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Case Report

Condylar femoral arthroplasty with bone cement as a salvage measure in open fracture with articular bone defect in a young patient

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ABSTRACT

Open fractures often require complex treatments, especially those with joint involvement or critical bone defects. Managing both combined injuries present even greater challenges and is not without complications.

We present the case of a young patient with an open fracture of the femoral condyle and loss of bone stock in the articular surface. In this case, a combined osteosynthesis approach was employed, utilizing cannulated screws and a femoral condyle arthroplasty with bone cement as a salvage measure, allowing a favorable clinical and functional outcome at the 3-year follow-up. This technique serves as a simple, reproducible, and cost-effective alternative for transient or potentially definitive management in such cases.

Introduction

Open fractures involving joint compromise and loss of bone stock around the knee are commonly caused by high-energy trauma [1]. The bone defect may result from the initial trauma itself or subsequent surgical debridement. When there is articular surface involvement in knee fractures, their definitive management poses a therapeutic challenge, encompassing options like arthrodesis, total knee arthroplasty, and the use of allografts [2]. However, these alternatives can be restricted in young patients due to concerns related to functionality, future loosening, or accessibility.

The objective of this present report is to showcase a case of an open fracture with loss of femoral condyle bone stock and describe a successful and functional management alternative. This approach allows for postponing the necessity for total knee prosthesis, allograft utilization, or arthrodesis in a young patient.

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Fig. 1. CT shows a fracture of the lateral femoral condyle with loss of the articular bone stock and comminuted fracture of the right knee patella.

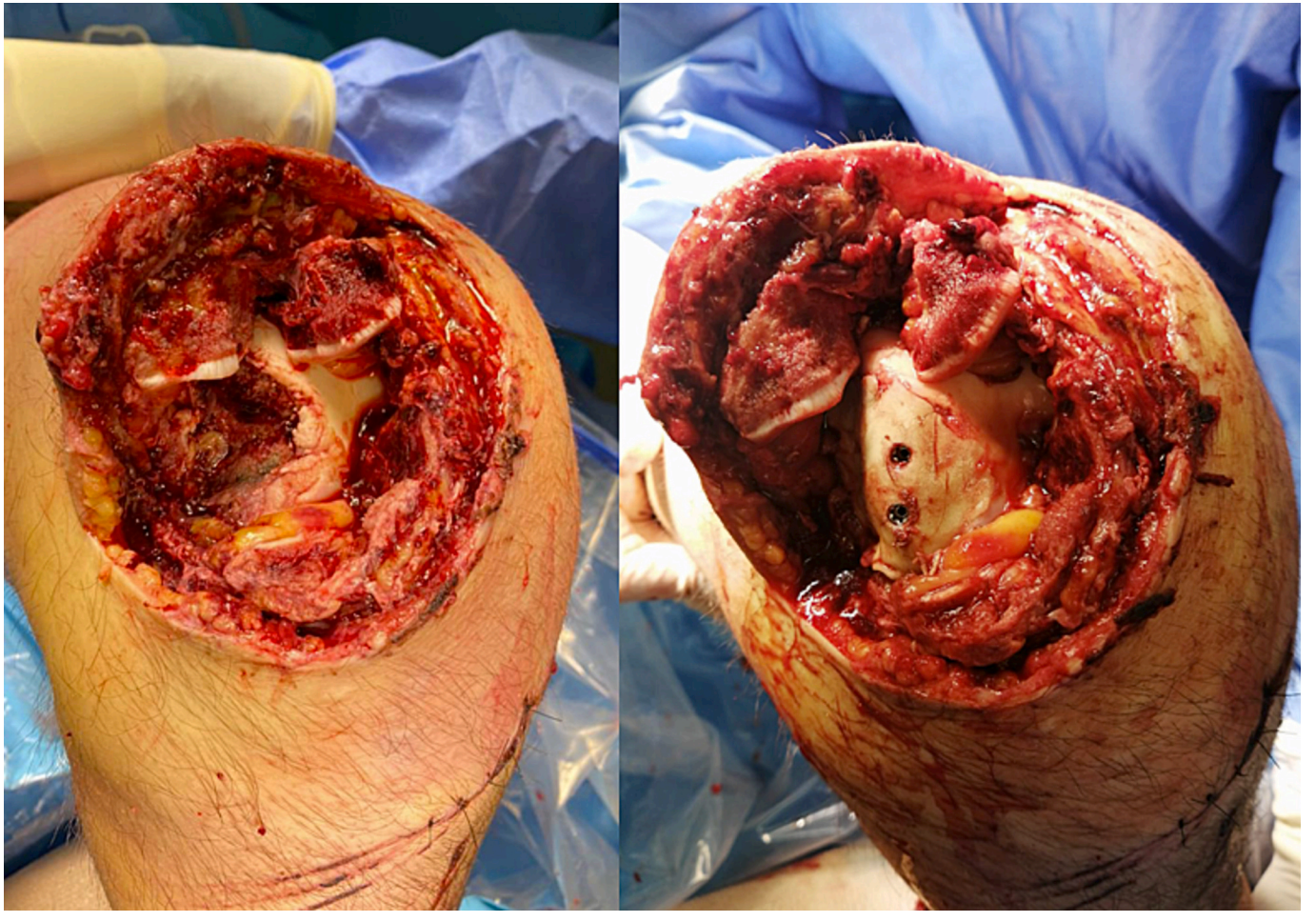

Fig. 2. Intraoperative image of the fractures on the left and right showing filling and shaping of the bone defect with PMMA and fixation with 2 headless 4.5 mm cannulated screws.

Fig. 3. Postoperative CT with synthesized fractures. PMMA filling the bone defect is observed.

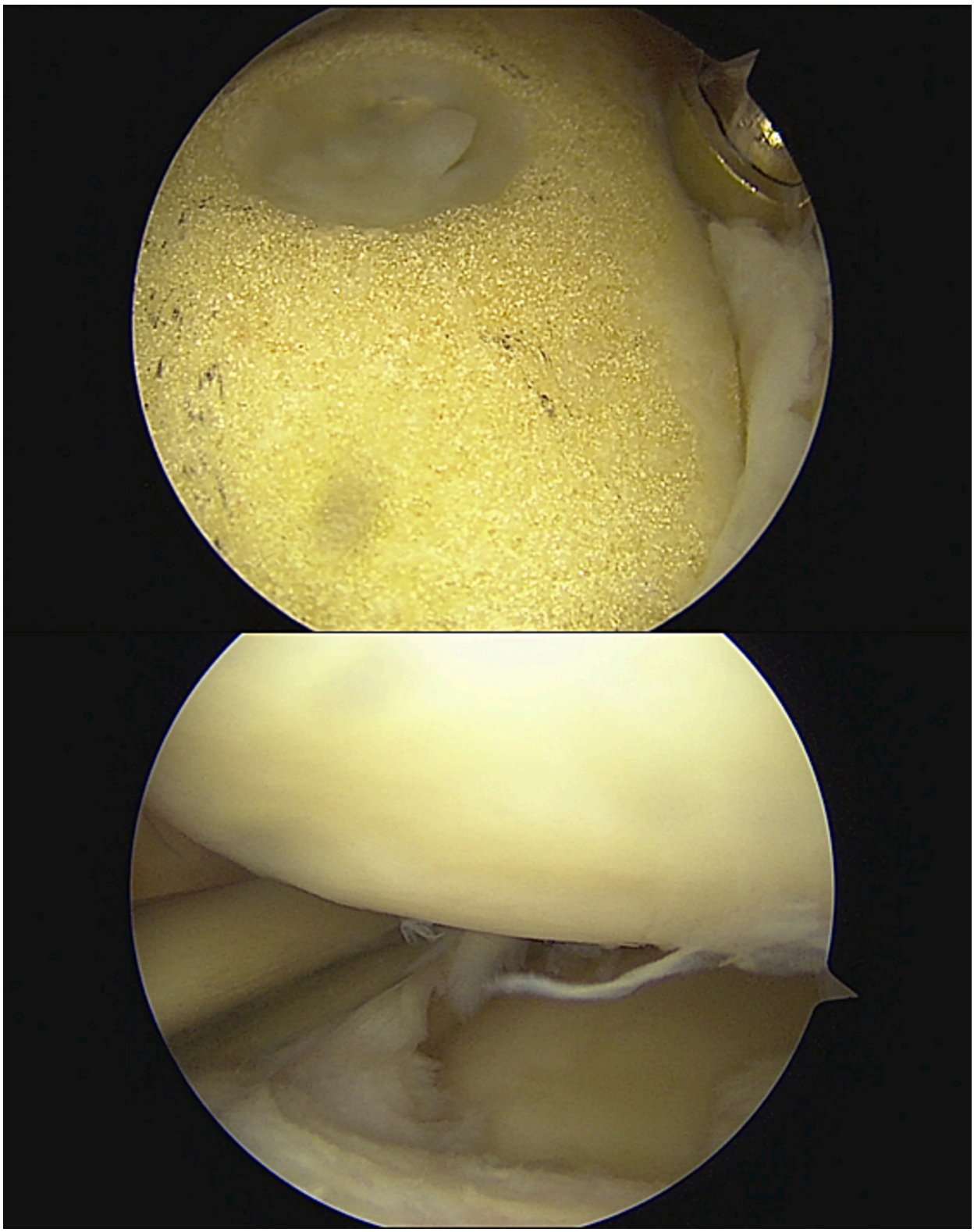

Fig. 4. Arthroscopic images 3 months after initial surgery. Above, the PMMA covering with coated screw.

Case report

A 19-year-old male patient, a smoker with no significant medical history, experienced a lateral impact from a truck while riding a motorcycle. He was initially evaluated at a Medium Complexity Hospital, where open fractures of the patella and distal femur were diagnosed, accompanied by extensively contaminated wounds on the anterior aspect of the right knee. Surgical debridement, antibiotics, and transarticular external knee fixation were performed at that center. Subsequently, he was transferred to our institution after 6 days for definitive management. Upon initial evaluation at our center, clinical examination revealed wounds of approximately 10 cm on the anterior aspect of the right knee and a second wound of around 5 cm on the medial infrapatellar region, sutured and devoid of purulent discharge. The wounds appeared clean, without erythematous borders or local warmth. Distal neurovascular examination showed no abnormalities, and the external fixation remained secure.

Imaging studies included a lower extremity Angio-CT, which did not reveal any vascular injury, and a computed tomography of the right knee showed a lateral femoral condyle fracture with a 4 cm anteroposterior axis defect and a 1 cm depth, along with a comminuted patellar fracture (Fig. 1). Admission diagnoses included Gustilo-Anderson III-A [3] open fractures of the right distal femur and comminuted right patellar fracture.

The patient underwent surgical intervention in the operating room on the following day of admission to our hospital. The procedure was conducted under spinal anesthesia by a team of specialized orthopedic surgeons. External fixators were removed, followed by surgical debridement and exposure of the lateral femoral condyle fracture with impacted wedge and absence of salvageable bone fragment. Considering this, the missing segment was filled with polymethylmethacrylate (PMMA) cement mixed with gentamicin and vancomycin, which was molded to cover the defect. Subsequently, osteosynthesis was carried out using two non-headed 4.5 mm cannulated screws to achieve proper fixation of the neocondyle to the remainder of the distal femur (Fig. 2). Osteosynthesis was then performed on the comminuted patellar fracture with three main non-congruent fragments and evident loss of bone stock. The two proximal fragments were first stabilized with a 3.5 mm headed cannulated screw, followed by synthesis of the distal fragment with two 3.5 mm cannulated screws with head fixation from distal to proximal. The osteosynthesis was augmented with tension band wiring through screws to compress the fragments, resulting in an acceptable reduction despite fragment incongruence (Fig. 3). The patient was discharged from the hospital 5 days after surgery.

Subsequent follow-up visits revealed patellar fracture consolidation at 3 months postoperatively. The patient progressed without pain and with full weight-bearing on the right lower extremity, yet experienced right knee stiffness with complete extension and limited flexion to 70°. Due to this stiffness, a second surgery was scheduled 3 months after the initial procedure: arthroscopic fibroarthrolysis (FAA) and manipulation under anesthesia (MUA). Arthroscopic visualization unveiled significant fibrosis and adhesions in all compartments of the knee, including the intercondylar groove and a complete coverage of cement on the lateral femoral condyle. FAA was conducted with a shaver and radiofrequency, revealing the reconstructed condyle. Tibiofemoral lateral compartment displayed a well-formed PMMA condyle with concomitant complex meniscal tear in the meniscal body and diffuse grade I ICRS tibial plateau chondropathy (Fig. 4). Following a careful MUA, the range of motion improved to 0° extension and 115° flexion. After 3 months of physical therapy, the patient progressed without pain, exhibited proper gait, and achieved a knee range of motion of 0–100°. He resumed his work activities following the accident but did not engage in sports activities. Regular follow-up appointments were maintained for 3 years without any need for further interventions.

Discussion

High-energy fractures with extensive articular involvement and bone stock loss that affect the knee in young populations are generally associated with significant postoperative morbidity, loss of joint function, and chronic pain. Particularly, unicondylar defects present a considerable therapeutic challenge. A review of the literature reveals a variety of surgical alternatives employed for these injuries, yet there is no consensus on the standardized approach [4]. Currently, multiple options exist for unicondylar reconstruction, with mega-prostheses and joint allografts standing out. In the past, the use of a patellar autograft was common, as proposed by Campanacci et al. in 1985 [5]. In their study, this group reported on 19 patients with a follow-up ranging from 2 to 19 years, showing graft consolidation and good joint stability. However, this technique was infrequently selected due to the significant morbidity associated with graft harvesting and its functional impact on the limb.

There is a scarcity of reports in the literature concerning the use of unicondylar allografts. Muscolo et al. [6] reported an 85 % survival rate for condylar allografts in their series of 40 patients (29 femoral allografts – 11 tibial allografts) with a follow-up of 5 to 10 years. They mention that this procedure is not exempt from complications, with infection and non-union being the most common. They also highlight the technical difficulty of finding a suitable allograft for each specific case.

Prostheses in young patients should be postponed as much as possible due to their longevity and potential subsequent revisions in this age group. Revision prostheses and mega-prostheses are prone to complications such as aseptic loosening and stem subsidence. The latter complication arises from the challenge of achieving a femoral component with proper metaphyseal support, given the condylar resection.

The two aforementioned joint reconstruction alternatives are associated with a high risk of wound complications, infections, pseudoarthrosis, and elevated costs [7,8], making them more challenging options in areas with limited access to such resources.

On the other hand, arthrodesis offers a replicable and safe alternative with favorable outcomes in terms of pain relief and joint stability, albeit with definitive limitations on the patient's daily activities.

Toy et al. [9] described their use of cement in non-contained femoral defects in their biomechanical cadaveric study, observing a reduced failure rate with the use of Steinmann pins or cement alone. The use of PMMA in extra-articular and periarticular bone defects

has long been established as an adjunct in managing bone tumors [10]. However, its clinical application in trauma-related joint defects is sparsely described. We present this case to highlight a technically straightforward, reproducible, cost-effective, and widely accessible solution. It is important to acknowledge that this approach is likely transient in nature, yet it yields positive outcomes in our case report. Condylar reconstruction using cement offers the benefits of immediate stability, the potential for localized antibiotic treatment, cost-effectiveness, and ease of replication.

Declaration of competing interest

The authors declare no conflicts of interest regarding this case report.

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