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Treatment of Unfixable Inferior Pole Fractures of the Patella Using an All-Suture Internal Fixation Technique

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Inferior pole fractures of the patella are a type of patellar fracture that has various complexities. Most current techniques are associated with hardware-related complications, which is one of the main concerns when treating this complex fracture. We present a new technique that does not require metal implant removal, causes little to no irritation of the quadriceps muscle, and provides strong fixation that allows for early range of motion postoperatively.

Keywords: *Patella, Fracture fixation, Comminuted fractures, Patella fracture*

Inferior pole fractures of the patella are an uncommon and intricate category of extra-articular patellar fractures. Inferior patellar pole fractures lead to disruption of the extensor mechanism, meaning that surgical repair is needed to restore functional kinematics. There are numerous surgical techniques and instruments currently being used to restore this type of patellar fracture. Partial patellectomy is one of the current techniques used, but it has limitations due to complications of patellar baja in the patellofemoral joint, ultimately resulting in late osteoarthritis.[1] Current methods using surgical instruments for internal fixation have been commonly associated with hardware irritation, hardware failure, and implant migration: fixation with a Kirschner-wire or cerclage wiring as there is an increased risk for patients with symptomatic hardware to receive revision surgery.[1,2] However, there is still no consensus on the best technique for treating inferior pole patellar fractures, especially for comminuted fractures. In addition, current techniques still present complications of patellar baja and hardware irritation with a risk of revision surgery, negatively affecting functional patient outcomes. The purpose of this technical note was to present a new technique that does not require metal implant removal, has little to no irritation of the quadriceps muscle, and provides strong fixation that allows for early range of motion (ROM) postoperatively.

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TECHNIQUE

Under adequate anesthesia, the patient was placed in a supine position. A longitudinal incision was made just medial to the midline of the patella (anteromedial approach). An incision was created 2–3 cm below the superior border of the patella and continued to 2–3 cm below the inferior border of the patella. The prepatellar bursae and retinaculum were identified and preserved. Following this, the fracture site at the lower pole of the patella and the patellar tendon were carefully identified.

Internal Fixation with Transosseous Suture Technique

A needle was inserted into the lower fragment of the patella using a no. 2 FiberWire with tapered needle (Arthrex) (Fig. 1A). Caution is advised with this step, especially in osteoporotic bone or a severe comminution to not further fracture the patella. The Krackow suture technique was

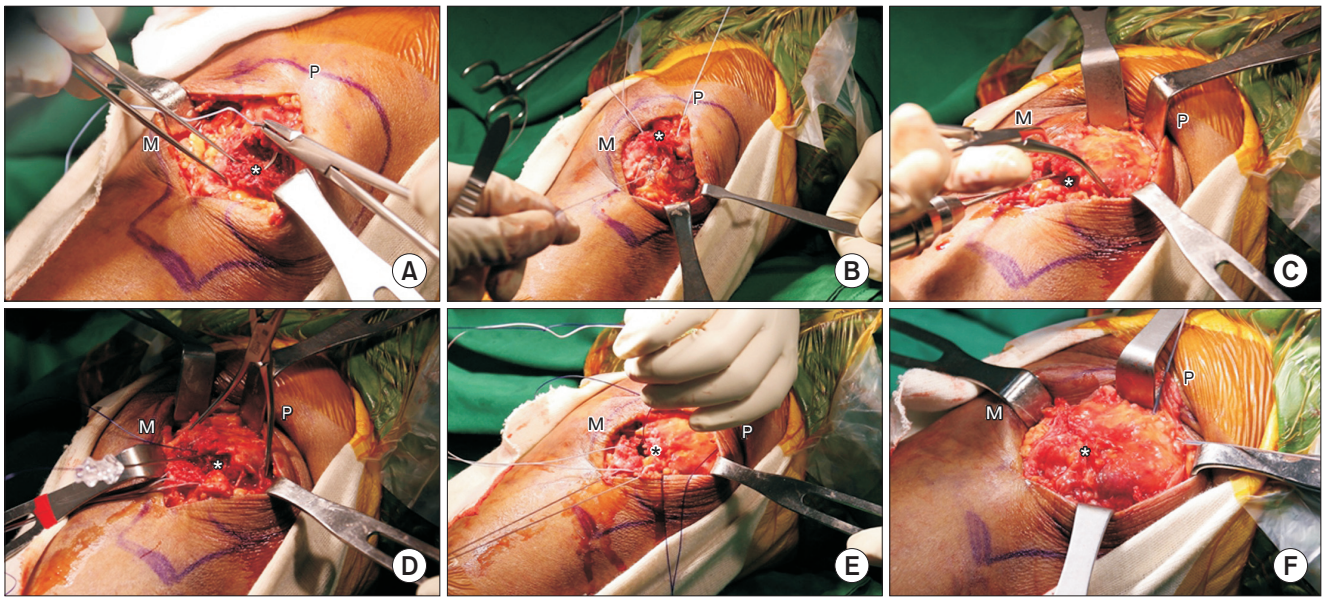

Fig. 1. Intraoperative photos of the left knee (supine position) showing internal fixation with a transosseous suture technique. (A) The needle was inserted into the lower fragment of the patella using no. 2 FiberWire with Tapered needle. (B) The Krackow suture technique was performed on the patellar tendon from proximal to distal and then passed back proximally to the fracture site. This technique was repeated at the medial and the lateral sides of the patellar tendon making four strands of FiberWire sutures. (C) Two parallel vertical transosseous tunnels were created at the medial one-third and lateral one-third of the proximal fragment of the patella with drill bit size 2 mm in the direction from inferior to superior. (D) No. 1 polydioxanone suture was inserted into no.18 epidural needle and passed through the tunnels. (E) One limb of the FiberWire suture from the lateral and one limb from the medial side of the patellar tendon were shuttled through the medial vertical transosseous tunnel. (F) Each pair of FiberWires was tied over the tunnels with the knee in full extension. M: medial side of the knee, P: proximal side of the knee. Asterisk: fracture site.

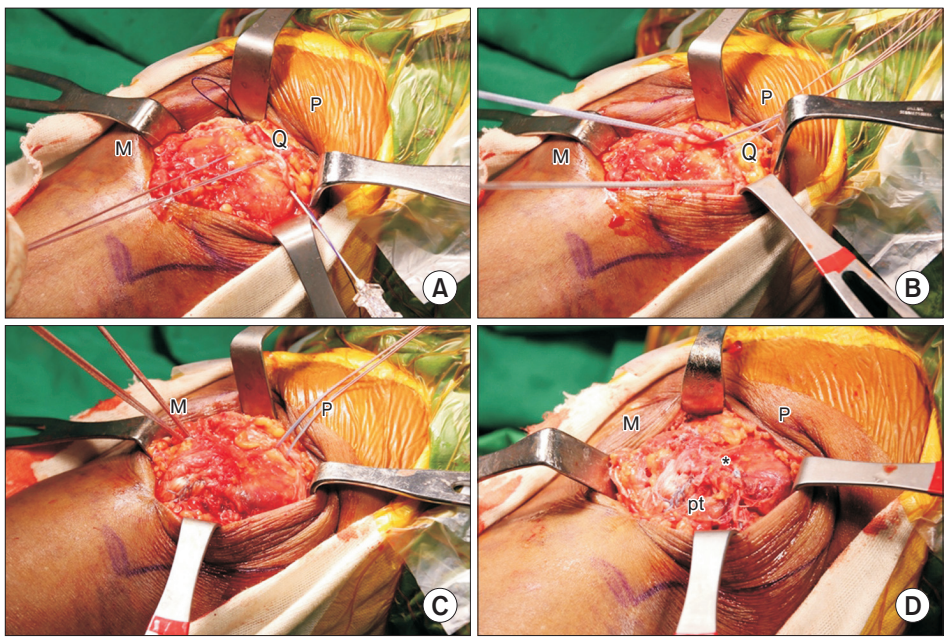

Fig. 2. Intraoperative photos of the left knee (supine position) showing cerclage augmentation with an all-suture technique. (A) A no. 18 epidural needle loaded with a polydioxanone suture (PDS) loop was inserted below the quadriceps tendon and as close to the superior pole of the patella. (B) The FiberTape was shuttled through the PDS loop at the superior pole of the patella. (C) The FiberTape should be as close to the border of the patella and under the quadriceps and patellar tendon. (D) FiberTape was pulled and tied at the anteromedial side of the patella with the patient's knee in 30° flexion. M: medial side of the knee, P: proximal side of the knee, Q: quadriceps tendon, pt: patellar tendon. Asterisk: fracture site.

performed on the patellar tendon proximally to distally and then returned to the proximal site. The needle was then passed back proximally to the fracture site. This technique was repeated at the medial and the lateral sides of the patellar tendon, making 4 strands of FiberWire sutures (Arthrex) (Fig. 1B).

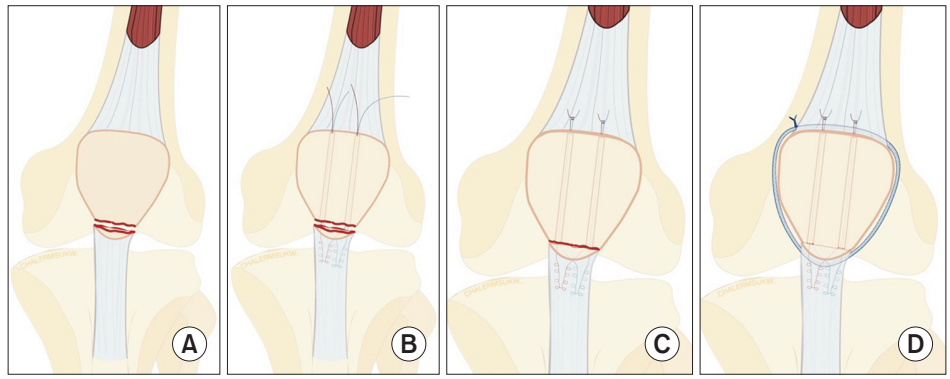

Fig. 3. An illustration of the left knee showing the detail of treatment of the inferior pole of the patella using an all-suture technique. (A) Inferior pole patella fracture. (B) Internal fixation with a transosseous suture technique. Two Krackow suture technique was performed on the patellar tendon and then the sutures were passed back proximally to the fracture site. One limb of the FiberWire suture from the lateral and one limb from the medial side of the patellar tendon were shuttled through the medial and lateral vertical transosseous tunnels. (C) Each pair of FiberWires was tied over the tunnels. (D) Cerclage augmentation with the all-suture technique.

Following this, two parallel vertical transosseous tunnels were created at the medial one-third and lateral one-third of the proximal fragment of the patella with a 2-mm drill bit from inferior to superior (Fig. 1C). A no. 1 polydioxanone suture (PDS; Ethicon) was inserted into a no.18 epidural needle and passed through the tunnels (Fig. 1D). One limb of the FiberWire suture from the lateral and one limb from the medial side of the patellar tendon were shuttled through the medial vertical transosseous tunnel using the PDS suture (Fig. 1E). The two remaining limbs were similarly shuttled through the lateral vertical transosseous tunnel creating a crossing bridge pattern. Two pairs of FiberWire sutures were then tied at the superior pole of the patella. The two patella fragments were provisionally reduced by pulling the transosseous sutures. In some cases, the fragments could not be reduced with the forceps due to the small and comminuted fracture of the inferior pole of the patella. The tension of the patellar tendon should be set with the knee in full extension. Following this, each pair of FiberWires was tied over the tunnels and secured in a fashion to ensure the suture knots were not pulled back from the bone and did not violate the quadriceps tendon (Fig. 1F).

Cerclage Augmentation with All-Suture Technique

After internal fixation with the transosseous suture technique was completed, cerclage augmentation was performed. A 2-mm FiberTape (Arthrex) was chosen for cerclage augmentation. The no. 18 epidural needle was loaded with a PDS suture loop and inserted below the quadriceps tendon and as close to the superior pole of the patella as possible (Fig. 2A). The FiberTape was then shuttled through the PDS loop at the superior pole of the patella (Fig. 2B). After that, the same technique was done to complete the whole area of the patella. The FiberTape should be as close as possible to the border of the patella and under the quadriceps and patellar tendon (Fig. 2C). The FiberTape was then pulled and tied with the patient's knee in 30° of flexion. The tension had been set, which allowed the full knee motion after tying. The knot of the FiberTape was then tied at the anteromedial area of the patella (Fig. 2D).

Lastly, the torn retinaculum was repaired with FiberTape. Flexion and extension of the patient's knee were performed to check for optimal stability of fixation. Fluoroscopy was utilized to ensure correct fracture fixation and patellar positioning. Illustrations showing the detail of this novel technique are demonstrated in Fig. 3.

Postoperative Rehabilitation Program

Postoperatively, the patient's knee was immobilized with a knee brace in 0° of flexion for the first 2 weeks and 90° in the 2–4 weeks postoperative period. Passive ROM exercise was initiated for the patient as early as tolerable. The patient could walk with crutches (protected weight) for the first 2 weeks and then under full weight-bearing after 2 weeks.

DISCUSSION

Surgically repairing fractures of the inferior pole of the patella can present challenges due to fragments typically being small and comminuted. The majority of the current techniques are limited by their use of hardware implanta-

Table 1. Pearls, Pitfalls, and Advantages for Treatment of Unfixable Inferior Pole Fractures of the Patella Using an All-Suture Internal Fixation Technique

Pearl	Pitfall	Advantage
Prepatellar bursae and retinaculum should be carefully identified and preserved.	Exposure should be maximized with the anteromedial approach to increase vision of the inferior pole of the patella.	Does not require metal or implant removal
Using two parallel vertical transosseous tunnels at the medial and lateral one-third of the proximal fragment of the patella with a 2-mm drill bit size going inferior to superior	Further fracture during needle piercing to the lower fragment of the patella in osteoporotic bone or severe comminution	Little or no irritation to the quadriceps tendon
Tying each pair of high-strength sutures over the tunnels and securing in a fashion to ensure the suture knots are not pulled back and do not violate the quadriceps tendon.	Fluoroscopy should be used to ensure correct fracture reduction and patellar positioning for reducing the risk of patella baja.	Strong fixation that promotes early postoperative motion
High-strength suture such as FiberWire or FiberTape is recommended for this technique to ensure adequate fixation strength.	Assessment of range of motion is also vital postoperatively to ensure maximum range of motion throughout the rehabilitation process.	Two vertical transosseous tunnels help decrease iatrogenic fracture risk and are more optimal for a small-size patella.
When performing cerclage suture augmentation, using suture tape as close as possible to the patellar border and under the quadriceps and patellar tendons reduces discomfort and quadriceps inhibition.		

tion, with no consensus on an ideal method for fixation. This technical note proposes a new technique to fix inferior pole patellar fractures, utilizing an all-suture technique that results in strong fixation, allowing for early ROM postoperatively and avoiding the use of hardware implants. The pearls, pitfalls, and advantages of this technique are listed in Table 1.

This proposed technique yields a multitude of advantages as compared to other techniques. Techniques using hardware for internal fixation, including cerclage wiring and tension band wiring, can have complications including hardware irritation and implant migration.[2,3] In addition, it can be difficult to achieve sufficient fixation with these techniques and the traditional tension-band fixation can cause skin irritation and breakage of the wire during motion. Our technique uses the method of tying the knot over the tunnel instead of tying each other to reduce the irritation of the quadriceps. The presented technique utilizes a high-strength suture that allows for optimal fixation, early ROM, and weight-bearing postoperatively. A previous study reported that fixation quality with braided polyester sutures was similar to that of steel wire.[4] To avoid the use of hardware, partial patellectomy and suture anchor fixation are possible options. However, partial patellectomy prolongs limb immobilization and is associated with multiple complications including anterior knee pain, limited ROM, and a decrease in quadriceps power.

The limitation of involving suture anchor fixation is associated with the quality and quantity of patellar bone, especially considering it is not uncommon for this type of fracture to be small and comminuted. It has been reported that fixation can also decrease the Insall-Salvati ratio (patella height).[5] Another strength of the proposed technique is the number of transosseous tunnels being created. While most other current techniques use three or four transosseous tunnels, this technique requires only two vertical transosseous tunnels; thus, this technique may help decrease the iatrogenic fracture risk and be more optimal for a patella that is of smaller size.

Caution should be exercised with this technique as there are several pitfalls. Exposure should be maximized with the anteromedial approach to increase vision of the inferior pole of the patella. High-strength sutures such as FiberWire or FiberTape are recommended for this technique to ensure adequate fixation strength. When performing cerclage suture augmentation, using suture tape as close as possible to the patellar border and under the quadriceps and patellar tendons reduces discomfort and quadriceps inhibition. Fluoroscopy should be used to ensure correct fracture reduction and patellar positioning for reducing the risk of patella baja. Assessment of ROM is also vital postoperatively to ensure maximum ROM throughout the rehabilitation process.

In conclusion, this technical note provides an alternative option for surgical repair of a comminuted fracture of the inferior pole of the patella. We believe that this technique is a safe and effective way that does not

require metal implant removal, has little to no irritation of the quadriceps muscle, and represents a strong fixation technique that allows for early ROM and weight-bearing postoperatively. These are distinct advantages that should be accounted for when determining the optimal technique to use for this type of fracture.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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