Mesh Plate Fixation for Complex Patella Fractures: A Surgical Technique

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ABSTRACT

Different types of low-profile plates have been designed for fixation of complex patellar fractures. Plate fixation of patella fractures provides stable fixation and allows earlier mobilization. This report describes three cases of complex patellar fractures. The report includes a detailed description and tips of the surgical technique.

Keywords: Patella, Fractures, Mesh plates

INTRODUCTION

Fractures of the patella account for about 1% of all skeletal injuries.[1] Tension-band wiring and cannulated screws have been the most commonly used techniques for the management of most patellar fractures.[2] Although tension band wiring techniques allow for dynamic compression at the fracture site, the rate of failure and hardware removal in more complex fractures can be unacceptably high.[3-6] Comminuted fracture patterns can be more challenging and often require more complex surgical techniques.[7]

Lower profile mesh plates provide stable fixation and less prominent hardware. This mode of fixation opened a new horizon for the treatment of complex patellar fractures.[5,8-12] Several case series of patellar plating and biomechanical studies have demonstrated equal or superior fixation strength with plates as compared to tension banding.[9,12-17] This report describes case-based technical tips and tricks to implement and achieve the desired clinical outcomes for patellar mesh plating.

Institutional Review Board approval (#E20016) was obtained to conduct this study.

CASE REPORT

Case 1

The patient was a 17-year-old man with a comminuted right patellar fracture with multiple fragments associated with contusion to the chondral surface. The fracture was preliminary reduced using multiple interfragmentary Kirschner wires (Figure 1A). The

Figure 1. *A) Preoperative anteroposterior (AP) and lateral radiographs of Case 1. B) Intraoperative lateral fluoroscopic images showing provisional stabilization with Kirschner wires. c) Lateral, skyline, and AP radiographic views showing united fracture and knee flexion at 7-months follow-up, respectively.*

mesh plate was then contoured and applied to the dorsal surface of the patella, and fixation of fracture fragments was performed using multiple screws through the mesh plate (Figure 1B). The patient was compliant with postoperative protocol. The fracture healed without complication. The patient achieved full knee range of motion (ROM) without pain at 7-month follow-up (Figure 1C).

***Figure 2**. A) Preoperative anteroposterior and skyline radiographs of Case 2. B) Intraoperative lateral fluoroscopic images showing large fragment fixation with Kirschner wires, and compression of the fracture site with a reduction clamp after application of the Mesh plate. C) Anteroposterior and lateral images of united anatomically reduced patellar fracture at 6-months follow-up.*

***Figure 3.** A) Preoperative anteroposterior and lateral radiographs of Case 3. B) Postoperative lateral fluoroscopic images showing the initial fixation with cannulated screws and combined fixation using screws and mesh plate. C) Anteroposterior and lateral images of the united fracture at 12-months follow-up.*

Case 2

The patient was a 46-year-old man with a complex right patellar fracture and comminuted distal pole (Figure 2A). Fracture reduction was performed using interfragmentary Kirschner wires. Reduction clamping was used to anatomically reduce the large fragment and restore the articular surface (Figure 2B). The patient was compliant with postoperative protocol. Imaging showed fracture healing without complication at 7-month follow-up. The patient had full ROM of the knee without pain (Figure 2C)**.**

Case 3

The patient was a 95-year-old man with a transverse patellar fracture in his knee with osteoarthritis (Figure 3A). The decision was made to fix the fracture with cannulated screws and suturing, as well as a mesh plate due to the poor quality of the bone (Figure 3B). The patient followed postoperative protocol; however, ROM was limited due to the knee joint osteoarthritis. The patient achieved bony union. At the last follow-up visit at 18 months postoperatively, the patient showed no complications (Figure 3C).

SURGICAL TECHNIQUE

The patient was positioned supine on the flattop table (Figure 4A) and was anesthetized with endotracheal intubation. A regional nerve block was used when appropriate. The injured extremity was ramped with bone foam for x-ray visualization, and the C-arm was positioned on the opposite side (Figure 4B). A non-sterile tourniquet was applied around mid-thigh.

A longitudinal incision was made for fracture exposure (Figure 5A), along with the traumatic rent of the retinaculum. The fracture fragments were identified and reduced with two-point large bone clamps. The clamps were then used to compress the fracture into a transverse fracture (Figures 5B and 5C), and multiple Kirschner wires were used in comminuted fractures. The fracture was then provisionally fixed using multiple Kirschner wires, as seen in (Figure 6A), and the measurement of the plate was obtained (Figure 6B).

The articular congruency was visualized and palpated through the arthrotomy incision using fluoroscopy. The wires were positioned away from the footprint of the plate, and the temporary reduction was checked using

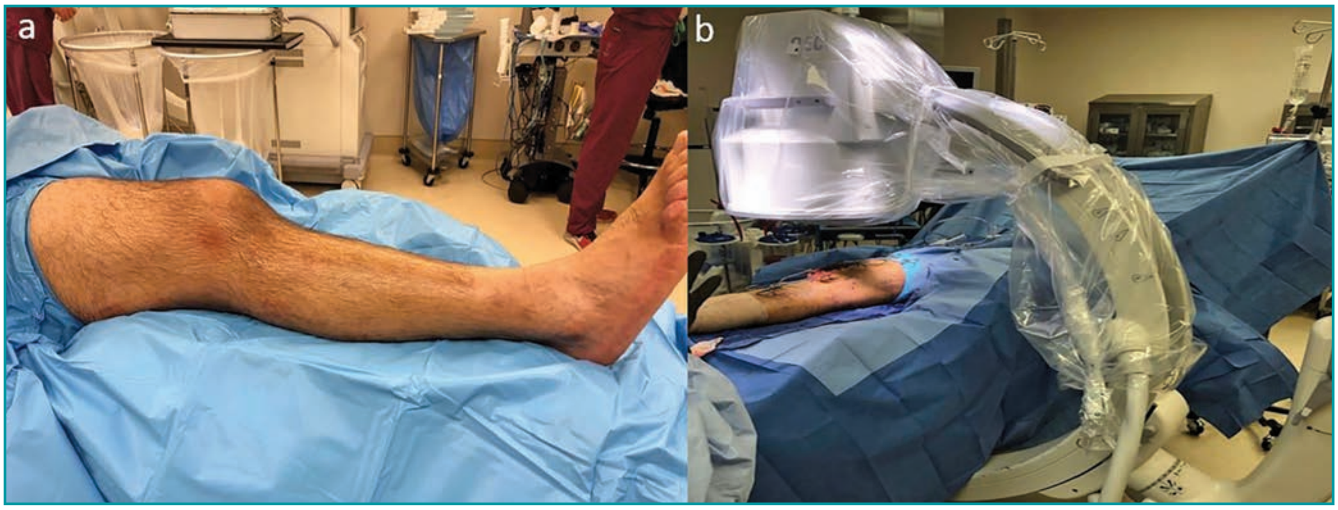

Figure 4. *A) Patient was positioned supine on the flattop table. B) The C-arm position in relation to the surgical site.*

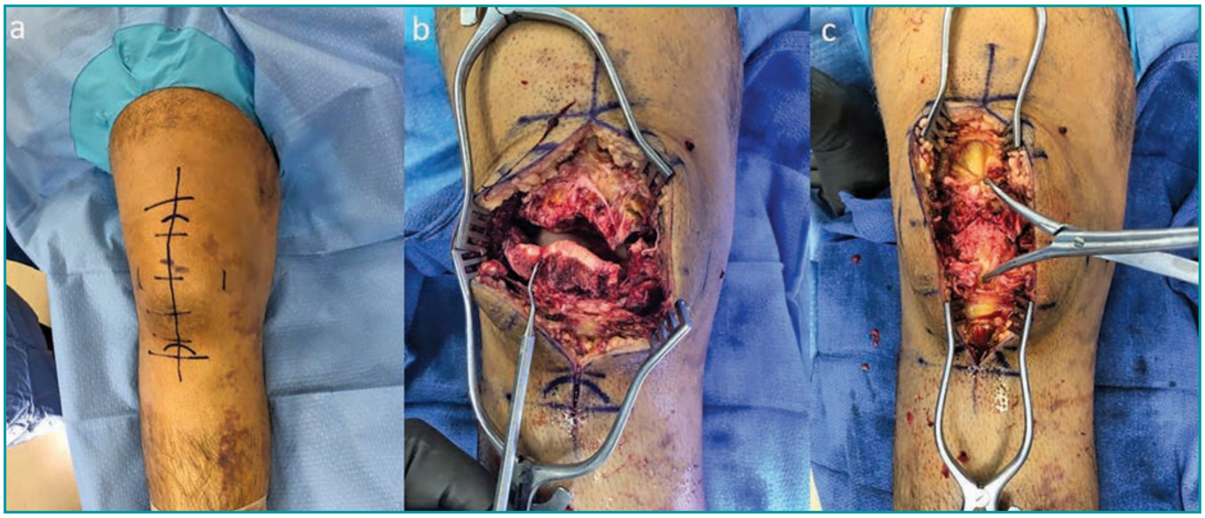

Figure 5. *Intraoperative photograph showing A) longitudinal incision used for fracture exposure, and B,C) the fracture fragments identified and reduced with two-point large bone clamps.*

fluoroscopy in two orthogonal views. A low profile 2.3 mm titanium mesh plate (Stryker, Mahwah, NJ) was cut to fit, and then it was fixed to the anterior surface of the patella using non-locking 2.3 mm screws (Figure 7A).

Further customization through contouring of the plate onto the bone may be performed before placing the screws. Fixation was continued using 2.3 mm self-tapping mini screws. Each screw was pre-drilled, with length measured using the depth gauge (Figure 7B). Care was taken to space the screws according to the fracture pattern and bone integrity. After placing a few screws to gain provisional stability, levering down the plate and further contouring were performed to bring the plate down to the bone. A total of four to six points of fixation were used in each fragment. Small bony fragments needed fewer screws for fixation. Reduction, length of screws, and positioning of the plate were rechecked with fluoroscopy,

The articular surface was examined under direct visualization by inverting the patella to ensure that there were no penetrating screws. Alternatively, fluoroscopy may be used to confirm the length of the screws. The Kirschner wires were removed after screw fixation. If the fracture pattern was markedly comminuted, a cerclage using a non-absorbable suture (Ethibond No. 5) and curved needle was passed all around the patella and through the patellar and quadriceps tendons, with care not to evert the patella. A combined suture tension band and mesh plate construct can be used in revision and nonunion cases. The fracture stability was then tested intraoperatively through a full range of flexion and extension.

Postoperative Follow-Up

Immediately after surgery, patients were mobilized in a hinged knee brace locked in full extension and instructed to bear weight as tolerated. The ROM was conducted through three phases.

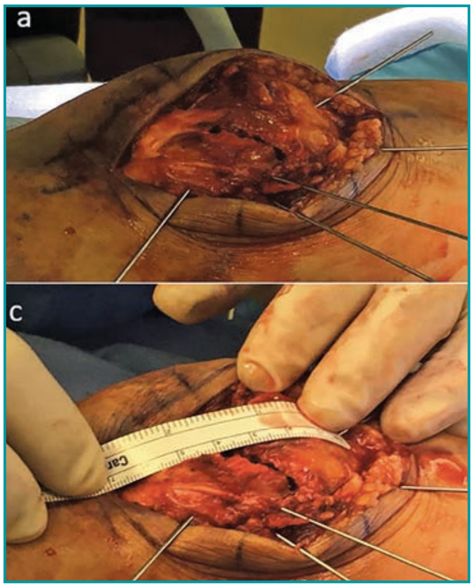

Figure 6. *A) Intraoperative photograph showing temporary fixation of an AO/OTA 34-C3 patellar fracture using Kirschner wires (fracture was highly comminuted). B) Intraoperative photograph showing patellar fracture fixed provisionally using Kirschner wires, and measurement of the patella to adjust the mesh plate (fracture was highly comminuted).*

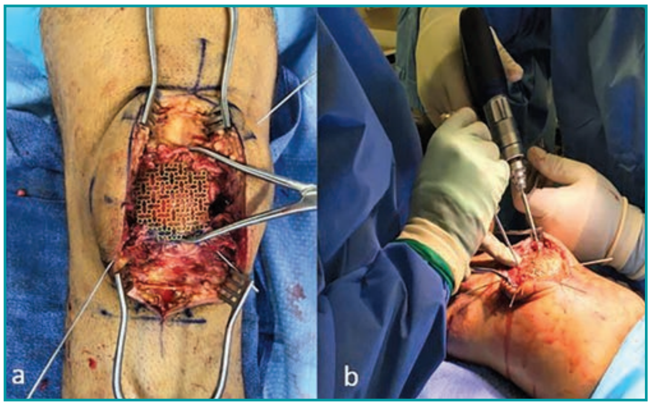

Figure 7. *A) Intraoperative photograph of trimming of low profile 2.3 mm titanium mesh plate to adjust to the size of the fractured patella. B) Intraoperative photograph of definitive fixation of patellar fracture using low profile 2.3 mm titanium mesh plate and non-locking screws.*

Phase 1 (Weeks 2-6): Postoperative hinged knee brace in full extension locked during weight bearing. Knee brace unlocked only for ROM exercises. Begin active ROM in a prone position, active assist ROM as tolerated, quadriceps muscle strengthening in brace immediately.

Phase 2 (Weeks 6-10): Hinged knee brace unlocked, and the patient is weaned from the brace. Scar massage, passive ROM, and increased strengthening exercises were performed.

Phase 3 (Week 10): Begin aggressive ROM exercises, strengthening gradual return to higher-level activity once quadriceps muscle strength returns, with typically no restrictions starting week 12. Evaluate for osseous union and functional outcomes with routine physical and radiographic examinations until full fracture healing.

DISCUSSION

Mesh plate fixation of patellar fractures has shown excellent rates of union with fewer revision operations in complex patellar fractures (Table 1).[8,13-15,17] A single prospective cohort study by Lorich et al[9] compared a mesh cage plate versus tension band wiring, and they found superior functional outcomes and considerably decreased anterior knee pain in the plate cohort.

Singer et al[14] conducted a study that included nine patients with closed displaced comminuted patella fractures that were fixed using a mesh plate and 2 mm mini screws. The authors found that a low profile mesh plate was an effective method of fixation in the management of comminuted patella fractures with good clinical outcome. The study added a new alternative fixation method to treat the comminuted fractures.

Symptomatic implant is the most common complication reported following patellar fracture fixation. Hoshino et al[3] conducted a retrospective study that included 448 surgical patellar fractures fixations. The authors reported symptomatic hardware removal in 22.6% of the patients fixed by cannulated screws and in 36.8% of patients treated by Kirschner wires and cerclage. LeBrun et al[5] echoed these same findings and found that the removal of symptomatic implant was required in 52% of the patients treated with osteosynthesis. Singer et al[14] reported no hardware complications or removal of patellar fractures when using low profile 1.5 mm mesh plates. Volgas and Dreger[17] reported irritation in several patients when using 2.7 mm mesh plates. Additionally, five patients needed hardware removal, which may be due to the relatively larger plate size and profile.

Several published biomechanical studies have compared the stability and strength of a mesh plate construct to that of a tension band wiring technique.[16,18,19] These studies demonstrated either equal or superior strength and stability achieved by plate constructs. Karakasli et al[19] compared fracture displacement after cyclic loading in two groups of cadaveric knees receiving either titanium plate or tension band-writing fixation. Cadaveric knees treated with plate fixation showed a considerable reduction in fracture displacement, and the study concluded that fixation with curved titanium plates provided satisfactory stability under cyclical loading, similar to the loading encountered during the postoperative rehabilitation period.[22] Additionally, Dickens et al[18] found that the augmented titanium mesh construct is equal to tension-band wire augmentation concerning the ultimate force required for failure.

A minor complication seen in tension band wiring is a loss of knee ROM due to postoperative stiffness. In one case series,[20] up to 71% of patients treated with tension band wiring and cast immobilization reported a lack of full extension. The authors proposed that the stability and rigidity of the mesh plate construct allowed earlier weight bearing and ambulation, resulting in decreased stiffness and improved recovery of ROM. Long-term and larger cohort follow-up is not available; however, it is needed to determine the actual efficacy of the plating construct and thus a limitation to this technical trick narrative.

In conclusion, mesh plates appear to be advantageous in the treatment of complex and comminuted fractures by providing stability and allowing fixation of bone fragments with lower rates of hardware removal. Larger comparative studies with long-term follow-up are needed between mesh plate and tension band fixation of patellar fractures to demonstrate whether one is clinically superior to the other. Additional studies comparing various types of mesh plates would be useful in establishing their best clinical uses.

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