CASE REPORT

Open Traumatic Osteochondral Fracture of the Femoral Medial Condyle and Trochlea Treated by Mosaicplasty: a Case Report at 11-Year Follow-Up

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Introduction

The management of articular cartilage defects continues to be one of the most challenging clinical problems for orthopaedic surgeons. Many surgical procedures have been described in literature with different outcomes, but it remains difficult to compare the efficacy of these techniques because of a paucity of well-designed randomized controlled trials [2].

Bone marrow stimulation, autologous chondrocyte transplantation and autologous-plus-scaffold transplantation are common solutions for superficial articular defects but are not recommended in deep articular lesions involving the subchondral bone. On the other hand, autologous osteochondral mosaicplasty is effective in repairing deep osteochondral defects of the knee. This technique consists of the transposition of multiple cylindrical autogenous osteochondral plugs, harvested from either the low-weight-bearing periphery of the articular surface of the femoral trochlea or the edges of the intercondylar notch, in order to resurface the defect in a congruent fashion [9, 12].

This paper reports the 11-year follow-up result of a large open osteochondral defect in the trochlea and medial condyle of the femur, sustained by a young female patient after a motorcycle accident and treated by an “emergency mosaicplasty”.

Case Report

A 21-year-old female sustained a direct trauma to the anterior region of both knees following a motorcycle accident in February 2000. Evaluated at the Emergency Room of the authors’ institution, an open quadriceps tendon rupture at the left knee was observed and an osteochondral fracture at the trochlea and the medial femoral condyle were also present. These lesions were confirmed by X-rays and CT scan (Fig. 1a, b). In addition, a large wound without further lesions was present in the anterior region of the right knee. Given the young age of the subject, the absence of particulate on the joints after prolonged pulsed washing, the patient gave her informed consent to the proposed acute repair of the osteochondral fracture of the left knee using mosaicplasty.

An intravenous antibiotic prophylaxis (ceftriaxone 2 g + Vancomycin 1 g + metronidazole 200 mg) and an immune globulin dose for tetanus prevention were administered in the Emergency Room. Under general anaesthesia, a new irrigation and debridement of both knees was carefully performed. The wound on the right knee was closed by a direct suture. The left knee was examined, and a complete rupture of the quadriceps tendon and a large and severe comminuted osteochondral fracture of the trochlea and the medial femoral condyle were observed. No chondral lesions of the patella or other ligamentous or meniscal lesions were observed. Seven 5-mm osteochondral cylinders were harvested from the lateral side of the trochlea and used to plug the defect (Fig. 2). The remaining large osteochondral fragment of the condyle was temporarily fixed by a Kirschner wire; however, the wire accidentally broke during its removal and therefore was left in situ. The quadriceps tendon was repaired with a termino-terminal nonabsorbable suture. At the end of the procedure, both knees were wrapped. Intravenous antibiotics were continued for 3 days after surgery.

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Fig. 1. **a** This photograph documents the transverse linear wound on the left knee with a quadriceps tendon rupture. **b** This CT scan documents the osteochondral fracture in the medial trochlea and on the femoral medial condyle.

No postoperative complications were recorded. Range of motion (ROM) exercises were allowed at the second postoperative day by a continuous passive mobilization (CPM) device with a ROM of 0° to 30°. No weight bearing on the left knee for 40 days was allowed. ROM exercises with the use of a brace (fixed at 0° to 60°) were allowed after this period. A partial weight bearing was then allowed, and a full weight bearing was allowed after 60 days.

A clinical and radiological evaluation was performed at 3 weeks (suture removal), 1 month, 2 months and 4 months postoperatively. X-rays revealed progressive osteointegration of the graft, and the clinical evaluation showed excellent results (Fig. 3a): particularly, the Merchant view showed no patellar malalignment and a good restoration of the trochlear shape. After 1 year, the patient was also evaluated, reporting good function and ROM performance.

At the latest follow-up (11 years after surgery), both knees showed no functional impairment and a full ROM (Fig. 3b). No instability or other symptoms were described by the patient; a slight crepitus was detected during range of motion without associated pain. The patient was able to perform her normal daily activities and swimming. The mean IKDC and KOOS scores were 75 points and 79 points, respectively. At the same time, X-rays, CT scan and MRI showed a substantial restoration of the articular surface,

complete osteointegration of the plugs and minimal alterations on the chondral layers: a little but asymptomatic joint space narrowing and artifacts resulting due to the K-wire left in situ were also visible (Fig. 3).

Discussion

The management of traumatic chondral lesions of the knee is a challenge for orthopaedic surgeons. The restoration of the subchondral bone, the anatomical reduction and a stable fixation of fragments are the goals of all procedures, in order to achieve an early return to daily and sports activities. However, an anatomical reduction and fixation in the present case was not feasible. The young age of the patient and the need to quickly perform a surgical procedure given the open fracture caused the authors to propose an uncommon and extemporized procedure for this case.

Mosaicplasty is a suitable surgical option to fill joint defects, widely reported in literature particularly in younger patients [4, 6, 15, 16, 18, 20]. Autologous osteochondral grafting offers several advantages over other techniques, such as the use of hyaline cartilage with its underlying subchondral bone, a relatively short rehabilitation period and one-step surgical procedure. Limitations of this technique include the poor availability of the grafts, a frequent donor site morbidity, as well as potential differences in thickness and mechanical properties between the donor and recipient tissues. Furthermore, the risk of superficial graft subsidence at recovery of weight bearing has always to be considered. The outcome is strictly correlated with the complete filling of the bone loss, with the lesser presence of uncovered areas [10]. Nonetheless, mosaicplasty has yielded encouraging results in the treatment of symptomatic chondral defects, and it is considered a viable procedure in large and deep traumatic osteochondral fractures occurring in young patients with high-demanding lifestyle [8].

Several authors have reported the successful use of autologous osteochondral grafts in the treatment of unstable osteochondritis dissecans (OCD) lesions [7, 13]. Emmerson

Fig. 2. **a** Intraoperative pictures show a large comminuted osteochondral fracture of the trochlea and the medial femoral condyle with significant bone loss (*thin white arrow*). A large osteochondral fragment detached from the medial femoral condyle was also present. **b** An intraoperative picture illustrates the appearance after performance of the mosaicplasty (*thin black arrow*, donor site; *large green arrow*, recipient site).

Fig. 3. Clinical photographs demonstrate the range of motion at **a** 1 year and at **b** 11 years follow-up. **d** X-rays, **c,f** CT scan and **e** MRI evaluation provide the substantial good joint anatomy at 11-year follow-up on both medial and lateral condyles and patella.

et al. reported a success rate in more than 70% 7 years after fresh osteochondral allograft transplantation used for a case of osteochondritis dissecans of the femoral condyle in patients where a previous surgery had failed [7]. Moreover, successful results of autogenous osteochondral grafting were reported by Miniaci et al. in the treatment of 20 patients with OCD with previous failure of noninvasive management [13]. In addition, Hangody et al. reviewed the long-term results of the autologous osteochondral grafting, reporting good to excellent results in 9% of patients with a femoral condyle lesion [9]. Agneskirchner et al. reported the outcomes of the press-fit transplantation of an autologous posterior femoral condyle for the treatment of large osteochondral defects of the femoral condyle. Concerns have been raised regarding the long-term effects of the loss of the posterior condyle, and there are some limitations in the depth of subchondral bone that can be obtained [1].

Bentley et al. compared mosaicplasty and autologous chondrocyte implantation (ACI) for the treatment of articular cartilage defects in the knee in a prospective, randomized study: they concluded that patients treated with a mosaicplasty had better clinical results by the ACI procedure [3]. However, it should be noted that ACI is a two-step procedure, requiring an intact subchondral bone, and was therefore not indicated in the case here reported.

Finally, Solheim et al. recently reported the long-term outcomes (10 to 14 years) of several mosaicplasties performed in a heterogeneous group of patients for several types of osteochondral fractures, reporting the

best results for young males, with an age <40 years, and defects lesser than 3.0 cm², with respect to females older than 40 years [19].

Several mosaicplasties in traumatic defects of various joints (hand, ankle, hip) have been reported with substantially satisfactory results [5, 11, 14, 17]; however, no open fracture was treated by this technique. Roffman reported about a 16-year-old boy with an osteochondral fracture in the lateral femoral condyle operated on 3 months after the injury with a graft from the nonweight-bearing area of the same condyle: after 10 years, the knee was free from pain and the range of motion was normal [17]. Capo and Orillaza reported about the use of an osteochondral graft from the dorsal nonarticular portion of the metacarpal head for a traumatic defect in the metacarpophalangeal joint surface with good clinical results in an adult patient [5]. Finally, Nam and colleagues reported about two cases of a chondral defect to the femoral head after a traumatic hip dislocation in very young patients (15 and 21 years old), treated by an osteochondral autograft from the ipsilateral knee and the inferior femoral head, respectively, combined with a surgical dislocation of the hip. At 1 and 5 years of follow-up, MRI study demonstrated good autograft incorporation and articular surface conformity and, in both cases, a satisfactory clinical outcomes [14].

In the present case, a mosaicplasty procedure was successfully performed in an open comminuted fracture of the knee, showing long-lasting clinical outcomes. The outcomes were surely correlated with the young age of the patient, as

demonstrated also by the mentioned experiences of other authors, and by the efficacy of the technique.

To our knowledge, this is the first report in literature of a traumatic osteochondral defect managed by mosaicplasty.

Disclosures

Conflict of Interest: Christian Carulli, MD, Fabrizio Matassi, MD, Stefano Soderi, MD, Lorenzo Nistri, MD, Roberto Civinini, MD and Massimo Innocenti, MD, have declared that they have no conflict of interest.

Human/Animal Rights: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Informed Consent: Informed consent was obtained from all patients for being included in the study. Additional informed consent was obtained from all patients for which identifying information is included in this article.

Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

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