Percutaneous Dowel Bone Grafting of a Patella Nonunion in a Football Player

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Percutaneous, autogeneic dowel bone grafting and compression screw fixation is a viable treatment option for a transverse patellar nonunion. This technique resulted in patellar healing and rapid return to sports in an athletic, adolescent male.

The primary function of the patella is to increase the efficacy of the quadriceps muscle by elevating the extensor mechanism from the knee’s axis of rotation. This provides a mechanical advantage by increasing the moment arm, thus allowing the knee to tolerate the substantial forces required by activities such as walking, rising from a chair, or jumping. This mechanism is often disrupted in the case of a patella fracture, but if the patellar retinaculum remains intact after a transverse fracture, the extensor mechanism of the knee can continue to function.

Nonoperative treatment of transverse patellar fractures with knee immobilization followed by quadriceps strengthening exercises has been advocated in cases of minimal extensor mechanism disruption and 2-mm ≤ of articular surface step-off. However, persistent patellofemoral contact stress and distracting tensile forces across the fracture site may contribute to the development of a nonunion. The superior pole of the patella is pulled proximally by the quadriceps tendon while the inferior pole is pulled distally by the patellar ligament.

This article presents a case of a 16-year-old multisport athlete with a nonunion of a minimally-displaced transverse patellar fracture. To our knowledge, treatment with percutaneous, autogeneic dowel bone grafting and cannulated compression screw fixation has not been previously reported in the literature.

CASE REPORT

A 16-year-old male athlete presented with anterior knee pain after running into a wall during a basketball game. Radiographs revealed a minimally displaced 2-mm transverse patella fracture with minimal displacement of the subchondral bone. Nonoperative management was recommended since the retinaculum was intact and active knee extension was preserved. He was treated with a knee immobilizer for walking, passive knee range of motion (ROM) exercises, and an ultrasonic bone stimulator.

Three months after the injury, the patient was able to participate in competitive golf, but reported anterior knee pain with running. In addition, he was eager to increase his activity level in preparation for the upcoming football season.

Radiographs at 4 months showed decreased mineralization and slight distraction at the fracture site. A computed tomography (CT) scan confirmed a nonunion revealing resorption at the fracture edges and no significant areas of bridging bone (Figure 1). The lack of radiographic healing, persistent pain with running, and the anticipated increased activity level prompted surgical intervention.

The patellar nonunion was treated with percutaneous, autogeneic bone grafting and compression screw fixation. A 2-cm skin incision was made at the lateral aspect of the midpatella. A guide pin was inserted across the nonunion site under fluoroscopic visualization and a 10-mm reamer was used to drill a tract, which terminated before reaching the medial patellar cortex (Figure 2). A 10-mm dowel of cancellous autograft was harvested from the proximal tibia through a 1-cm incision in the region of Gerdy’s tubercle. The bone graft was inserted and packed into the patellar tract. Two
percutaneous, 5-mm cannulated, compression screws were inserted from proximal to distal. Antero-posterior and lateral fluoroscopic views revealed excellent screw position with thread engagement in the distal fragment (Figure 3). Following surgery, the patient was allowed to bear weight as tolerated using crutches, perform full knee ROM exercises, and straight leg lifts.

At 2 months postoperatively, the patient reported no knee pain. Physical examination revealed symmetric knee ROM from 0° to 140°, full knee extension strength against resistance and no tenderness at the fracture site or the screw heads. Radiographs and a CT scan revealed bridging bone at the anterior aspect of the patella and at the dowel site, with gap narrowing at the subchondral bone articular surface site.

The patient was released to begin activities as tolerated, including football practice. Following completion of a successful football season, repeat radiographs and a CT scan at 5 months postoperatively revealed full incorporation of the bone graft, bridging bone, and no evidence of screw migration (Figure 4).

**DISCUSSION**

Current surgical options for the treatment of transverse patella fractures include partial and total patellectomy, tension-band wiring, and lag screw fixation. Variations of tension band wiring include modified anterior tension-band wiring, modified anterior tension-band wiring though cannulated compression screws as described by Berg,6 longitudinal anterior band plus cerclage wiring as described by Lotke and Ecker,7 and independent lag screws plus modified anterior tension-band wiring.

Carpenter et al8 used cadaveric knees to study the effects of 3 fixation techniques: the modified tension band, parallel interfragmentary lag screws, and cannulated lag screws with a tension band through the cannulated screws. During the first few cycles of initial loading of the knee, the patellar fragments fixed with a modified tension band would slide apart and stabilize in that distracted position. The study revealed that cannulated lag screws plus the tension band, or screws alone, experienced the least amount of fracture displacement (<1 mm) and the highest load to failure. They concluded that the screws and tension band construct provided the most secure fixation of transverse patellar fractures, although there was no statisti-
cally significant difference between the screws with tension band group and the screws alone group.\textsuperscript{8} Benjamin et al\textsuperscript{9} conducted a biomechanical evaluation of 4 different fixation methods in 23 formalin-fixed samples, ultimately recommending screw fixation with washers in patients with healthy bone stock.

Our patient underwent internal fixation of a transverse patellar fracture with 2 cannulated compression screws and percutaneous insertion of an autogeneic dowel bone graft as an outpatient procedure. The autograft provided an osteoconductive and osteoinductive bridge between the fracture fragments and filled the gap created by resorption of the fracture edges while preventing overcompression and displacement of a well-aligned articular surface. The lag screws placed perpendicular to the fracture provided compression and allowed for aggressive postoperative rehabilitation. The percutaneous technique did not disrupt the anterior or medial fracture callous and preserved patellar blood flow by avoiding soft tissue dissection.

REFERENCES