Open Journal of Orthopedics, 2026, 16(2), 38-45
https://www.scirp.org/journal/ojo
ISSN Online: 2164-3016
ISSN Print: 2164-3008

Arthroscopic Quadriceps Tendon Repair—The JRC Technique

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How to cite this paper: Espiritu, W.P.A., Go, J.A., Ngo, R.J.Y., Barroga, C.I.F. and Virola, C.A.T. (2026) Arthroscopic Quadriceps Tendon Repair—The JRC Technique. *Open Journal of Orthopedics*, **16**, 38-45.
https://doi.org/10.4236/ojo.2026.162005

Received: December 28, 2025
Accepted: February 2, 2026
Published: February 5, 2026

Abstract

The quadriceps femoris tendon is a critical component of the extensor mechanism and one of the strongest tendons in the human body. It is a robust tendon composed of four layers. Quadriceps tendon ruptures (QTR) can result from trauma or systemic causes that lead to loss of quadriceps tendon strength, resulting in pain, loss of active knee extension, and a prolonged rehabilitation course. Techniques described in the literature for QTR repair are predominantly open surgeries that utilize either suture anchors or bone tunnels. However, limited data are available regarding arthroscopic techniques. This technical note describes a surgical technique for arthroscopic quadriceps tendon repair utilizing the Jose Reyes Configuration (JRC) technique. This configuration is characterized by a combined use of a single suture anchor and two bone tunnels for stabilization, aiming for enhanced biomechanical alignment and cost-efficiency.

Keywords

Arthroscopic Quadriceps Tendon Repair, Quadriceps Tendon Rupture, Quadriceps Tendon

1. Introduction

The quadriceps femoris tendon constitutes a crucial component of the human motor system and ranks among the strongest tendons in the human body [1]. It is composed of a robust unit of tendon made up of four different layers [2]. The layers are: the independent first layer formed by the rectus femoris tendon; the second layer formed by the superficial parts of the vastus lateralis and vastus medialis; the third layer formed by the intermediate part of the vastus lateralis; and the deepest fourth layer composed of the vastus intermedius [2].

The principal role of the quadriceps is to facilitate the extension of the knee joint, which is essential for standing up, walking, running, jumping, kicking, and squatting [3]. Its functions affect the knee joint, hip joint, posture, walking, and the relationship between the pelvis and the spine [4]. The rectus femoris can flex the hip, while its synergistic action with the vastus lateralis, vastus medialis, and vastus intermedius extends the knee [4]. Structurally and biomechanically, the quadriceps tendon can withstand very high loads without rupture [5].

Quadriceps tendon rupture (QTR) is relatively uncommon but can result in substantial disability, because active knee extension is compromised and the quadriceps is central to mobility [6]. QTR most often arises in middle-aged to older adults with comorbidities or degenerative tendon changes, and in younger patients after direct trauma [6]. Patients typically report a sudden, painful event, often a stumble or attempted recovery from a fall, sometimes with a popping or tearing sensation. Symptoms include anterior knee pain, swelling, bruising around the superior patella or anterior thigh, difficulty bearing weight, and loss of active knee extension [7]. Magnetic Resonance Imaging (MRI) is the gold-standard test for diagnosis, providing a sensitivity, specificity, and positive predictive value of 1.0.7 MRI is also the modality of choice for confirming the site and grade of rupture, assessing retraction and tissue quality, and facilitating pre-operative planning [8].

Although some partial tears can be treated conservatively, surgical repair is recommended for most complete tears due to the functional limitations associated with an incompetent extensor mechanism [9]. The common procedure to reattach the torn quadriceps tendon is transosseous repair, which involves passing high tensile-strength suture through parallel tunnels drilled into the patella [9]. Recent studies suggest that transosseous and suture anchor techniques for QTR yield similar biomechanical and postoperative outcomes, with no observed difference in ultimate load-to-failure among comparative biomechanical studies [10] [11]. Arthroscopic techniques have also been described using transosseous tunnels or suture anchors [10] [12].

This technical note aims to present the Jose Reyes Configuration (JRC), an original and reproducible arthroscopic technique for QTR repair. The JRC differs from conventional techniques by utilizing only two slightly oblique transosseous tunnels (instead of three parallel ones) and one suture anchor (instead of two to three). The use of two oblique tunnels is designed to recreate the native, slightly oblique insertion orientation of the vastus medialis and vastus lateralis fibers on the patella as well as to make one of the steps of the technique easier to execute by eliminating the need for manual manipulation of the patella just to achieve a straight and parallel tunnels seen in other arthroscopic repair technique described which is somehow difficult to do when the knee is distended by fluids during arthroscopy [10] [12]. This configuration also offers improved cost-efficiency due to reduced implant utilization [12].

2. Objective

The objective of this study is to present a surgical technique on how to perform an arthroscopic quadriceps repair utilizing the "Jose Reyes Configuration (JRC)" technique.

3. Surgical Technique

This technical note describes how to perform an arthroscopic quadriceps repair utilizing the "Jose Reyes Configuration (JRC)" technique. The JRC differs from conventional techniques by utilizing only two slightly oblique transosseous tunnels (instead of three parallel ones) and one suture anchor (instead of two to three). The advantages and disadvantages of this technique are summarized in **Table 1**.

Table 1. The advantages and disadvantages of JRC technique.

Advantages	Disadvantages
Requires fewer implants	Requires a steep learning curve compared to open technique
Requires fewer bone tunnels	
Side tunnels are almost aligned with the arthroscopic portals	
Minimally invasive technique compared to the conventional open technique	

3.1. Patient Positioning and Landmarks

The patient is placed in a supine position on the operating table. Initially, the knee is maintained on 90 degrees of knee flexion. Appropriate landmarks are palpated and marked, including patella, patellar tendon, joint line and AL portal. Other portals will be created with needle guidance.

3.2. Diagnostic Arthroscopy and Portal Placement

Insert the arthroscope through the anterolateral (AL) portal with the knee in full extension viewing the suprapatellar recess. Slowly retract the arthroscope until the stump of the ruptured quadriceps tendon is seen (**Figure 1**). Using a gauge 18 spinal needle, insert the needle on the lateral side at the level of the stump via outside-in technique (**Figure 2**). Once trajectory and level is confirmed, make a superolateral (SL) portal using a blade number 11 and place a PassPort cannula. Repeat this on the medial side creating the superomedial (SM) portal. Alternatively, the creation of a superomedial (SM) portal can be guided by transillumination from the SL portal.

Create far superolateral (FSL) and far superomedial (FSM) portals at the same level of the SL and SM portal. Making sure that the location of the FSL and FSM can allow the drilling of the superior pole of the patella.

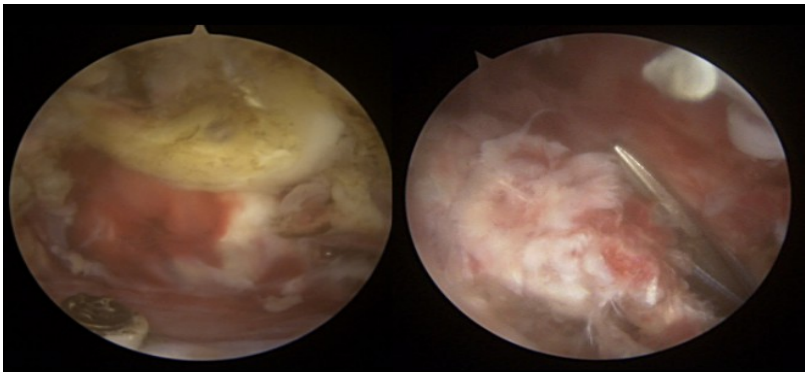

Figure 1. Stump of the ruptured quadriceps tendon.

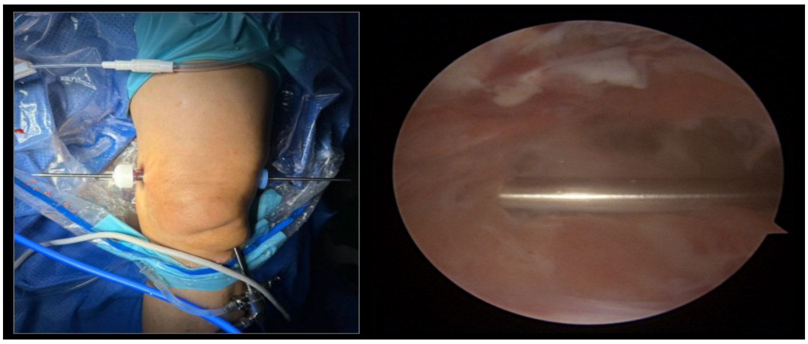

Figure 2. The needle on the lateral side at the level of the of the stump via outside in technique.

3.3. Quadriceps Repair

Viewing from the AL portal and switching from time to time to the SM portal, freshen up the stump of the torn quadriceps tendon using a radiofrequency probe (Figure 3). Tendon debridement is continued extra-articularly over the anterior side of the tendon until there is room for a suture passer. Focus now will be shifted to the superior pole of the patella, remove any unstable fibers and reach up to the bleeding bone using an arthroscopic shaver inserted through the SM portal and viewing from the SL portal or vice versa.

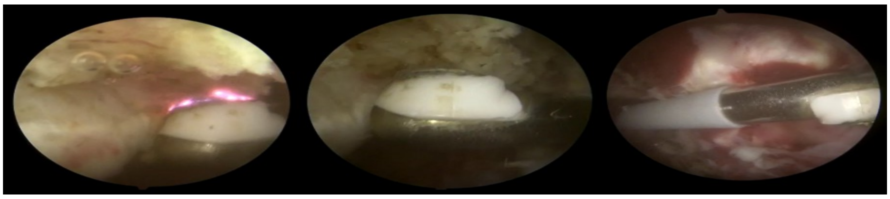

Figure 3. Freshen up the stump of the torn quadriceps tendon using a radiofrequency probe.

Once preparation of the tendon stump and superior patellar pole is done, suture both sides of the patellar tendon by placing 3 - 4 luggage tags using #2 FiberWire on both sides (Figure 4). Using the FSL portal, insert a BitPin and drill through the patella at 30 to 45 degrees trajectory with C arm guidance. AP and lateral views of the knee in extension are used for BitPin positioning (**Figure 5**). Do the same on the medial side of the patella using the FSM portal. Pass the 3 limbs of the luggage tags and do the same on the other side of the patella. Tie all FiberWire sutures at the inferior pole of the patella (**Figure 6**). Using the Arthrex scorpion, pass a FiberTape through the central part of the quads tendon twice parallel to each other creating a horizontal mattress, both limbs of this suture will be fixed to the central part of the patella using a 4.75 mm.

Using the Arthrex scorpion, pass a FiberTape through the central part of the quads tendon twice parallel to each other creating a horizontal mattress, both limbs of this suture will be fixed to the central part of the patella using a 4.75 mm Biocomposite knotless suture achor (**Figure 7**).

Figure 4. Suture both sides of the patellar tendon by placing 3 - 4 luggage tags using #2 FiberWire on both sides.

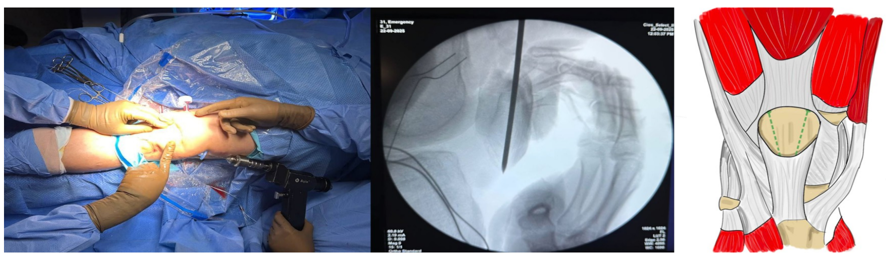

Figure 5. Inserting a BitPin and drill through the patella at 30 - 45 degrees trajectory with C arm guidance. AP and lateral views of the knee in extension are used to BitPin positioning.

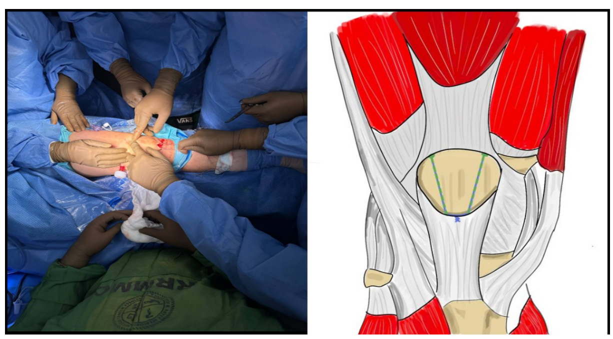

Figure 6. Tying all FiberWire sutures at the inferior pole of the patella.

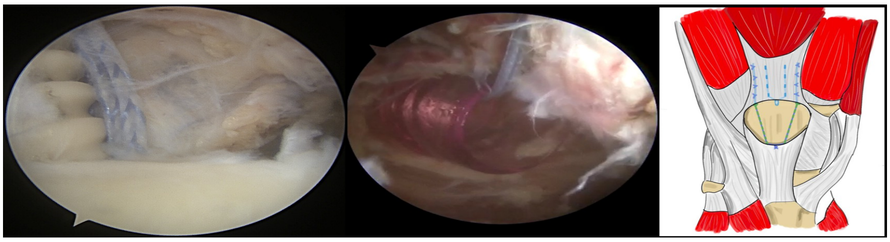

Figure 7. Using the Arthrex scorpion, passing a FiberTape through the central part of the quads tendon twice parallel to each other creating a horizontal mattress, both limbs of this suture will be fixed to the central part of the patella using an Arthrex 4.75mm Knotless Swivelock.

3.4. Post OP Rehabilitation

Weight bearing as tolerated with crutches is allowed immediately while the patient wears a knee extension brace for 6 weeks. Passive range of motion work is initiated on day 3 at 30˚ and gradually to be able to flex 90 degrees at 8 weeks after surgery, 120 degrees at 12 weeks and full flexion at 6 months [10] [12]. At 6 weeks post operatively, wean assistive devices if any are still used.

4. Discussion

Quadriceps tendon ruptures (QTR) have a positive correlation with age and multiple medical comorbidities, contrasting with patellar tendon ruptures which commonly occur before age 40 and are often related to sports injuries [5]. A reliable and reproducible technique with minimal soft tissue violation is crucial to decreasing the chance of failure and improving patient outcomes.

Common repair procedures involve open surgery using either transosseous tunnels or suture anchors. Recent comparative studies show similar biomechanical and postoperative outcomes between transosseous and suture anchor techniques, with no significant difference observed in the ultimate load to failure [13].

The goal of this technical note is to describe an original and reproducible method for arthroscopic reattachment of the quadriceps tendon using the JRC technique. Two patients in our institution underwent QTR repair utilizing this technique with good 1 year follow up both returning to their preinjury state. The primary differentiators of the JRC technique are:

- Reduced Tunnels: It utilizes two transosseous tunnels instead of the conventional three, which decreases the risk of tunnel convergence and the potential for iatrogenic patellar fracture.
- Reduced Implants & Cost: It employs only one suture anchor instead of two to three, making the technique more cost-efficient.
- Biomechanical Trajectory: The trajectory of the two transosseous tunnels is not parallel but slightly oblique. This configuration is designed to recreate the oblique attachment of the quadriceps tendon's side layers (Vastus Medialis and Vastus Lateralis fibers) on the superior pole of the patella. Recreating this native orientation enhances reproducibility by eliminating the need for manual patellar manipulation, which is often required to create perfectly parallel tun-

nels seen in other techniques [10]. The positioning of the FSL and FSM portals naturally creates the ideal trajectory for this configuration [14] [15].

5. Conclusions

In summary, this technical note describes an arthroscopic quadriceps tendon repair utilizing the "JRC" technique. This method is reliable and reproducible, offering significant advantages in terms of cost-efficiency by using only one suture anchor instead of three. By utilizing only two bone tunnels, the technique reduces the risk of iatrogenic patellar fractures while simultaneously recreating the native, oblique trajectory of the quadriceps fibers. Furthermore, although the arthroscopic technique has a steeper learning curve compared to open technique, the JRC technique simplifies one of the steps in the procedure by eliminating the need for manual manipulation of the patella to achieve a parallel tunnel seen in other arthroscopic techniques.

Further clinical studies with larger patient cohorts and long-term follow-up are warranted to evaluate the biomechanical durability and functional outcomes of the JRC technique compared to traditional open or arthroscopic repairs. Additionally, prospective comparative trials could help quantify the potential reduction in post-operative pain and recovery time associated with this minimally invasive approach.

Funding

No funding sources.

Ethical Approval

Not required.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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