Technical Note

Arthroscopically Assisted, Minimally Invasive Percutaneous Fixation of a Patellar Fracture

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Abstract: Operative fixation of a patellar fracture can be accomplished through a variety of techniques. However, drawbacks have been associated with many of these techniques, including painful hardware, poor skin healing due to bruising and swelling, inadequate cartilage reduction, and eventual post-traumatic osteoarthritis. Throughout the orthopaedic field, minimally invasive approaches have become popular. We describe an arthroscopically assisted method for ensuring fracture reduction intraoperatively and addressing associated defects while the patella is stabilized using a minimally invasive percutaneous fixation technique with screws and a tension band construct.

Patellar fractures are relatively uncommon lower-extremity injuries that typically occur either during a rapid contracture of the quadriceps tendon with a flexed knee or via direct trauma to the patella. These fractures can frequently lead to extensor mechanism disruption and often require surgical intervention when displaced.[1] Physical examination findings in patients with patellar fractures may include ecchymosis, knee effusion, a palpable defect, and the inability to perform a straight leg raise. The latter is indicative of an incompetent extensor mechanism.[1,2]

Treatment of patellar fractures can vary depending on the degree of fracture displacement, as well as the integrity of the extensor mechanism. Historically, surgical intervention has been indicated for displaced fractures and/or disruption of the extensor mechanism. Anatomic reduction of the articular surface and restoration of the extensor mechanism are the primary goals of surgical intervention. Failure to achieve these goals can lead to suboptimal outcomes including stiffness and a potential for early patellofemoral osteoarthritis.[3]

Surgical treatment historically has included open reduction—internal fixation (ORIF). This can be achieved using a variety of techniques, including plating, screw fixation, and tension band constructs. Each technique has advantages and drawbacks. ORIF often can lead to issues with symptomatic hardware, particularly with plates or wires. Furthermore, although intraoperative fluoroscopy is able to identify gross reduction of the fracture, confirmation of the integrity and alignment of the patellar articular surface remains less clear. Minimally invasive percutaneous fixation (MIPF) is a newer surgical technique designed to minimize some of the established disadvantages of traditional ORIF. Lo and Chen[4] performed a meta-analysis of 6 articles comparing traditional ORIF with MIPF. They concluded that patients who had MIPF had more favorable outcomes in terms of knee range of motion, pain scores, and complications, as well as lower rates of implant removal. We describe a surgical technique for arthroscopically assisted percutaneous fixation of a closed patellar fracture with screws and a tension band construct.

Surgical Technique

Our surgical technique (Video 1) combines an arthroscopic approach with MIPF for the treatment of a displaced patellar fracture (Fig 1) using 4.0-mm cannulated screws and figure-of-8 FiberTape (Arthrex, Naples FL) tension band augmentation. Pearls and pitfalls of this technique can be found in Table 1.

The patient is positioned supine on a radiolucent table with a bump placed under the ipsilateral hip. A

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Fig 1. Fluoroscopic images showing comminuted left patellar fracture with significant displacement noted prior to reduction.

tourniquet is applied to the operative thigh but is not routinely inflated. The fluoroscopy system is brought to the surgical field from the contralateral side of the bed. The arthroscopy tower is positioned toward the head of the bed on the contralateral side of the operative leg, above the C-arm. The lead author (M.A.) does not routinely use a nerve block but recommends paralysis for the procedure to minimize tension on fracture fragments during reduction.

A closed fracture reduction is initially achieved. Two clamps are used percutaneously to obtain reduction. An 18-gauge spinal needle is used to help reduce the tilt of the proximal fragment (Fig 2). Alternatively, K-wires can be placed into the fragments and used as a joystick for reduction with or without clamps. Fluoroscopy in the anteroposterior, oblique, and lateral planes is used to evaluate reduction of the fracture.

Once provisional fixation is achieved, an arthroscopic superolateral visualization portal and inferomedial working portal are created to help evaluate the articular surface and the reduction, to clear the joint of any loose bodies, and to perform a gentle chondroplasty at the fracture site (Fig 3). After confirmation of radiographic and arthroscopic reduction, 2 parallel K-wires are percutaneously placed, running from inferior to superior in the patella. Fluoroscopy is used to confirm appropriate positioning. The wires are then passed percutaneously to the superior pole of the patella using an army-navy retractor to depress the skin below the wires (Fig 4). Once the wires are passed, percutaneous incisions of approximately 3 mm are made through the skin and quadriceps tendon, localized under lateral fluoroscopy to be placed just at the level of the superior pole of the patella to ensure that later passage of the FiberTape tension band is on bone without any soft-tissue interposition. The wires are then backed out to the level of the bone and repositioned through these percutaneous incisions.

Percutaneous incisions are also made at the inferior pole of the patella at each wire, just large enough to allow passage of a screw. A depth gauge is used to determine screw length, and the wires are over-drilled prior to placement of the 4.0-mm cannulated screws. It is important to drill one side and place the screw before drilling the other side to minimize the risk of losing the reduction. Additionally, positioning the screws in the posterior half of the patella for the tension band construct is recommended to avoid posterior cortex gapping during range of motion of the knee.

Once the wires are passed and the percutaneous incisions are made, a mosquito clamp is introduced just

Table 1. Pearls and Pitfalls

Pearls
The use of accessory arthroscopic portals may better facilitate cartilage assessment and shaver debridement.
The use of K-wires or a spinal needle may help to manipulate fracture fragments and achieve closed reduction.
Percutaneous incisions for the screws should be made at the inferior and superior poles of the patella through the skin and tendon down to bone to ensure no soft-tissue interposition in the construct. Fluoroscopy may be helpful to ensure appropriate incision placement.
Knot tying of the FiberTape sutures should be performed on the superior pole of the patella to minimize discomfort with kneeling and palpation.
Pitfalls
Failure to undermine the soft tissue anterior to the patella may result in difficulty passing the suture-passing device.
Appropriate patient selection should be undertaken when considering this technique. Patients with a large body habitus may not be amenable to the procedure.

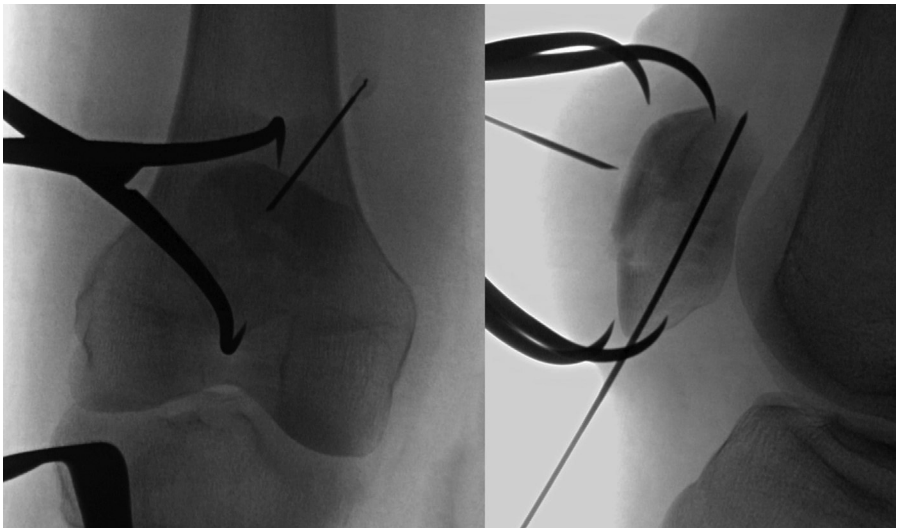

Fig 2. Anteroposterior radiograph of a left leg showing initial reduction using pointed reduction clamp and spinal needle (left) and lateral radiograph showing second clamp and provisional wire placed from inferior to superior within patellar body (right).

anterior to the patella while the bone is palpated with the tip. The mosquito clamp is directed bluntly toward the center of the patella from each incision and spread to undermine the plane just anterior to the bone for planned passage of the FiberTape tension band.

After the soft-tissue plane is developed, the FiberTape tension band is passed. This can first be passed from inferior to superior at the medial screw by pulling out the wire and passing the needle of the FiberTape through the same path, confirming positioning within the screw by use of radiographs. Once passed, a FiberStick (Arthrex), a Hewson suture passer, or a similar device is tunneled through the soft-tissue plane anterior to the patella and is used to pass the needle and FiberTape back from superomedial to inferolateral, completing the first pass of the figure-of-8 tension band. The lateral wire is then withdrawn, and the needle is passed from inferior to superior through the lateral screw in a similar fashion. To complete the figure-of-8 pattern, the suture passer is then sent back again through the same plane, through which it should move freely if well undermined. By use of the suture passer, the FiberTape is passed from the inferomedial incision back to the superolateral incision, completing the figure-of-8 configuration, and is tied with the knee in full extension using an arthroscopic knot pusher. The FiberTape sutures are tied at the superior pole of the patella because it tends to have more soft-tissue coverage and is less likely to cause irritation during kneeling. The sutures are cut flush, and all instrumentation is removed from the surgical wounds. Final anteroposterior and lateral fluoroscopic views show

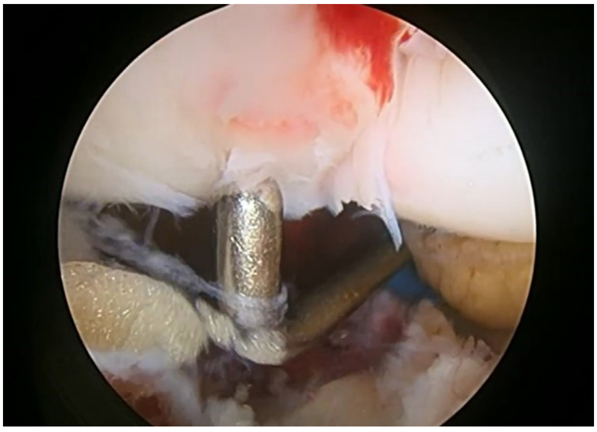

Fig 3. Viewing a left leg from the superolateral portal, the articular cartilage is probed through the inferomedial working portal. Visualization of the articular surface is confirmed, and a mechanical shaver is used to perform an abrasion chondroplasty as needed.

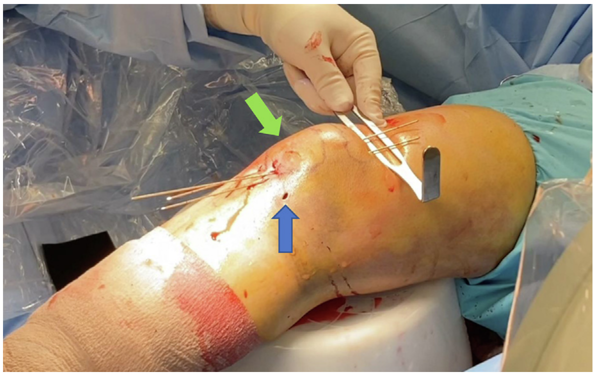

Fig 4. Two pins with screws are placed in a left leg inferior to superior in a parallel manner. A central provisional fixation pin is present. The inferomedial working portal (blue arrow) is visible. The superolateral portal for visualization of the 50-yard line where the fracture line is out of view is noted by the green arrow.

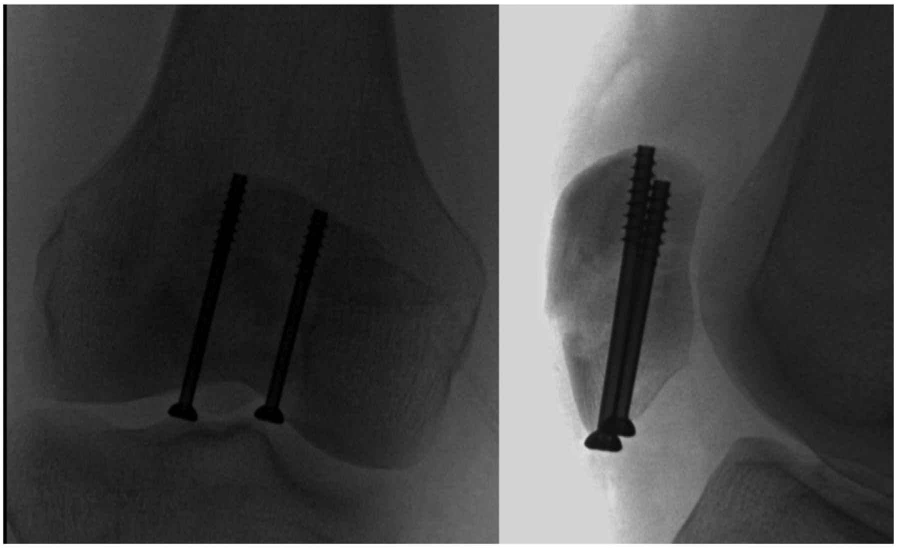

Fig 5. Final anteroposterior (left) and lateral (right) fluoroscopic views of a left leg showing anatomic reduction of articular surface despite some comminution of fracture, especially anteriorly.

anatomic reduction of the articular surface despite some comminution of the fracture, especially anteriorly (Fig 5). The final construct has been completed through 6 percutaneous incisions (Fig 6).

Discussion

The treatment of patellar fractures is based on a standard (AO) classification system dictated by the degree of displacement of the bone fragments.[5] Current operative treatment methods for patellar fractures are focused on the manual alignment of the bone fragments through an anterior knee incision. However, intraoperative fluoroscopic evaluation is limited in its ability to allow accurate assessment of the alignment of the articular cartilage of the patella, especially considering its multiple facets. Nevertheless, the alignment of the articular surface is paramount to minimize the risk of post-traumatic osteoarthritis. Larsen et al.[6] found a 26% moderate to severe osteoarthritis rate at a mean of 8.5 years in their cohort of patients with patellar fractures.

The described technique uses an approach that is both percutaneous and arthroscopic to help confirm anatomic reduction while avoiding an open incision. Numerous advantages are associated with this approach. Arthroscopic evaluation can be a useful adjunct in these cases to ensure an anatomic reduction. Furthermore, the ability to debride the unstable edges of the articular cartilage and remove potential loose bodies may reduce postoperative symptomatology within the knee joint. The percutaneous nature of the fracture fixation, in contrast to a large open incision, is more cosmetic and allows the procedure to be performed in patients with abrasions or other compromised skin conditions that may result in surgical delay or wound complications.

There are some disadvantages with the described procedure, however. A certain level of difficulty is noted in performing arthroscopy in the setting of fracture care. For surgeons not accustomed to routinely performing arthroscopy, this may present a challenge. In acute settings, hemarthrosis may obscure visualization initially, requiring joint lavage prior to proceeding. Nevertheless, the MIPF portion of this procedure can also be performed without arthroscopy in select patients in whom there is no fracture comminution or suspicion of intra-articular loose bodies. Fracture reduction can be challenging through a percutaneous approach. In displaced fractures, the K-wires may need to be used as a joystick to provisionally fixate the fracture. Furthermore, percutaneous reduction and fixation may prove more difficult in patients who are of a large body habitus.

Arthroscopically assisted percutaneous fixation of a patellar fracture offers the treating surgeon and patient a viable option for restoration of the articular surface

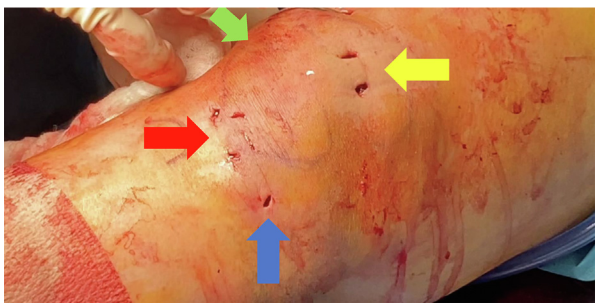

Fig 6. A final survey of the surgical wounds in a left leg is undertaken after the FiberTape has been tied. The entire procedure has been completed through 6 percutaneous incisions: an incision for the inferomedial arthroscopic working portal (blue arrow), an incision for the superolateral visualization portal (green arrow), 2 small inferior incisions for screws (red arrow), and 2 small superior incisions for screws (yellow arrow).

without the inherent risks of an open incision. Although this technique offers many advantages, appropriate patient selection and recognition of the fracture pattern being treated are important to allow for optimal patient outcomes. Continued monitoring of patients undergoing this technique is warranted to accurately assess the rates of osteoarthritis and wound complications compared with traditional ORIF of patellar fractures.

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