Lemaire lateral extra articular tenodesis (LET) is a surgical technique specifically developed to correct deficiencies in the anterolateral complex of the knee. This procedure involves augmenting the primary ACL reconstruction surgery to effectively reduce rotational laxity in the knee. Various studies have shown that the addition of the LET significantly improves rotational control and lowers the risk of the ACL reconstruction failure.^{7,15}

The following indications were developed from a recent International ALC (Anterolateral Complex) Consensus Group Meeting and represent the current thinking as to when LET may be added to ACLR: Revision ACLR, high-grade rotational laxity (grade 2 or 3 pivot shift), generalized ligamentous laxity or genu recurvatum of 10 degree, young patient (25 years old) returning to a contact pivoting sport.

There are no specific contraindications; however, caution should be observed in patients with posterolateral corner injury and lateral compartment osteoarthritis.

The concern in this combined surgery is tunnel coalition. When reconstruction tunnels converge, the reconstruction graft integrity can be damaged and the reconstruction procedure compromised.

Additionally, tunnel convergence may result in damage to fixation devices as well as the poor graft fixation, leading to the reconstruction failure.⁸

Objective

The objective of this study is to present a surgical technique on how to prevent tunnel convergence during a combined ACL reconstruction and lateral extra articular tenodesis by using the “antero medial window”.

SURGICAL TECHNIQUE

This technical note describes how to avoid tunnel convergence when performing a combined ACL reconstruction and LEA tenodesis utilizing the “Antero medial window”. Advantage and disadvantage of this technique are summarized in Table 1.

Table 1: Advantages and disadvantage of using “antero medial window” in combine ACLR and LET.

Advantages	Disadvantage
Using the antero medial window avoids tunnel convergence.	It will change the usual flow of the surgery.
Direct visualization of the femoral tunnel violation during entry of the bit pin during LET tunnel creation can allow intraoperative adjustment of trajectory of the beath pin away from it.	
Same standard anteromedial portal during ACL reconstruction can be used as “antero medial window”.	

PATIENT POSITIONING AND LANDMARKS

Patient is placed in supine position on operating table with a side post at level of padded tourniquet and a foot holder positioned to maintain the knee in 90 degrees of knee flexion. Appropriate landmarks are palpated and marked, including patella, patellar tendon, joint line, AM and AL portal for ACL reconstruction while Gerdy’s tubercle and lateral condyle for the LEA tenodesis (Figure 2).⁹

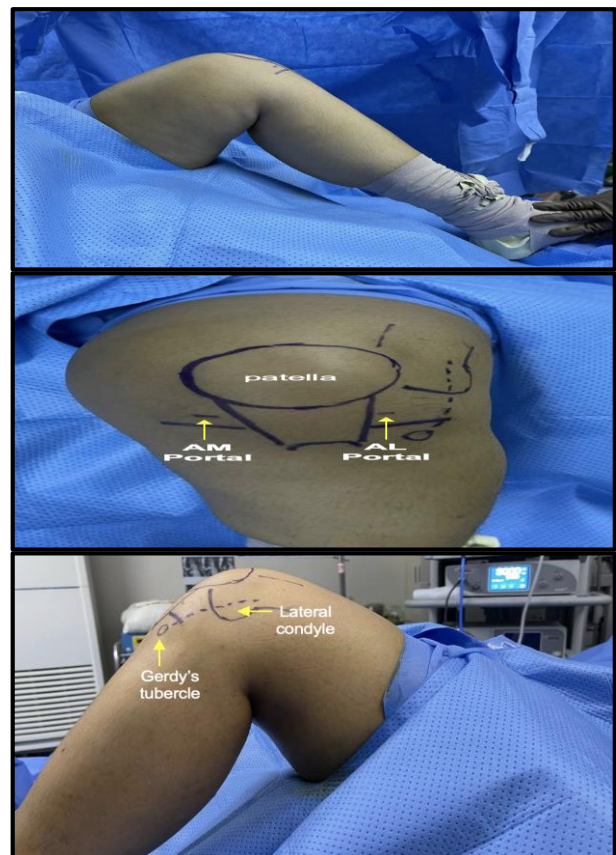


Figure 2: Patient position supine in operating table and landmarks identified for ACLR and LET.

GRAFT HARVEST FOR ACL RECONSTRUCTION

Oblique incision is placed along pes anserinus (palpable) midway between tibial tubercle and posteromedial border of tibia (Figure 3).¹⁰ Soft tissue dissection is done up to level of sartorial fascia. An “inverted L” shaped incision in sartorial fascia with transverse limb of L along superior border of the gracilis and the longitudinal limb of L along its attachment to the tibial crest. Using a right angle clamp or mixer, gracilis is dissected free from the sartorial fascia and free end of tendon will be whipstitched with a no. 2 fiberwire (Arthrex). Same will be done to semitendinosus tendon. A combination of blunt and sharp dissection is used to free up the tendon from any soft tissue attachments. A tendon stripper then is used to release each tendon from its proximal musculotendinous attachment (Figure 5). The released tendon is taken to back table for graft preparation.

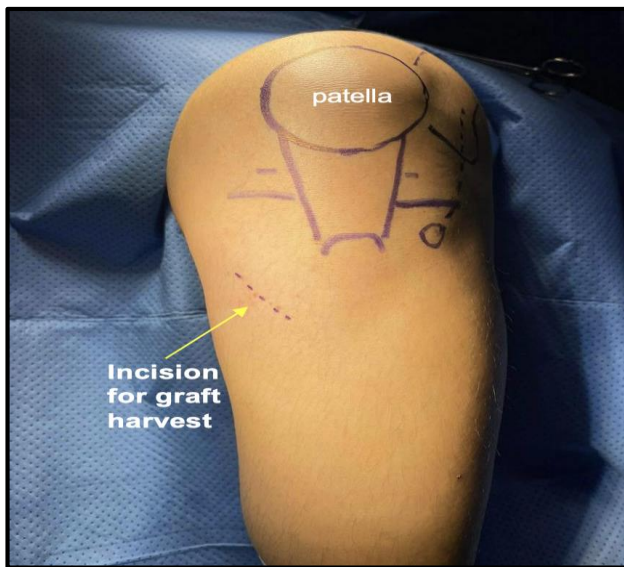


Figure 3: Oblique incision for graft harvest.

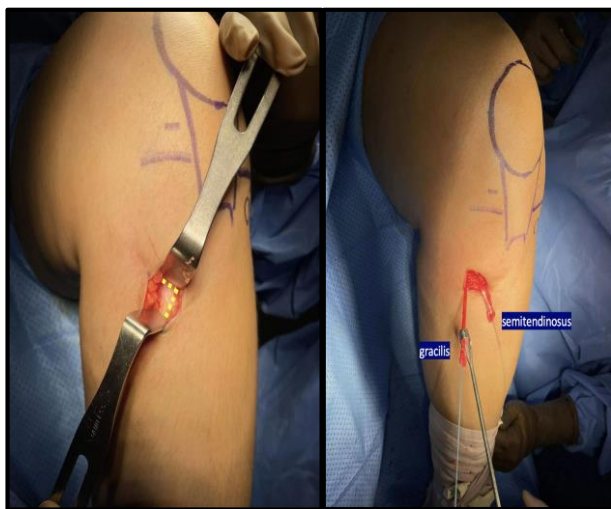


Figure 4: An ‘inverted L’ shaped incision in sartorial fascia. Tendon stripper is used to release each tendon from its proximal musculotendinous attachment.

ACL RECONSTRUCTION AND LATERAL EXTRA ARTICULAR TENODESIS

With the knee positioned in 90 degrees of knee flexion, anterolateral portal will be created, diagnostic arthroscopy will be done with the knee in full extension starting at the suprapatellar pouch going to the undersurface of patella, lateral gutter and medial gutter, knee will be placed in 90 degrees flexion and the arthroscope will be focused on the femoral notch. Using a gauge 18 spinal needle, a far antero medial (FAM) portal will be created, remember that this is the same portal that will be used as the “Antero Medial Window” when creating the femoral tunnel for the LET tenodesis (Figure 6). After confirming that the needle can access the femoral ACL attachment from the Far Antero Medial portal under anterolateral arthroscopic view, a longitudinal skin incision is made¹¹. Debridement will be done to improve visualization, lateral and compartment then will be inspected for associated lesions.



Figure 5: Far anteromedial portal (“Antero Medial Window”).

The femoral drill guide will be inserted through the Far Antero Medial portal and the anterolateral portal as the primary viewing portal with the knee flexed to 90 degrees. The femoral drill guide will be positioned at 10 o'clock if left knee and 2 o'clock if right knee (Figure 7). Once correct position confirmed, knee will be hyperflexed to increase the femoral tunnel length. The passing pin is inserted and drilled advancing to the two cortices. A femoral tunnel of 25-30 mm long is established with a cannulated reamer with the diameter identical to the graft.¹² Shuttle suture will then be passed to tibia tunnel for later graft passage.

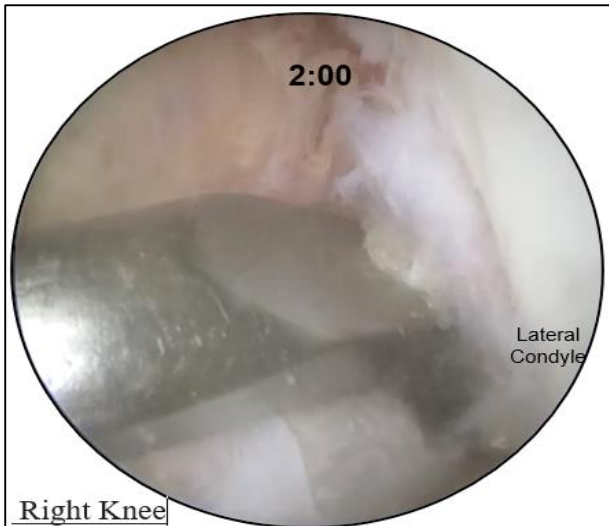


Figure 6: Femoral drill guide.

Instead of going to next step of ACL reconstruction which is creation of tibial tunnel, we now will shift to performing the Lateral Extraarticular tenodesis. Position the leg with the knee in 90 degrees of knee flexion. Make a minimum 6 cm longitudinal incision 1 cm posterior to lateral femoral condyle, starting 2 cm proximal to Gerdy's tubercle.⁷

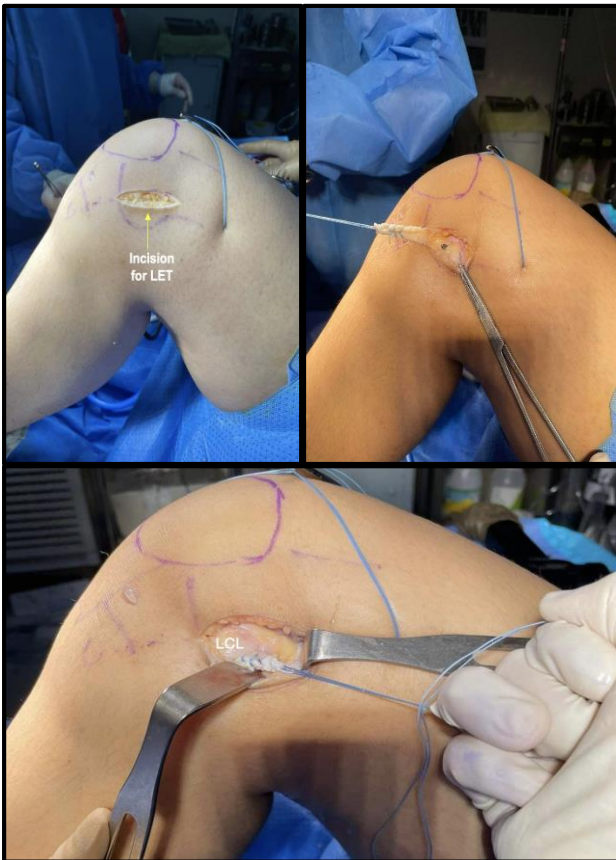


Figure 7: Longitudinal incision for LET, 1 cm posterior to the lateral femoral condyle, starting 2 cm proximal to the Gerdy's tubercle. Iliotibial band whipstitched and passed beneath LCL.

Dissect the subcutaneous fat down to the Iliotibial band (ITB), Harvest an 8-cm wide strip of ITB from the posterior half of the ITB, ensuring that the most posterior fibers of the deep ITB remain intact.⁷ Leave the distal limb attachment to the Gerdy's tubercle intact while the proximal limb will be whipstitched. Identify the LCL by palpation, pass the ITB beneath the LCL using a right angle clamp (Figure 8).

The LET femoral fixation point was chosen to be 10mm proximal and 5mm posterior to the femoral insertion of LCL.⁶ Before drilling the guide pin to LET femoral fixation site, arthroscope will be introduced again to the "Antero Medial window" focusing to the ACL femoral tunnel previously created. LET guide pin will be advanced from the lateral femoral cortex to the medial femoral cortex, viewing from the "Antero medial window", we will be able to see if the guide pin will penetrate or collide with the previously created ACL femoral tunnel (Figure 9). In the event that penetration/collision occur, reposition the trajectory of bit pin. Once successful passage of bit pin is ensured, pass a shuttling suture to the bit pin and shuttle the graft.



Figure 8: Antero medial window. Guide pin did not penetrate with previously created ACL femoral tunnel.

Hold the graft taut, but not over tensioned with the knee at 30-70 degrees and the foot at neutral rotation. Secure the graft with a swivelock, 4.5 mm. Close the wound then resume ACL reconstruction.

The tibial tunnel is created using a 55 degree drilling guide introduced through the anteromedial portal. The tip of the guide is placed slightly medial to the center of the intercondylar notch, 7mm anterior to the PCL, on a line joining the inner edge of the anterior horn of lateral meniscus.¹² Drilling is performed in the anteromedial tibia then it is over drilled with a cannulated drill. With a suture passer, the graft can be passed into the knee by passing a nylon loop shuttle suture through the joint (Figure 10). It will be fixed by a suspensory device in the femoral side, cyclic loading will be performed then the tibial side will be fixed using a bioabsorbable screw with the knee in 30 degrees knee flexion.

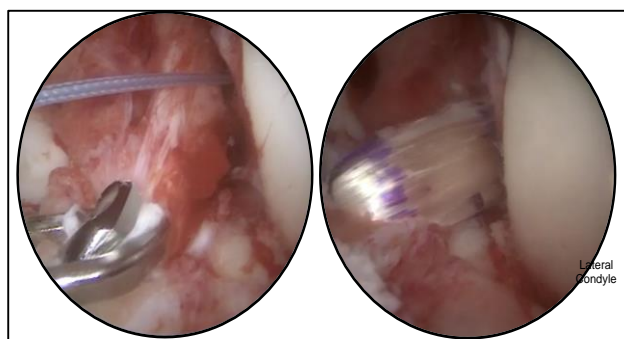


Figure 9: Tibial tunnel creation and graft passage.

POST OPERATIVE REHABILITATION

Post operative rehabilitation is based upon the ACLR rehabilitation and consists of brace free, immediate full weight bearing and progressive range of motion exercises.⁹ Non weight bearing for 4 weeks with restriction of range of motion to 0-90 degrees for 6 weeks for patients who underwent meniscal repair. Early rehabilitation focused on maintaining full extension and quadriceps activation exercises.

DISCUSSION

Since the initial technique introduced by Lemaire in 1967, several different variations of the LET procedure have emerged.¹⁷ These variations aim to address the anterolateral complex deficiency in the knee. Studies have demonstrated that the anterolateral soft tissue structures of the knee play a significant role in contributing to anterolateral rotary stability. As a result, there is an increasing interest in utilizing LET and anatomic ALL procedures to help prevent residual anterolateral instability following ACL reconstruction.^{18,19}

This technical note describes how to avoid tunnel convergence when performing a combined ACL reconstruction and LET by utilizing the far antero medial

portal as the “Antero Medial window”. This allows direct visualization of the ACL femoral tunnel while drilling and passing the guide pin for the LET femoral fixation site. Violation or collision of the tunnels during passage can easily be adjusted and corrected by doing this technique.

Tunnel convergence has been reported in the literature and it was more frequently observed in combined ACL and LET using modified Lemaire technique.^{9,14,16} However, the benefit of adding LET to selected population outweighs this risk, as this procedure demonstrated the effectiveness in restoring anterior translational stability and persistent rotational instability following the surgery.²⁰

Recent studies show that the addition of LET to ACL reconstruction results in a statistically significant reduction in graft failure.¹³ Failure rates are >50% lower in young patients at high risk of reinjury.¹

CONCLUSION

In summary, this technique describes how to avoid tunnel collision or convergence in combined ACL reconstruction and LEAT procedures by utilizing the “antero medial window”. It is a reliable and reproducible technique that can greatly decrease the chance of failure during this kind of procedures.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: Not required

REFERENCES

1. Guarino A, Farinelli L, Iacono V, Screpis D, Piovan G, Rizzo M et al. Lateral extra-articular tenodesis and anterior cruciate ligament reconstruction in young patients: clinical results and return to sport. *Orthop Rev (Pavia)*. 2022;14(2):33696.
2. Sebastian A, Lars S, Gaston C, Hector Z, Jorge C, Francisco V, Roberto Y. Lateral Extra-articular Tenodesis: A Technique with an Iliotibial Band Strand Without Implants. *Arthroscopy Techn*. 2021;10(1):e85-9.
3. Jacquet C, Pioger C, Seil R, Khakha R, Parratte S, Steltzlen C et al. Incidence and Risk Factors for Residual High-Grade Pivot Shift After ACL Reconstruction with or Without a Lateral Extra-articular Tenodesis. *Orthop J Sports Med*. 2021;9(5):23259671211003590.
4. Cerciello S, Batailler C, Darwich N, Neyret P. Extra-Articular Tenodesis in Combination with Anterior Cruciate Ligament Reconstruction: An Overview. *Clin Sports Med*. 2018;37(1):87-100.
5. Jacquet C, Pioger C, Seil R, Khakha R, Parratte S, Steltzlen C et al. Incidence and Risk Factors for Residual High-Grade Pivot Shift After ACL Reconstruction with or Without a Lateral Extra-

- articular Tenodesis. *Orthop J Sports Med.* 2021;9(5):23259671211003590.
6. Monaco E, Carrozzo A, Saithna A, Conteduca F, Annibaldi A, Marzilli F, Minucci M, Sonnery-Cottet B, Ferretti A. Isolated ACL Reconstruction Versus ACL Reconstruction Combined With Lateral Extra-articular Tenodesis: A Comparative Study of Clinical Outcomes in Adolescent Patients. *Am J Sports Med.* 2022;50(12):3244-55.
 7. Jesani S, Getgood A. Modified Lemaire Lateral Extra-Articular Tenodesis Augmentation of Anterior Cruciate Ligament Reconstruction. *JBJS Essent Surg Tech.* 2019;9(4):e41.1-7.
 8. Moatshe G, Brady AW, Slette EL, Chahla J, Turnbull TL, Engebretsen L et al. Multiple Ligament Reconstruction Femoral Tunnels: Intertunnel Relationships and Guidelines to Avoid Convergence. *Am J Sports Med.* 2017;45(3):563-9.
 9. Frank RM, Hamamoto JT, Bernardoni E, Cvetanovich G, Bach BR Jr, Verma NN et al. ACL Reconstruction Basics: Quadruple (4-Strand) Hamstring Autograft Harvest. *Arthrosc Tech.* 2017;6(4):e1309-13.
 10. Zhu M, Han Lee DY, Williams A. Safe Femoral Fixation Depth and Orientation for Lateral Extra-Articular Tenodesis in Anterior Cruciate Ligament Reconstruction. *Orthop J Sports Med.* 2021;9(1):2325967120976591.
 11. Kamei G, Ochi M, Usman MA, Mahmoud EH. A new technique to avoid articular cartilage injury in anterior cruciate ligament reconstruction through far antero-medial portal. *Orthop Traumatol Surg Res.* 2014;100(7):827-30.
 12. Garofalo R, Moretti B, Kombot C, Moretti L, Mouhsine E. Femoral tunnel placement in anterior cruciate ligament reconstruction: rationale of the two incision technique. *J Orthop Surg Res.* 2007;2:10.
 13. Getgood A. Editorial Commentary: Indications for Lateral Extra-Articular Tenodesis in Primary Anterior Cruciate Ligament Reconstruction. *Arthroscopy.* 2022;38(1):125-7.
 14. Graeme PH, Abdo EH, Corentin P, Joao PC, Thais DV, Sonnery-Cottet B. How to Avoid Knee Tunnel Convergence When Performing a Modified Lemaire Extra-Articular Tenodesis. *Arthroscopy Techn.* 2022;11(6):e1111-5.
 15. Satyen J, Getgood A. Modified Lemaire Lateral Extra-Articular Tenodesis Augmentation of Anterior Cruciate Ligament Reconstruction. *JBJS Essential Surgical Techn.* 2019;9(4):e41(1-7).
 16. Jaecker V, Ibe P, Endler CH, Pfeiffer TR, Herbort M, Shafizadeh S. High Risk of Tunnel Convergence in Combined Anterior Cruciate Ligament Reconstruction and Lateral Extra-articular Tenodesis. *Am J Sports Med.* 2019;036354651985422.
 17. Kennedy MI, Claes S, Fuso FA. The anterolateral ligament: An anatomic, radiographic, and biomechanical analysis. *Am J Sports Med* 2015;43:1606-15.
 18. Spencer L, Burkhart TA, Tran MN. Biomechanical analysis of simulated clinical testing and reconstruction of the anterolateral ligament of the knee. *Am J Sports Med.* 2015;43:2189-97.
 19. Bernholt DL, Mitchell IK, Matthew DC, Nicholas ND, Robert FL. Combined Anterior Cruciate Ligament Reconstruction and Lateral Extra-Articular Tenodesis. *Arthroscopy Techn.* 2019;8(8):e855-9.
 20. Temperato J, Clayton WN. Lateral Extra-articular Tenodesis with Iliotibial Band Using Knotless All-Suture Anchor Femoral Fixation. *Arthroscopy Techn.* 2023;12(5):e677-82.

Cite this article as: Espiritu WPA, Sanchez MMR. How to avoid knee tunnel convergence when performing a combined anterior cruciate ligament reconstruction and lateral extraarticular tenodesis utilizing the antero medial window. *Int J Res Orthop* 2023;9:1292-7.