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CASE REPORT

Modified basket plate for inferior patellar pole avulsion fractures—A report of three cases

Hui-Cheng Huang, Jiing-Yuan Su*, Yuh-Min Cheng

Department of Orthopaedics, Kaohsiung Medical University Hospital, Kaohsiung Medical University, Kaohsiung, Taiwan

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Abstract In patients who have sustained an avulsion fracture of the inferior patellar pole, the extensor mechanism is disrupted and should be repaired. The normal height of the patella can be maintained by preserving the patellar pole, but fractures of the inferior pole of the patella are not easy to reduce and fix firmly. In contrast with partial patellectomy, which requires postoperative immobilization, internal fixation with a basket plate allows for immediate mobilization and early weight-bearing. Owing to the unavailability of the basket plate in Taiwan, we have modified the plate with the titanium mesh as a possible alternative. We present three cases of this modified basket plate, which took place between 2008 and 2010. This technique avoided long-term immobilization of the knee with good clinical results. Copyright © 2012, Elsevier Taiwan LLC. All rights reserved.

Introduction

Patellar fractures account for approximately 1% of all skeletal fractures [1], and inferior patellar pole avulsion fractures account for 9.3–22.4% of all patellar fractures that are treated surgically [2]. In patients who have an avulsion fracture of the patellar pole, the extensor mechanism is disrupted and should be repaired. Preservation of the inferior patellar pole and osteosynthesis maintain the patellar height and the normal anatomic and biomechanical relationships of the patellofemoral joint. Thus, they can

provide better clinical results compared with those of excision of the patellar pole fragments combined with patellar tendon repair. Internal fixation with a basket plate is an alternative method of treatment of comminuted distal patellar fractures [3]. The basket plate was designed for the treatment of comminuted distal patellar fractures by Smiljani [4] in 1988 and was constructed in the Zagreb Department of Instrumentaria Research. We modified the basket plate by means of a titanium mesh (Fig. 1A). The modified plate has the shape of the inferior pole of the patella, which allows it to hold the comminuted patellar pole fragments in position (Fig. 1B). In the present report, we describe the modification of a basket plate that provides stable fixation and preserves the patellar pole, even in patients with comminuted avulsion fractures.

* Corresponding author. Department of Orthopaedics, Kaohsiung Medical University, Number 100, Tzyou 1st Road, Kaohsiung 807, Taiwan.

E-mail address: jiing.su@msa.hinet.net (J.-Y. Su).

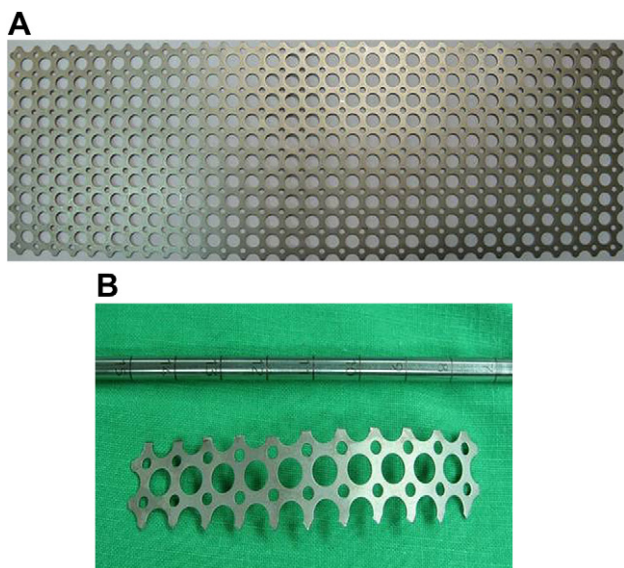


Figure 1. (A) The titanium mesh. (B) The titanium mesh shaved into the contour of the lower patella.

Case presentation

Case 1

A healthy 89-year-old male presented at the emergency department after a fall from a step in December 2008. He complained of pain around the right knee, and he was unable to stand on his right leg. Physical examination showed pain and swelling around the right knee, inability to stand on the affected leg, and extension lags. Active extension was clearly diminished but possible for a few degrees starting from full extension. Active flexion of the knee was possible. No neurovascular deficits were noted, and the medical history was unremarkable. Plain radiographs showed a small bone flake at the lower pole of the patella, and this was diagnosed as an avulsion fracture of the lower pole of the patella (Fig. 3A).

A long leg splint was applied with the right knee in extension, and the patient was referred to the orthopedic department immediately. Surgery was performed 1 day after trauma, and the tension band wiring technique was used for open reduction internal fixation. However, mild displacement of the distal pole of patella with the tension band fixation was noted 2 weeks later (Fig. 3B), and the patient complained of weakness of the right knee extension. The patient received reopen reduction internal fixation 3 weeks after the initial injury.

The lesion was approached through a midline skin incision. Small osseous fragments were found at the lower pole of the patella with a gap of 1 cm. We removed the preliminary internal fixators, refreshed the fracture site, and followed with sufficient reduction. According to the lower shape of the patella, we shaved the titanium mesh to a 10-hole basket plate. The plate was fixed to the main patellar fragment with two parallel cancellous screws to provide interfragmentary compression. Two more screws, positioned obliquely, were threaded to increase stability against distraction forces (Fig. 2). Cerclage wires were

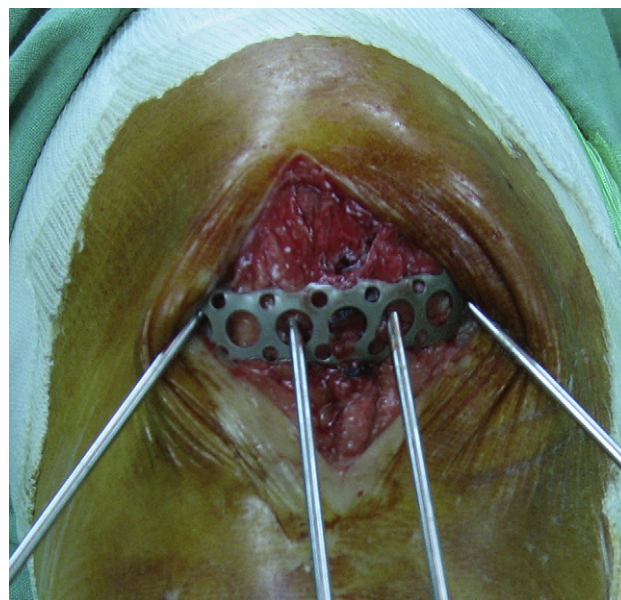


Figure 2. Intraoperative picture showing that the modified basket plate holds the low pole fragment in position; four guide pins of the cancellous screws were inserted into the intercalated holes of the mesh.

passed along the circumference of the patella to surround the entire patella (Figs. 3C and 3D). The associated retinaculum tear and the wound were repaired. Postoperatively, the patient started active and passive motion exercises of the right knee 1 day after surgery. Passive range of motion was from 0° to 90° in 1 week. The patient was also encouraged to start bearing weight with knee brace protection, and full weight-bearing without limitation was encouraged within 1 month. Active range of motion was 0–100° and 0–120° 2 weeks and 2 months after the secondary surgery, respectively. No complication such as wound infection, implant loosening, or knee stiffness was noted. At the time of the 32-month follow-up, there was no evidence of any motion deficit of the right knee, and the range of motion was 0–125° (Fig. 3E). The patient was able to walk independently without external support. The lateral radiograph showed osseous union with obliteration of all fracture lines (Fig. 3F), and the patient expressed unwillingness to receive implant removal.

Case 2

An 87-year-old male presented to our emergency department in February 2009 with left knee painful disability after a fall on his left knee. The initial finding included painful left knee swelling and extension lag, and left inferior patellar pole fracture was recorded according to the radiograph. He received the modified basket plate technique for open reduction internal fixation. Postoperatively, the knee was packed in an elastic bandage. The physiotherapy of left knee extension to flexion from 0° to 80° was started 1 day after surgery. Eight weeks after trauma, the patient could walk normally. He was pain-free, and able to perform an active range of motion with good quadriceps function. The left knee extension and flexion measured

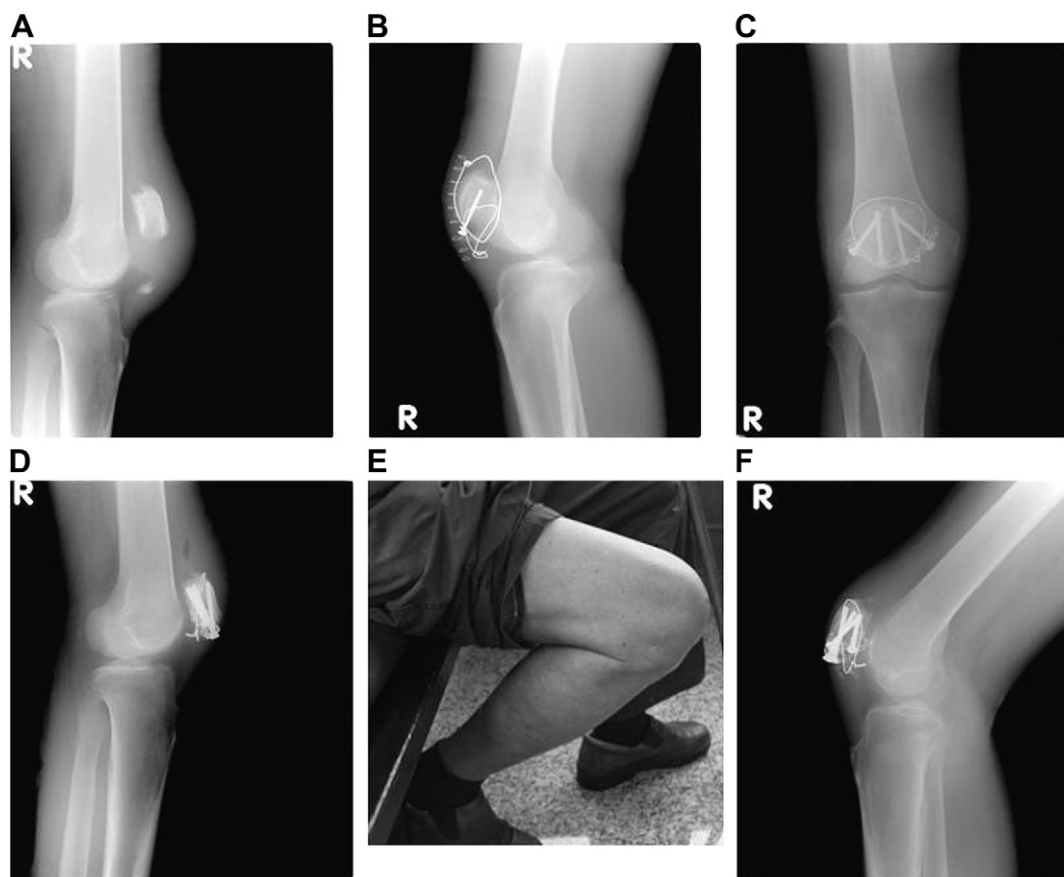


Figure 3. (A) One patient received open reduction internal fixation with tension band and cerclage wire for the right inferior patellar pole avulsion fracture, and (B) displacement of the distal pole of patella under the tension band fixation was noted 2 weeks after the preliminary operation. The patellar pole fragments were reduced under the fixation of modified basket plate and cerclage wire. (C, D) Normal patellar height was checked. (E) No evidence of any motion deficit of the right knee was impressed, and the range of motion was 0–125°. (F) There was radiological union without implant failure 27 months after osteosynthesis by basket plate.

0° and 115°, showing a flexion deficit of about 15°. Later, he migrated to Japan and received his latest follow-up by telephone. At the time of the final follow-up (26 months after surgery), he was free of pain and could walk and climb stairs without any difficulty or need of assistance.

Case 3

A 54-year-old female with painful right knee disability owing to an incidental fall was found to have right inferior patellar pole avulsion fracture in the emergency department in July 2010. She received open reduction internal fixation immediately with the modified basket plate. Postoperatively, the knee was packed without protection of immobilizer or knee brace. She tried right knee passive range of motion of 0–90° 1 day after surgery. Two weeks after trauma, she could walk normally. She was pain-free, and able to perform an active range of motion with excellent quadriceps function. The right knee active range of motion measured 0° and 125°. Nine months later, she was able to walk well on her right knee and had no signs of implant loosening or of any other complications. Osseous union was noted 10 months after the operation (Fig. 4B), and the right knee extension and flexion measured 0° and 130° (Fig. 4C).

Results

Three patients were invited to return for a final follow-up evaluation. One who had been managed with internal fixation later migrated to Japan, and so he received the latest follow-up by telephone. The average time between the surgery and the final evaluation was about 20 months. At the time of the final follow-up, the patients were free of pain. Mean knee extension and flexion measured 0° and 121.6°, which showed a flexion deficit of about 10°. No complication, including wound infection, implant loosening, or knee stiffness, was noted.

Discussion

Inferior patellar pole avulsion fractures are analogous to ruptures of the patellar tendon, and they are difficult to reduce and fix firmly enough to allow early movement of the knee. Conventionally, multifragment fractures of the patellar apex are treated by partial patellectomy with unsatisfactory results [5,6]. Partial patellectomy may cause patellar baja, which disrupts the normal physiology of the patellofemoral joint. A period of several weeks of immobilization in plaster



Figure 4. A 54-year-old woman had right inferior patellar pole fracture and received osteosynthesis by modified basket plate. (A) There was no implant loosening 9 months after the procedure, and (B) osseous healing was noted after implant removal. (C) The right knee extension and flexion measured 0° and 130° .

cast following partial patellectomy is known to have harmful effects on the involved knee joint, and it may delay rehabilitation and result in weakness of the quadriceps muscle.

The extensor mechanism must be reestablished with good function without pain or stiffness, but the size of the bony fragments prevents firm stabilization by ordinary wiring or screws. Since partial patellectomy is the final option in the surgical treatment, various types of osteosynthesis were applied to maintain the length of the patella and decrease the risk of patella baja. Fixation with patellotibial cerclage or figure-of-eight wire may result in breakage of the wire and cause irritation at the anterior aspect of the knee because of tenting of the implants [7]. Augmentation of the cerclage wire usually decreases the length of the patellar tendon and may injure the soft tissue around the tendon, which causes scarring and patellar baja. Yang and Byun [8] used separate vertical wiring technique for the fixation of comminuted fractures of the inferior pole of the patella with bone union and without breakage of wires or infection. After the operation, the knee is immobilized in a long leg splint for 2 days and protected with a brace for a period of 1 month. This method allows restoration of the patellar height, but there is a lack of immediate mobilization and early weight-bearing of the knee joint.

In our review of the literature, we found only two studies separately to evaluate alternative methods of treatment of inferior patellar pole avulsion fractures [3,9]. Kastelec and Veselko [3] compared osteosynthesis by basket plate with pole resection for avulsion fractures of the inferior pole of the patella in two groups, and the final result indicates that basket plate osteosynthesis can provide better clinical results. Matejčić et al. [9] retrospectively studied larger groups of patients between 1988 and 2004. Overall, 71 patients had basket plate osteosynthesis, while 49 patients had partial patellectomy. This demonstrates that the normal height of the patella can be maintained by preserving the patellar pole and that internal fixation with a basket plate allows for early weight-bearing and better functional outcomes.

In principle, total patellectomy should be avoided if possible because of the importance of the patella in the knee's mechanics. Although there are various methods for stabilizing inferior patellar pole fractures, only basket plate osteosynthesis allows for early weight-bearing without knee immobilization. Osteosynthesis with a basket plate is an alternative method of treatment that allows for the preservation of the patella. Since 1990, it has been used in Croatia, Slovenia, Italy, Bosnia, Herzegovina, Macedonia, the former Yugoslavia, and other countries of the region.

In case 1, the tension band wiring technique for initial internal fixation loosened, and the patient complained of weakness of the right knee extension. Owing to the unavailability of the basket plate in Taiwan, we have modified the plate with titanium mesh as a possible alternative according to similar biomechanical concepts. Titanium is a great alternative as a structural material in terms of its weight and strength, and it is lighter than steel if made for the same load. The shaved titanium mesh could conform more readily to the contour of the inferior patellar pole fragments and possesses excellent corrosion resistance without fragmentation. The cannulated cancellous screws can be threaded into the holes of the titanium mesh to increase stability against distraction forces. Compared with the hooks thrust through the patellar tendon in the original basket plate, there were shorter spikes in the shaved titanium mesh to hold the small osseous fragments in our cases. Instead of the function of the hooks of the original plate, a cerclage wire throughout the entire circumference of the patella was applied for augmentation of sufficient compressive strength. The mechanism is very similar to the original basket plate, and knee immobilization is unnecessary. Consequently, the modified basket plate provides stable fixation, and it is less bulky and more comfortable for the active motion of the knee.

Our modified basket plate technique using titanium mesh in the treatment of inferior patellar pole fracture resulted in immediate postoperative mobilization and early full weight-bearing on the affected joint. Basket plate osteosynthesis had

not only these advantages but also offers the benefits of preservation of the functional length of the extensor mechanism and the normal height of the patella. Significant improvements were noted with regard to knee pain, level of activity, and range of motion. No implant-related complications such as wiring rupture, implant loosening, anterior knee pain, or quadriceps atrophy were reported in our series. Our study is limited by its small sample size and the lack of a control group. However, considering the excellent clinical outcomes without complications, our cases indicate that internal fixation with use of a modified basket plate may provide an alternative for the fixation of the inferior patellar pole fracture.

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