Technical Note

Augmentation of Patellar Tendon Repair With Autologous Semitendinosus Graft—Porto Technique

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Abstract: Patellar tendon ruptures can lead to significant functional deficiency of the extensor mechanism of the knee. These injuries, because of their inherent nature and associated complications, may require a complex treatment and remains a challenge for orthopaedic surgeons. Current surgical techniques present significant complications, including patellar fracture, damage to patellar articular cartilage, and abnormal patella height. This note describes a surgical technique to provide an additional reinforcement to the patellar tendon repair with a semitendinous autograft, without the necessity to perform any transosseous tunnels at the patella bone. First, the patellar tendon is repaired with an end-to-end technique and the semitendinous tendon is harvested. A transosseous tunnel at the tibial tubercle is drilled and 2 rents are made, both medial and lateral to the retinaculum at the level of the intermedial segment of the patella close to the patellar margin. The graft is passed through the tunnel and rents in a U-shaped form. The graft is sutured along the length of the patellar tendon on both margins in tension at 30° of knee flexion. Fluoroscopy imaging is performed to assess the patella height. This technique provides a significant augmentation of patellar tendon, avoiding the potential patella bone tunnel complications.

Patellar tendon ruptures and their treatment have been a challenge because of the inherent nature of the injury, treatment complexity, and the various associated complications. Although relatively uncommon, ruptures of the patellar tendon cause significant functional deficiency to the knee's extensor mechanism.[1] Several surgical treatment methods have emerged, including an end-to-end suturing of the rupture with nonabsorbable sutures, augmentation using encircling wires or Dall-Miles cables, synthetic grafts, allografts, autografts such as the semitendinosus and gracilis tendons as contralateral bone—patellar tendon—bone grafts.[2]

Kelikian et al.[3] first described the use of semitendinosus tendon graft for augmentation of patellar tendon rupture in cases where there was an extensive fraying of the torn edges and the end-to-end repair alone was not suitable. Subsequently, investigators have been describing variations of this principle, using different methods to anchor the autograft.[4-6] These surgical techniques describe a transosseous tendon repair through a transversal tunnel in the patella. Despite providing a stable method of fixation of the graft, they could result in potential complications. Commonly observed complications due to tunnelling include patellar fracture, damage to patellar articular cartilage and patella alta or baja as a result of overtightening or undertightening.[7] In addition, a figure-of-8 placement of the graft[5,8] can cause a concentration of tension load over the patellar tendon and consequent

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Fig 1. Patient supine, left leg. Under anesthesia, the patellar tendon integrity is tested by palpation with the knee in full extension. In the figure, it is possible to observe an infrapatellar depression.

repair failure. Our Porto technique describes a method of augmentation with the semitendinosus graft, which ensures a complete repair of the patellar tendon while avoiding a transosseous tunnel and, consequently, complications above.

Surgical Technique

Preoperative Planning and Patient Setup

Preoperative imaging procedures include bilateral knee radiography and magnetic resonance to assess the patella height and tendon integrity.

At the operating room, the patient is supine and the affected limb is prepared for the surgery with a tourniquet in place. The operating room must be equipped with a C-arm (GE Healthcare, Waukesha, WI) to assess the patellar height. Under anesthesia, the surgeon manually tests the patellar tendon integrity with the knee in extension (Fig 1) by palpating the gap related to the tendon tear (Video 1). Consecutively, on flexing the knee (Fig 2), the absence of tendon integrity is highlighted and patella elevation is clearly observed.

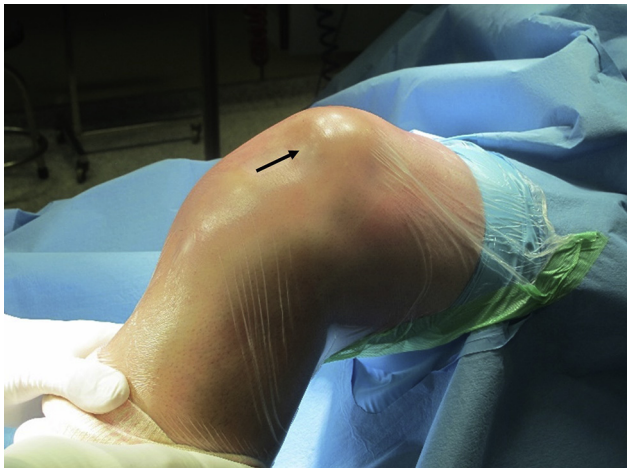

Fig 2. Patient supine, left leg. While flexing the knee, it is possible to observe the patella proximal mobilization (indicated by an arrow), exhibiting the absence of patellar tendon integrity.

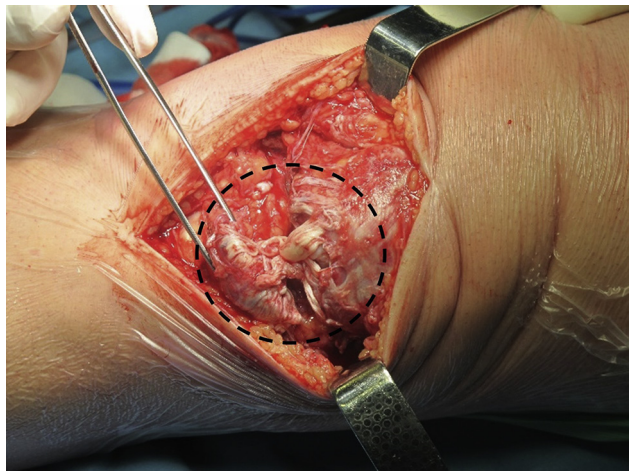

Fig 3. Patient supine, left leg. After dissection, the patellar tendon ends are exposed and visualized (exposed area displayed within the dotted circle).

Surgical Approach

A vertical incision along the midline is made from the inferior pole of the patella extending up to the tibial tuberosity. After careful subcutaneous dissection, the area of the rupture is exposed (Fig 3). If needed, the peritenon is longitudinally divided, exposing the proximal and distal ends of the tear. The proximal and distal ends of the patellar tendon are dissected and clearly identified.

Patellar Tendon Repair

Torn tendon fibers are carefully realigned to their anatomic position to allow normal patellar tracking (Table 1). After an adequate patella height is obtained, an end-to-end repair of the patellar tendon is done

Table 1. Surgical Key Points

The patellar tendon ends are dissected and carefully identified.
End-to-end repair of patella tendon is performed.
The semitendinous tendon is harvested from the ipsilateral side, at the pes anserine. A minimum of 22-cm-long graft is needed.
A 4.5-mm transversal transosseous tunnel at the tibial tubercle is made.
The graft is passed through the tunnel, from medial to lateral.
Two rents with an interval of 5 mm on both the medial and lateral retinaculum are made, close to the patellar margin.
The semitendinosus graft is passed through the rents, from distal to proximal.
The graft ends are looped and sutured in its own substance, creating an anchorage.
The graft is sutured along the length of the patellar tendon on both margins in tension.

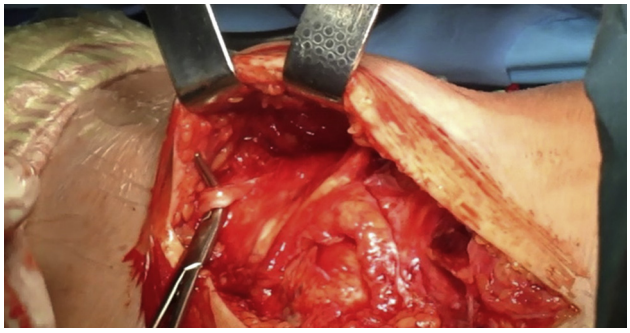

Fig 4. Patient supine, left leg. The semitendinosus tendon is identified and isolated at the pes anserine insertion, and harvested ipsilaterally using a tendon stripper.

using fibre wire (Arthrex, Naples, FL) with Krakow technique.[9] The optimal level of the patella is then confirmed comparing the preoperative knee contralateral images in lateral view, with the intraoperative image in lateral view obtained by fluoroscopy.

Harvesting Procedures

Next, the semitendinosus is identified and isolated at the pes anserine insertion. Using a tendon stripper, the semitendinosus is harvested (Fig 4), releasing its tibial insertion. The ends of the graft are sutured by Bunnell stitches using Vicryl sutures (Ethicon, Johnson & Johnson, Somerville, NJ). The semitendinosus graft is prepared and cleaned. The graft is measured to be at least 22 cm long (Fig 5) to comprise the length required to cover the borders of the patellar tendon and quadricipital retinaculum (Fig 6).

Patellar Tendon Autograft Augmentation

A guidewire is passed from medial to lateral side, 1 cm posterior to the tibial tuberosity. A 4.5-mm transversal transosseous tunnel is made using a drill over the guidewire (Fig 7). The graft is then passed through the tibial tunnel from the medial to the lateral side (Fig 8).

The surgeon creates 2 incision rents, one proximal and other distal on both the medial and lateral retinaculum, with an interval of 5 mm, close to the patellar margin (Fig 9). Next, the semitendinous graft is inserted through the retinaculum rents from distal to proximal, on either side of the patella (Fig 10). Then, with the knee at 30° flexion, the graft ends are looped (Fig 11) and sutured over its one substance using Vicryl sutures (Fig 12). The graft is sutured in tension along the length

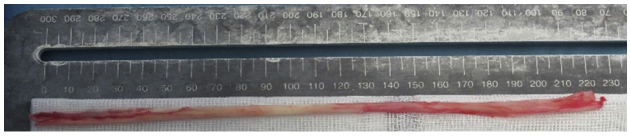

Fig 5. The harvested semitendinosus graft is prepared, cleaned, and measured to ensure that it is at least 22 cm long.

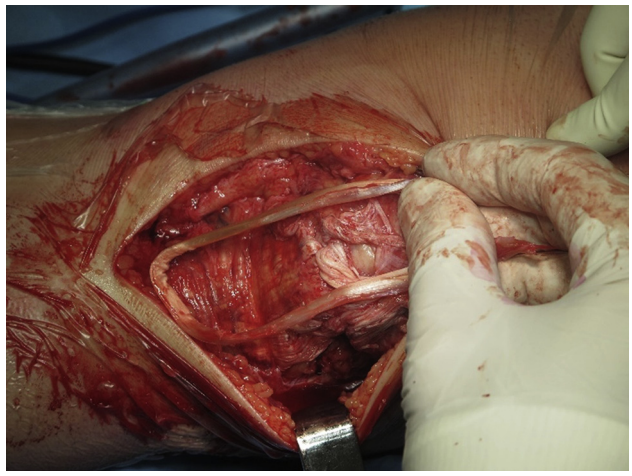

Fig 6. Patient supine, left leg. The graft is placed over the borders of the patellar tendon and quadricipital retinaculum in a U-shaped fashion to confirm the graft length suitability.

of the patellar tendon on both margins, to allow adequate range of motion (Fig 13). The final result is a completely restored and reinforced patellar tendon, without increasing the patellar height (Fig 14). Postoperative fluoroscopy imaging should be performed to confirm the patella height.

Postoperative Rehabilitation

For the first 6 weeks postoperatively, the patient uses a knee brace in full extension. Passive mobilization is encouraged immediately and limited to 90° of flexion. Additionally, partial weight-bearing is allowed with 2 crutches.

After the 6 weeks, passive and active range of motion is increased as tolerated and full weight-bearing is gradually permitted. Rehabilitation is focused on restoring full knee range of motion, patellar mobilization, preoperative

Fig 7. Patient supine, left leg. The 4.5 mm transversal transosseous tunnel is made from medial to the lateral side (arrow), at 1 cm posterior to the tibial tubercle.

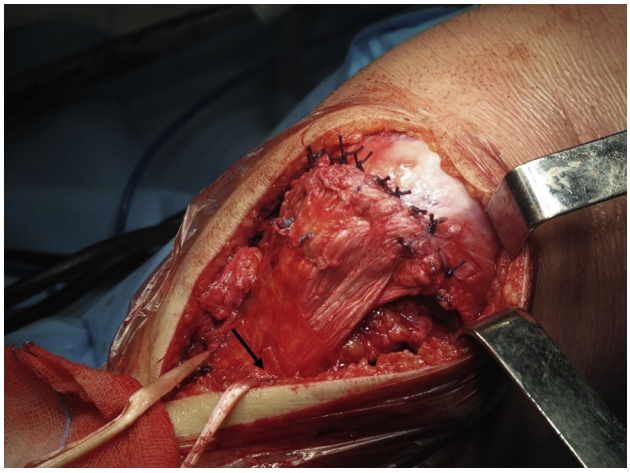

Fig 8. Patient supine, left leg. The graft is passed through the tibial tunnel, from medial to lateral (arrow).

quadriceps muscle activation and strength, effusion control, and pain management. Return to sports is not allowed before 6 months and usually achieved at 9 months.

Discussion

Patellar tendon ruptures may result from a variety of causes ranging from trauma to a spontaneous rupture, either in chronic patellar tendon irritation or patellar tendon degeneration due to systemic inflammatory illnesses.[1] A traumatic rupture, often seen in young sportspersons, classically occurs as a result of an eccentric overload of the quadriceps while the foot is planted and the knee is in flexion.[10] The site of injury is usually near the distal pole of the patella where an avulsion of the tendon may occur. Midsubstance tears and an avulsion from the tibial tuberosity have also been reported, though less frequently.[2] In any case, surgical repair is warranted for complete restoration of the extensor mechanism.

The repair and augmentation of the patellar tendon should focus on restoring the quadriceps mechanism function and the congruity of the patellofemoral joint to avoid cartilage lesions, achieving an adequate range of motion and splinting of the patellar tendon to allow early mobilization while preserving its vascularity for satisfactory healing.[5] The end-to-end direct repair method is used in isolation and requires prolonged immobilization and can lead to failure as a result of

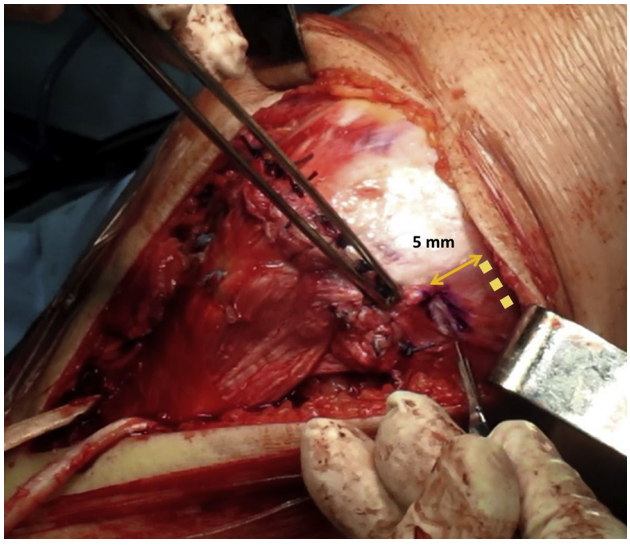

Fig 9. Patient supine, left leg. Two incision rents are made, medially and laterally to the retinaculum, at the level of the intermedial segment of the patella close to the patellar margin. The second rent should be made 5 mm proximally to the initial rent (dotted line).

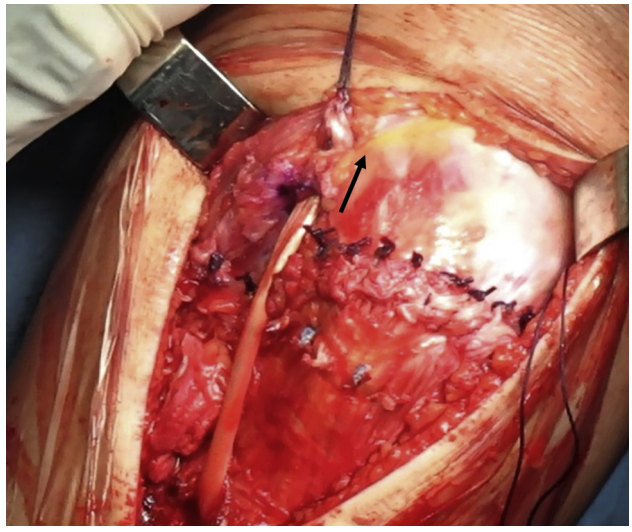

Fig 10. Patient supine, left leg. The graft is then inserted through the retinaculum rents. This should be accomplished from the distal rent to the proximal one (arrow).

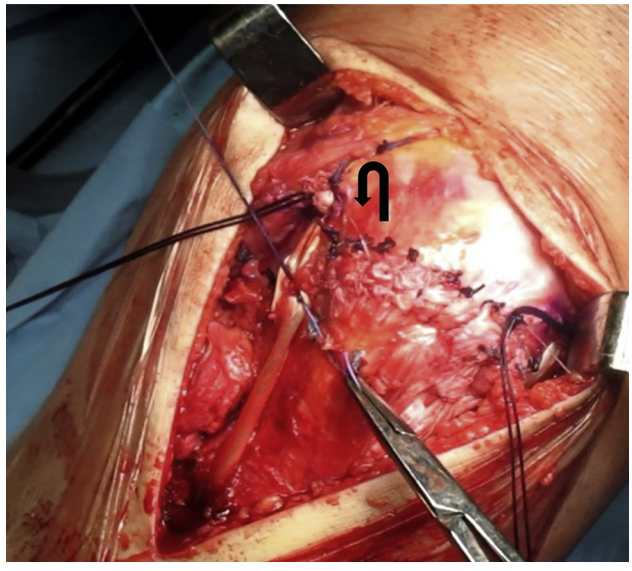

Fig 11. Patient supine, left leg. The graft is looped over the retinaculum rents (indicated by the curved arrow).

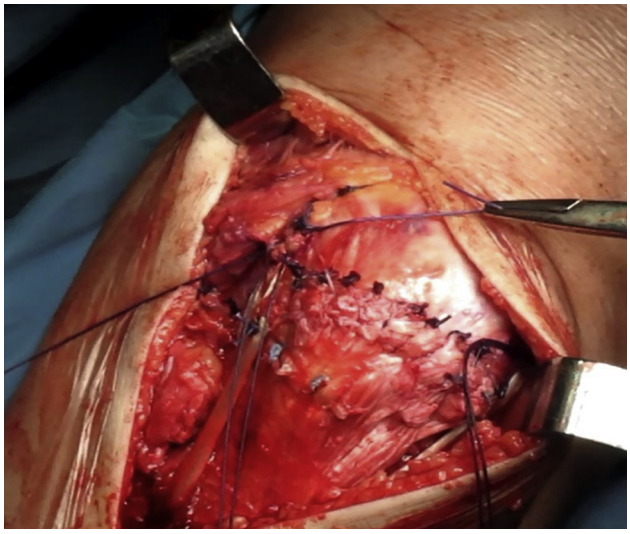

Fig 12. Patient supine, left leg. The graft is sutured on its own substance, creating an anchorage.

inadequate splinting of the tendon, quadriceps weakening, or a stiff knee.[6] Hence, augmentation is essential for early mobilization, protection of patellar tendon repair, and prevention of patella alta.

The extent of achievement of the goals of repair depends mainly on 2 factors: the nature and strength of the graft used and the method of fixation. Although various grafts such as allografts and synthetic grafts may be used, the semitendinosus graft is most suitable, as it is a robust indigenous local tissue and does not require any implant for fixation.[2] Previously described techniques using semitendinosus graft have involved the drilling of a transverse tunnel through the patella, for anchoring the tendon graft.[4-6] Such tunneling creates a

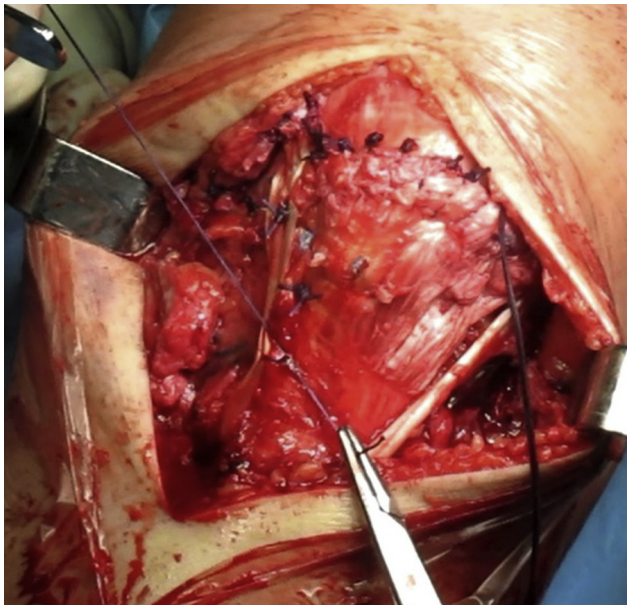

Fig 13. Patient supine, left leg. The graft is sutured in tension along the patellar tendon on both medial and lateral margins.

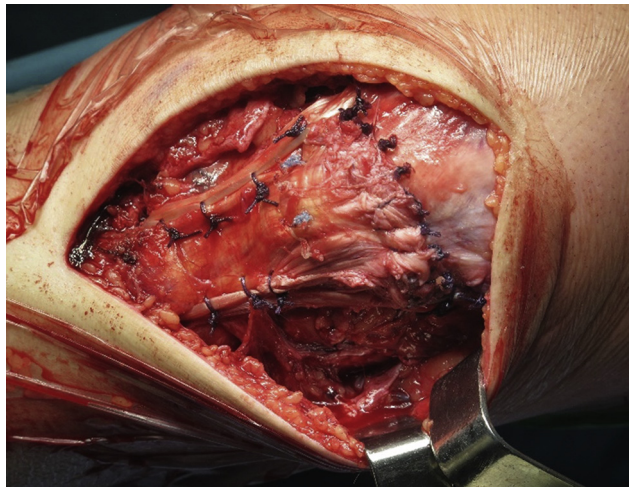

Fig 14. Patient supine, left leg. Final result of the repair and reinforced patellar tendon.

high risk for a fracture of the patella, damage to the patellar articular cartilage, and patella alta or baja due to overtightening or undertightening.[7] By contrast, the Porto technique anchors the tendon graft through the retinaculum on either side of the patella, thereby safeguarding the patella itself from potential fracture and the articular cartilage from any damage (Table 2). Additionally, the reinforcement allows different graft tensioning aiming an ideal patellar height, as shown in the postoperative radiography (Fig 15).

Some techniques also prescribe a criss-crossing of the graft in a figure-of-8 manner over the anterior surface of the patella and the patella tendon.[5,8] Criss-crossing of the graft leads to a higher tension load at points over the patella and along the patellar tendon, which in turn could cause a potential repair failure. In this sense, the Porto technique achieves a U-shaped graft fixation, transmitting the tension load along the retinaculum

Table 2. Advantages, Risks, and Limitations of the Presented Technique

Advantages	Risks and Limitations
Anchoring the tendon graft through the retinaculum on either side of the patella avoids a transosseous tunnel, protecting the patella from a potential fracture and the articular cartilage from damage	Unpredictability of graft length and width
The U-shaped graft avoids concentration of the tension load over the patella and the repaired patellar tendon	In extensive knee extensor mechanism injury, retinaculum damage may preclude this surgical technique
Autologous graft allows biological healing; no synthetic or metallic hardware is needed	Risk of tibial tubercle fracture during tunnel drilling
The U-shaped graft fixation avoids overtightening or undertightening and consequent patella alta or baja	

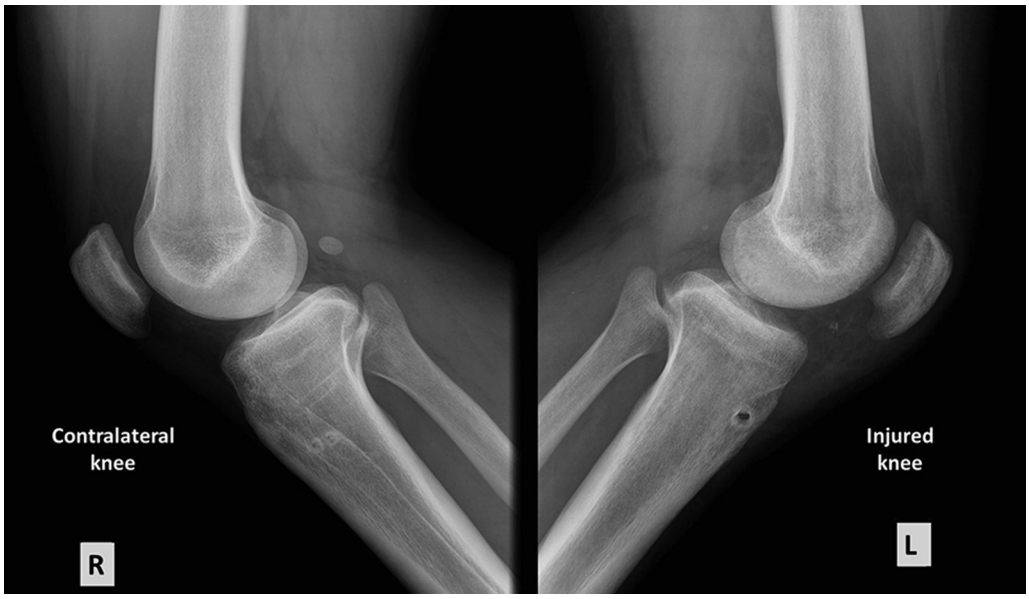

Fig 15. Postoperative follow-up radiograph (3 months) of a patient with patellar tendon repair using the semitendinous augmentation showing no differences in the patellar height when compared to the contralateral side. (L, left; R, right.)

and through the graft to the anterior tibial tubercle when the knee is flexed. This avoids concentration of the tension load over the patella and the repaired patellar tendon. Also, the U-shaped graft prevents patella alta and anterior translation of the patella, while maintaining its normal tracking. The inherent stability provided by this method of graft anchoring translates into earlier initiation of mobilization of the knee joint. Our technique, therefore, effectively achieves the goals of repair and significant augmentation of the patellar tendon and successfully avoids the potential complications of previously described augmentation procedures using a semitendinosus graft.[1,7,11,12]

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