

## Case Report

# Iatrogenic Trochlear Chondral Defects After Anterolateral Placement of Retrograde Femoral Nails

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**Abstract:** Femoral shaft fractures are common injuries with an incidence of 37.1 per 100,000 person-years in the United States. Retrograde femoral nailing is an increasingly used treatment strategy to manage these injuries, particularly in fractures below stemmed hip prostheses, in supracondylar or distal femur fractures, in fractures in pregnant or obese patients, and when concomitant ipsilateral acetabular/pelvic ring fractures are present. Retrograde fixation has been shown to be a viable option with union rates comparable to antegrade intramedullary nailing. Despite having excellent results in the treatment of femoral fractures, retrograde femoral nails have been associated with iatrogenic patellofemoral chondral damage that may occur because of malpositioning of the intramedullary nail at the entry point. The objective of this case report is to describe 2 patients who suffered iatrogenic trochlear chondral defects after retrograde femoral nailing and subsequently underwent osteoarticular allograft transplantation surgery.

Femoral shaft fractures are common injuries with an incidence reported to be 37.1 per 100,000 person-years in the United States.<sup>1</sup> Femoral nailing has been associated with excellent fracture healing and a rapid recovery from surgery. Although antegrade femoral fixation is the conventional approach, retrograde femoral nailing can be a useful method for the treatment of fractures below stemmed hip prostheses, distal femur fractures, fractures in pregnant or obese patients, or when concomitant ipsilateral acetabular/pelvic ring fractures are present.<sup>2-4</sup> In this regard, the advantages of retrograde compared with antegrade femoral nailing may include improved fixation for distal fractures,

decreased operative time, and preserving the surgical planes of the proximal thigh and hip for other procedures, as in cases of polytrauma patients with pelvic or acetabular fractures.<sup>5-7</sup>

Despite having excellent healing rates, fracture fixation with retrograde femoral nailing is not without fault and has been associated with some unique complications, most notably postoperative anterior knee pain.<sup>8-10</sup> Acharya et al.<sup>11</sup> reported knee pain in 70% of patients after the placement of retrograde femoral nails. A factor that may contribute to this subset of patients with anterior knee pain is iatrogenic chondral injury to the trochlear groove. The objective of this case report is to describe 2 patients who suffered iatrogenic chondral defects after retrograde femoral nailing and who subsequently underwent an osteoarticular allograft transplantation surgery (OATS) of the trochlear groove.

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## Case Report

### Case 1

The first patient was a 49-year-old man who presented with significant right anterior knee pain that had been present since he underwent the placement of a retrograde femoral nail to treat a femoral shaft fracture he sustained during a motorcycle accident. He presented 2 months after this procedure complaining of constant anterior knee pain. The patient described his pain to be manageable at rest but increased with activity.

On physical examination, the patient had full range of motion of the knee but did have a mild effusion. Both magnetic resonance imaging (MRI) and plain radiographs showed articular chondral wear in the central trochlear notch (Fig 1A). The patient underwent diagnostic arthroscopy that showed a 15-mm-diameter osteochondral trochlear defect (Fig 1B). The chondral defect was later treated with an OATS procedure to address the grade IV osteochondral defect (Fig 1C).

## Case 2

The second patient was a 29-year-old man who suffered a spiral fracture of the right femoral shaft while wakeboarding. The patient subsequently underwent fracture fixation with a retrograde femoral nail. He presented 7 months after this procedure complaining of anterior knee pain localized directly posteriorly to the patella.

On physical examination, he was noted to have pain with passive knee flexion and resisted knee extension and also a significant decrease in range of motion when compared with the contralateral knee. Plain radiographs showed interval healing of the femoral shaft fracture, and an MRI was significant for scar tissue in the anterior interval as well as a full-thickness osteochondral defect of the trochlea. At the time of arthroscopy, the intramedullary nail was noted to have entered through approximately 90% of the diameter of the articular cartilage of the trochlea, and there was a significant full-thickness cartilage defect present. This patient similarly underwent an OATS procedure to address the osteochondral defect (Fig 2).

## Discussion

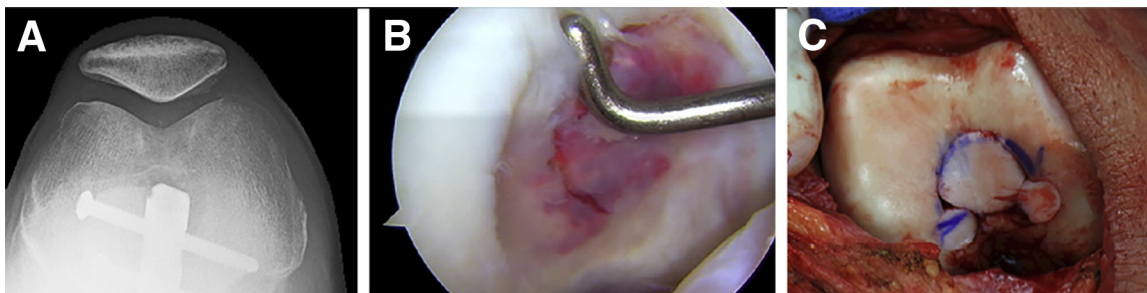
The most important finding in this case series was the presence of full-thickness central trochlear lesions after retrograde femoral nailing for the treatment of femur fractures. Although there is an inherent risk of damage to the articular cartilage in retrograde nailing techniques, to our knowledge, no studies have reported

full-thickness, grade IV chondral defects of the trochlea after this procedure.

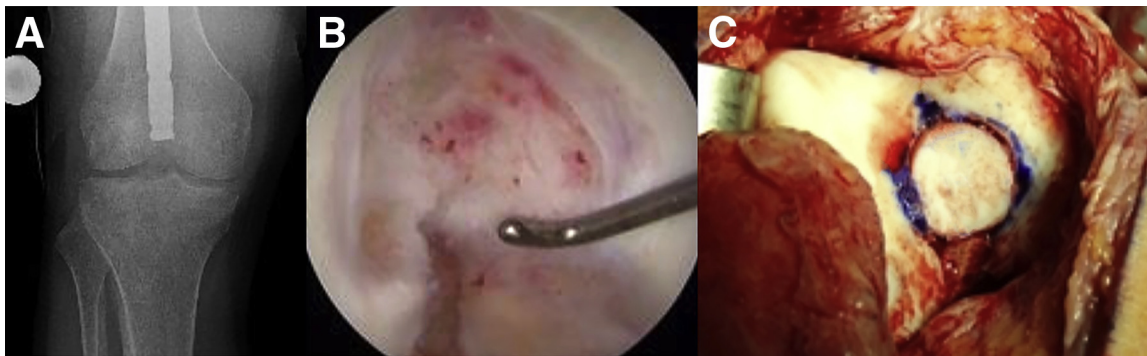
Retrograde intramedullary (IM) nailing has been shown to be an efficacious treatment option for femur fractures in many clinical scenarios including polytrauma, pregnancy, obesity, when the fracture occurs below stemmed hip prostheses, in supracondylar or distal femur fractures, and when there are associated acetabular or pelvis injuries. Nevertheless, retrograde nailing has been associated with significantly higher rates of anterior knee pain and has a risk of iatrogenic damage to the articular cartilage of the distal femur, particularly the trochlear groove.

Numerous cadaveric studies have evaluated the ideal femoral entry point for the retrograde nail,<sup>6,12-14</sup> and the optimal location varies in the literature.<sup>11</sup> Overall, the ideal entry point should align with the femoral shaft on both the anteroposterior and lateral plain radiographs and should also attempt to avoid iatrogenic damage to the patellofemoral articular surface. Carmack et al. located the ideal entry point in 26 cadaveric femurs and concluded that in most femurs, the ideal location exists in the “safe position” just anterior to the posterior cruciate ligament and slightly medial to the intercondylar groove.<sup>15-18</sup> These authors did note, however, that because of anatomic variation, the ideal starting position may sometimes be located in the patellofemoral contact area.

The most common risks associated with IM nail placement in the distal femur include shortening, malrotation, and pain due to prominent distal hardware. Surgical alternatives other than cartilage resurfacing include marrow stimulation procedures, subchondral drilling, and microfracture. The main indication for an OATS procedure is a symptomatic full-thickness articular cartilage or osteochondral defect  $>3 \text{ cm}^2$ . An OATS procedure was chosen in these cases because our patients were young and their defects were large, full-thickness osteochondral lesions with no supporting subchondral bone due to the retrograde nail



**Fig 1.** (A) Sunrise view of the right knee. The sunrise view depicts the placement of the femoral nail in the femoral shaft. Also apparent in the image is a significant cartilage defect located in the trochlear notch. (B) Intra-arthroscopic image taken of the affected area of the trochlear notch. This image shows the significant, full thickness defect of the trochlear notch. On arthroscopic examination it became clear that the intramedullary nail had entered through 90% of the diameter of the articular cartilage. (C) Image after osteochondral allograft placement. This image depicts the placement of the osteochondral allograft in the trochlear defect.



**Fig 2.** (A) Coronal radiograph of the right knee. The coronal radiograph shows the intramedullary nail centered in the femoral shaft. It also shows some chondral wearing in the trochlear notch. (B) Intraoperative arthroscopic image of a chondral defect. This intraoperative arthroscopic image shows the significant chondral defect with exposed subchondral bone (grade IV). The arthroscopic probe has a 5 mm width at its tip that helps show the width of the trochlear defect. (C) Image after osteochondral allograft placement. The osteochondral allograft is in place, filling the area of the defect. The edges of the graft are flush with the sides, and there are no prominent edges.

placement. Contraindications for an OATS procedure include kissing lesions of the corresponding articular cartilage surface, joint space narrowing, malalignment, ligamentous instability, or absence of >50% of the meniscus in the ipsilateral compartment.<sup>19</sup>

Because the IM nail is placed proximal to the knee joint, MRI is a reasonable modality to evaluate articular cartilage and other pathology within the knee. However, diagnostic arthroscopy is the gold standard to evaluate and diagnose articular cartilage lesions. Because of the variability in MRI, the lack of diagnostic information on physical examination, and the patient's functional limitations, the authors emphasize a 2-stage surgical approach. First, a diagnostic arthroscopy is performed to confirm the diagnosis and to verify that the opposing patella articular cartilage surface is intact. At the time of the diagnostic arthroscopy, a chondroplasty is performed to trim the chondral defect to a stable border; however, this treatment is usually not sufficient for large chondral defects. Thus, the senior author's (R.F.L.) practice is to directly proceed with the osteoarticular allograft procurement and subsequent surgery at a minimum of 6 weeks after the diagnostic arthroscopy.

Hardware removal should be considered in the case of proud hardware (IM nail or interlocking screws) that is either limiting a patient's range of motion, causing pain, or impinging on anatomic structures and causing continued tissue injury or articular cartilage degeneration. In addition, hardware removal should be considered cautiously in patients in whom complete healing of the femoral fracture is not shown.

In conclusion, this case series illustrates an important sequela related to malposition of the retrograde nail entry point on the central trochlea. These patients had symptomatic, grade IV full-thickness chondral lesions present less than a year after their femoral intramedullary nailing procedures. Because of these

findings, careful assessment of the nail entry point should be performed during fracture fixation. Furthermore, a complete evaluation consisting of plain radiographs, MRI, and if necessary diagnostic arthroscopy should be performed to evaluate the extent of chondral damage in cases of anterior pain after retrograde femoral nail fixation. For those patients with large grade IV trochlear defects, an OATS procedure may be a feasible option. When anatomic variance does not allow the safe placement of a retrograde femoral nail, alternative fixation strategies should be considered.

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