



Original Research Article

TUNNEL-IN-TUNNEL CONFIGURATION FOR COMBINED ANTERIOR CRUCIATE LIGAMENT RECONSTRUCTION AND MENISCAL ROOT REPAIR: A CASE REPORT

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Abstract: Combined anterior cruciate ligament (ACL) rupture with concomitant meniscal root tear is a complex injury pattern that significantly alters knee biomechanics and accelerates degenerative changes if inadequately treated. Simultaneous ACL reconstruction and meniscal root repair are technically challenging due to limited tibial footprint and risk of tunnel convergence. The tunnel-in-tunnel configuration has emerged as a practical solution to address these challenges. We report a case of combined ACL rupture and medial meniscal posterior root tear managed using a tunnel-in-tunnel technique. The approach enabled anatomic reconstruction of both structures while avoiding tunnel collision. The patient achieved satisfactory functional recovery with restoration of knee stability. This case highlights the feasibility and clinical relevance of the tunnel-in-tunnel configuration in managing combined ligamentous and meniscal root injuries.

Keywords: Anterior cruciate ligament; Meniscal root tear; Tunnel-in-tunnel technique; Knee arthroscopy; Combined injury

INTRODUCTION

Anterior cruciate ligament (ACL) injuries are among the most common sports-related knee injuries worldwide, particularly affecting young and physically active individuals.¹ Globally, the incidence of ACL tears continues to rise with increasing participation in competitive and recreational sports.² In India, ACL injuries constitute a substantial proportion of knee ligament injuries presenting to tertiary care centers, especially among young athletes and manual workers.³ Meniscal injuries frequently coexist with ACL rupture, with increasing recognition of meniscal root tears as a distinct and clinically significant entity. Biomechanically, meniscal root tears are equivalent to total meniscectomy, leading to loss of hoop stresses, increased tibiofemoral contact pressures, and early osteoarthritis.⁴ Failure to identify and repair meniscal root tears during ACL reconstruction may compromise joint stability and long-term outcomes.

Several biomechanical and clinical studies have demonstrated that untreated meniscal root tears in ACL-deficient knees contribute to persistent instability and accelerated cartilage degeneration [5]. Consequently, simultaneous ACL reconstruction and meniscal root repair is now recommended to restore near-normal knee biomechanics.^{5,6}

However, performing both procedures concurrently presents technical challenges, particularly during tibial tunnel creation. The proximity of the ACL tibial footprint and the meniscal root attachment increase the risk of tunnel convergence, compromised fixation, and weakening of tibial bone stock. Various strategies have been described to overcome this, among which the tunnel-in-tunnel configuration offers a simple and reproducible solution. Indian literature on this technique remains limited, warranting further clinical reporting.⁷ We present a case managed using this approach, highlighting surgical technique and outcome.

Case Report

A 26-year-old male presented with pain, recurrent swelling, and episodes of instability in the right knee following a twisting injury sustained during recreational sports three months prior. There was no history of previous knee surgery.

Clinical examination revealed a positive Lachman test and anterior drawer test, suggestive of ACL insufficiency. Medial joint line tenderness was present, and McMurray test elicited pain. Knee range of motion was 0–120°, with mild discomfort at terminal flexion.

Magnetic resonance imaging (MRI) demonstrated a complete ACL rupture with a posterior root tear of the medial meniscus, accompanied by mild meniscal extrusion. Articular cartilage surfaces were preserved.

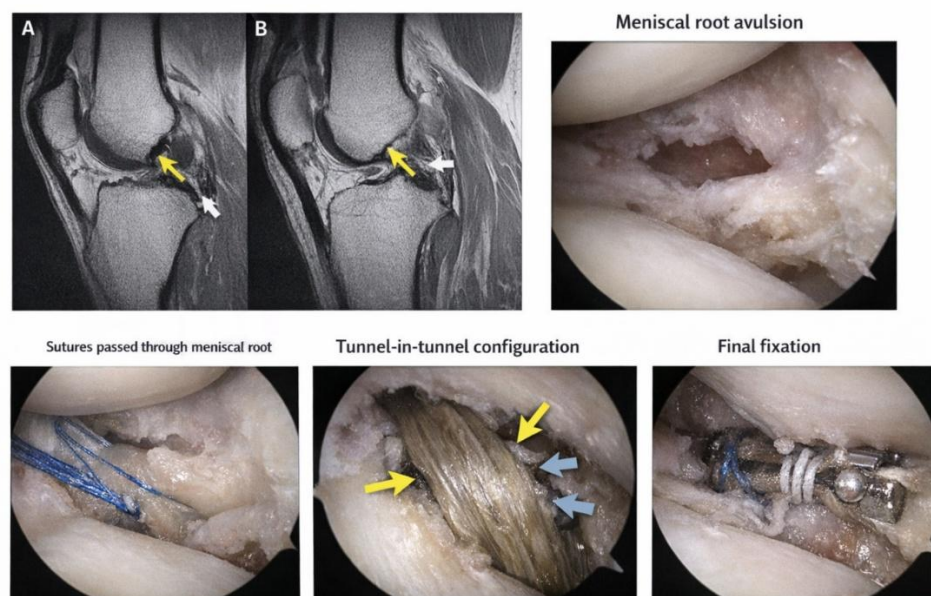
Given the combined injury pattern, arthroscopic ACL reconstruction with medial meniscal posterior root repair using a tunnel-in-tunnel configuration was planned.

Surgical Technique

Arthroscopy confirmed a complete ACL rupture and avulsion-type posterior root tear of the medial meniscus.

Two high-strength sutures were passed through the meniscal root using a suture-passing device. A single tibial tunnel was created using an ACL tibial guide, positioned to allow both anatomic ACL graft placement and meniscal root fixation without tunnel collision. The meniscal root sutures were shuttled through the same tibial tunnel.

ACL reconstruction was performed using a quadrupled hamstring autograft. Femoral fixation was achieved using a suspensory device, and tibial fixation was secured with an interference screw. The meniscal root sutures were tied over a cortical button on the anteromedial tibial cortex, creating a tunnel-in-tunnel configuration.



Postoperative Rehabilitation

The patient was placed in a hinged knee brace. Partial weight-bearing was allowed for six weeks. Range-of-motion

exercises were initiated early, with restriction of deep flexion and squatting for three months to protect the meniscal repair.

Outcome

At six-month follow-up, the patient had no pain or instability. Knee examination showed a negative Lachman test and full range of motion. The patient returned to low-impact sports without difficulty

DISCUSSION

Combined ACL rupture and meniscal root tear significantly alters knee biomechanics, leading to increased joint loading and risk of early osteoarthritis if inadequately addressed.⁸ Several biomechanical studies have demonstrated that meniscal root tears result in increased tibiofemoral contact pressures comparable to total meniscectomy.⁹

Clinical studies have shown that isolated ACL reconstruction without meniscal root repair may lead to persistent instability and inferior outcomes. Therefore, addressing both pathologies in a single surgical setting is increasingly advocated.^{10,11} However, simultaneous ACL reconstruction and meniscal root repair pose technical difficulties due to the close anatomical relationship between the ACL tibial footprint and the meniscal root attachment. Tunnel convergence has been reported as a significant intraoperative concern, potentially compromising graft fixation and tibial integrity. The tunnel-in-tunnel configuration provides a practical solution by utilizing a shared or overlapping tibial tunnel trajectory. This technique preserves bone stock, simplifies tunnel placement, and avoids convergence.¹² Previous reports have demonstrated satisfactory biomechanical stability and clinical outcomes using this approach.¹³ In the present case, the tunnel-in-tunnel technique allowed secure fixation of both the ACL graft and meniscal root repair without compromising anatomic positioning. Similar findings have been reported in recent arthroscopic series, where this configuration minimized technical complexity and reduced operative morbidity.¹⁴

From an Indian perspective, where delayed presentation and resource constraints are common, techniques that reduce operative time and hardware usage are particularly valuable.¹⁵ The tunnel-in-tunnel configuration aligns well with these practical considerations.

Although short-term outcomes are encouraging, long-term follow-up is required to assess graft survivorship, meniscal healing, and prevention of degenerative changes. Nevertheless, this case supports existing evidence that the tunnel-in-tunnel configuration is a reliable option in combined ACL and meniscal root injuries.¹⁶

CONCLUSION

The tunnel-in-tunnel configuration is an effective and

reproducible technique for managing combined ACL rupture and meniscal root tear. It facilitates anatomic repair, avoids tunnel convergence, and yields favourable early functional outcomes. This approach should be considered when performing simultaneous ACL reconstruction and meniscal root repair.

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