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Lateral Unicompartmental Arthroplasty As A Treatment For A Massive Osteochondral Defect In The Lateral Tibial Plateau Of A Young Patient

Serrano-Toledano D[1*], Payo Ollero J[1,2], Santos Rodas A[1,3], Muela Velasco R[1], Montilla Jiménez FJ[1]

[1] Hospital Viamed Santa Ángela de la Cruz, Seville, Spain

[2] Hospital General Básico de Riotinto, Minas de Riotinto, Huelva, Spain

[3] Hospital Universitario Virgen del Rocío, Seville, Spain

***Corresponding author:** Serrano-Toledano David, Hospital Viamed Santa Ángela de la Cruz, Calle Gallos 22, 2C, 41003, Seville, Spain

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Abstract

Introduction

Despite the good outcomes achieved through open reduction and internal fixation of lateral tibial plateau fractures, osteochondral defects frequently occur as sequelae in such injuries. Depending on their size and depth, treatment options can range from debridement, microfractures, autologous chondrocyte transplantation, mosaicoplasty, massive allograft or arthroplasty. For large defects and young patients with high functional demand, reconstruction with a massive osteochondral graft is often the recommended option. Arthroplasty is typically reserved for older patients with lower functional demand.

Case Report

A 35-year-old female patient with septic pseudoarthrosis of the tibial diaphysis and lateral tibial plateau sinking fracture of two years duration after a traffic accident. After reconstruction with a vascularized flap and pedicled vascularized autologous fibular graft, the patient developed valgus deformity of the knee and a massive osteochondral defect on the lateral tibial plateau as a consequence of inadequate treatment of the fracture-sinking injury at that level.

Discussion

The treatment of voluminous osteochondral defects of the lateral tibial plateau largely depends on the patient's age and functional demand. In young patients with high functional demand, massive osteochondral allografts have shown good results, although they are a technically complex option dependent on graft availability. For patients who cannot undergo surgery, lateral unicompartmental surgery can represent a useful alternative treatment.

Conclusion

Lateral unicompartmental knee arthroplasty can be a valuable treatment alternative for voluminous osteochondral defects of the lateral tibial plateau in young patients where reconstruction with a massive osteochondral graft is not technically feasible.

1. Introduction

Lateral tibial plateau fractures are relatively common injuries in daily clinical practice. Although open reduction and internal fixation usually provide anatomical reduction and functional recovery, these fractures can lead to rapid joint deterioration. Posttraumatic osteoarthritis represents approximately 10% of knee arthritis cases [1]. Since these fractures often occur in young patients, they are more likely to develop advanced stages of arthritis at an earlier age, when the functional demand for work or recreational activities is higher [2]. The percentage of joint fractures that progress to arthritis ranges from 22% to 44%. The causes of this rapid

degeneration can be diverse (wrong reduction, lack of bone healing, osteochondral defects, poor bone quality, or malalignment), and in a significant portion of cases, they require subsequent surgeries [3].

The treatment of sequelae from these fractures primarily depends on the size of the lesion, the patient's age, and functional demand. Osteochondral defects with minimal subchondral bone involvement can be treated with debridement, microfractures, autologous chondrocyte transplantation, or mosaicoplasty [4]. In massive defects (larger than 3 cm in diameter or over 1 cm deep), treatment alternatives are limited and range between massive osteochondral transplantation, which is technically complex and restricted to centers with tissue banks, or total knee arthroplasty, which is usually associated with augmentation and stems [5].

Total Knee Arthroplasty (TKA) has shown pain and functional improvement in patients with secondary arthritis from lateral tibial plateau fractures, although it has been associated with worse outcomes than TKA for primary arthritis [6]. Unicompartmental Knee Arthroplasty (UKA) is an accepted treatment option for primary lateral knee arthritis. Posttraumatic arthritis is a less common indication for UKA, and there are few studies in the literature specifically analysing its use as a treatment option for this type of injury [8-10].

The case presented is a young patient in whom lateral UKA was used as an alternative treatment for a voluminous osteochondral defect following an inadequately treated lateral tibial plateau fracture. As this was a limb in which previous reconstruction with a pedicled vascularized fibular graft and free microvascularized latissimus dorsi flap had been performed due to septic pseudoarthrosis of the tibial diaphysis, massive osteochondral grafting was not technically feasible.

2. Clinical Case

Patient

A 35-year-old female patient with no significant medical history had active septic pseudoarthrosis of the tibial diaphysis, active pretibial fistula, poor soft tissue coverage, and poorly tolerated external fixator immobilization at the initial consultation (Figure 1). She had undergone several surgeries at another hospital after a traffic accident and a type IIIA open bifocal fracture of the tibia and fibula according to Gustilo's classification, associated with a type III external tibial plateau fracture according to Schatzker's classification, with a torpid evolution.

Figure 1: Clinical and radiographic appearance at the start of treatment

Surgical Technique

A three-step treatment plan was decided upon. In the first step, external fixation was removed, and the limb was immobilized with a functional brace. In the second step, radical debridement and reconstruction of the bone defect were performed using a T2 tibial nail (Stryker, Warsaw, USA) coated with vancomycin and tobramycin-impregnated acrylic cement. Soft tissue coverage was ensured with a free latissimus dorsi flap (Figure 2). The third step involved removal of the nail and cement spacer and reconstruction of the bone defect with a pedicled vascularized autologous fibular graft from the same leg. Fixation was performed with a 12-hole proximal and lateral tibial plateau locked plate (AxSOS, Stryker, Warsaw, USA) for the lateral tibial plateau fracture (Figure 3). The limb was immobilized with a functional brace allowing complete knee and ankle mobility, and full weight-bearing was delayed until clinical and radiological graft consolidation and fracture healing were ensured.

Figure 2: Clinical and radiographic appearance after second treatment

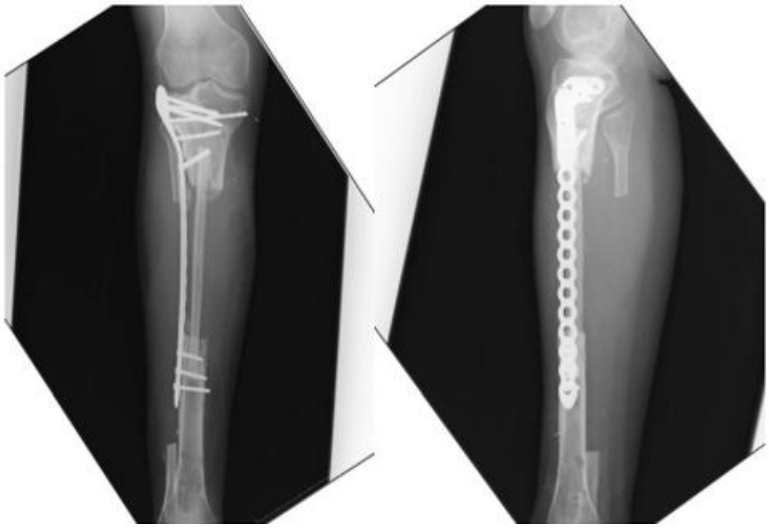

Figure 3: X-rays after reconstruction of the tibial plateau sinking fracture and tibial diaphyseal defect with pedicled vascularized fibular autograft

Upon starting full weight-bearing approximately 3 months after the last surgery, the patient began experiencing pain and progressive valgus deformity of the knee. Radiological tests confirmed complete integration of the pedicled vascularized fibular graft despite the failure of the osteosynthesis material distally and a 3 cm wide and 2 cm deep osteochondral defect as a consequence of inadequate treatment of the previous lateral tibial plateau fracture (Figure 4).

Figure 4: Lower limb radiography showing right knee valgus displacement

As the remaining proximal tibial bone prevented reconstruction of the defect with a massive osteochondral graft, removal of the osteosynthesis material and subsequent two-stage arthroplasty were decided upon (Figure 5). Using an approach that preserved the vascularity of the previous latissimus dorsi flap, a lateral unicompartmental knee prosthesis (Triathlon PKR, Stryker, Warsaw, USA) was implanted. The limb was immobilized with a functional brace allowing complete knee and ankle mobility, and progressive weight-bearing began in the second week, reaching full weight-bearing one month after surgery.

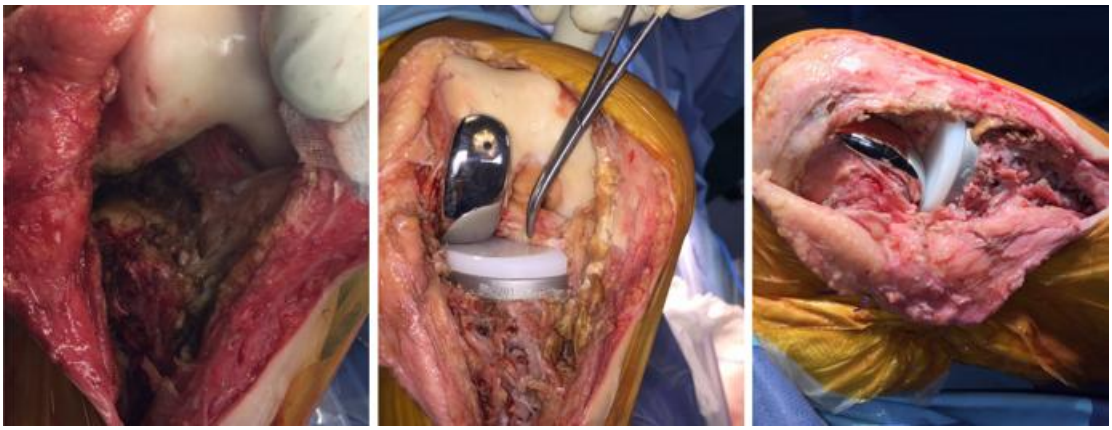

Figure 5: Intraoperative detail showing the approach, the osteochondral defect, and the performed reconstruction

Clinical and radiological follow-up was performed at two weeks, one month, three and six months and subsequently annually after surgery (Figure 6). Written consent from the patient was obtained for publication of the case.

Figure 6: Updated radiographic study

2. Results

The patient had a favorable postoperative course. The wound, soft tissues, and analytical parameters progressed favorably. After 9 years of follow-up following tibial defect reconstruction with a pedicled vascularized fibular graft and free latissimus dorsi flap, the infection was clinically and analytically resolved. At 8 years after prosthetic surgery and following an accidental fall, the patient sustained a proximal femur fracture in the same limb, which needed surgical treatment with a long Gamma 3 trochanteric nail (Stryker, Warsaw, USA). After consolidation of the proximal femur fracture and 9 years following prosthetic surgery, the patient did not present obvious limb length discrepancy, and the range of motion of the hip, knee, and ankle was complete. The Knee

Society Score (KSS) for clinical and functional aspects at 9 years showed scores of 88.6 and 92.6, respectively, compared to previous values of 47.5 and 45.2. She is capable of performing daily activities with a cane without pain, and her satisfaction level regarding the surgeries is high.

3. Discussion

The main objective of this study is to describe lateral UKA as an alternative treatment option for a voluminous osteochondral defect following a lateral tibial plateau fracture sequela in a young patient in whom reconstruction with a massive osteochondral graft was not feasible due to inadequate remaining bone at the proximal tibia after reconstruction of a large bone defect with a pedicled vascularized fibular graft and free microvascularized latissimus dorsi flap.

While open reduction and internal fixation of lateral tibial plateau fractures typically provide anatomical reduction and good functional outcomes, a significant proportion of these fractures rapidly progress to osteoarthritis [3]. Poor bone quality, associated soft tissue, ligament, and meniscus injuries, surgical technique errors, or valgus malalignment can lead to large osteochondral injuries at this site. Massive osteochondral grafting is an appealing treatment option for voluminous osteochondral lesions in young patients with high functional demand, allowing restoration of the joint surface, filling of bone defects, and the potential to preserve arthroplasty for the future [5]. Despite showing good medium- and long-term results, this technique is highly demanding and requires advanced logistics not available in all hospital centers. The disadvantages of massive osteochondral grafting also include the risk of disease transmission, graft nonincorporation or resorption, and infection risk. In the presented case, this treatment option was discarded due to insufficient remaining bone at the proximal tibia, which hindered graft reconstruction.

TKA represents an interesting treatment option for sequelae of lateral tibial plateau fractures that cannot be reconstructed using standard techniques. Compared to its use in primary osteoarthritis, TKA for this type of injury is more technically demanding and although associated with a higher complication rate, implant survival is comparable to that after TKA for primary osteoarthritis [6,11-13]. However, the results of TKA after lateral tibial plateau fractures are not as favorable as when used for primary osteoarthritis [3].

Lateral UKA is an established treatment option for primary lateral knee osteoarthritis. There are several documented advantages of UKA over TKA, including faster recovery, better postoperative range of motion, improved functional outcomes, fewer complications, shorter hospital stay and greater ease of potential revision surgery [14-16]. Despite concerns about UKA compared to TKA, including its lower medium- and long-term survival rates, UKA has been shown to have 5-year survival rates of 93.2%, 10-year survival rates of 91.4%, and 15-year survival rates of 89.5% [17].

To date, only three studies have specifically analysed the use of lateral UKA in sequelae after lateral tibial plateau fractures [2,8,9], while other studies have described the use of lateral UKA for all indications, with a small number of patients with posttraumatic osteoarthritis [18,19]. Romagnoli et al. conducted a case–control study to compare the clinical and radiographic outcomes of 13 lateral UKAs used in sequelae after lateral tibial plateau fractures with 13 cases following primary lateral osteoarthritis. Survival rates were the same in both groups, at 92% at 9 years, and no differences were found in the analysed radiographic and functional parameters. In another similar study, Sah and Scott compared 38 lateral UKAs used in primary osteoarthritis with 10 lateral UKAs in posttraumatic osteoarthritis following lateral tibial plateau fractures, finding better results in the Knee Score in the primary osteoarthritis group with an average of 5.2 years of follow-up. They justified these differences by the use of a medial approach for lateral arthroplasty. Lustig et al. retrospectively analysed the clinical, functional, and survival outcomes of a consecutive series of 13 lateral UKAs following lateral tibial plateau fracture sequelae, with an average follow-up of 10.2 years. They found improvement in functional parameters in the International Knee Score of knee and function and a 100% survival rate at 5 and 10 years. Argenson et al. presented a series of 40 lateral UKAs with an average follow-up of 12.6 years, including 12 cases (30%) of lateral tibial plateau fracture sequelae with a 92% survival rate at 10 years. In a similar study, Edmiston et al. evaluated 65 lateral UKAs with an average follow-up of 82 months, although only 2 patients had lateral tibial plateau fracture sequelae. Taking all this into account, lateral UKA may be a viable treatment option in patients with posttraumatic osteoarthritis following lateral tibial plateau fractures, typically

young patients with high functional demand, with the understanding that subsequent revision surgery would generally be technically easier and less aggressive than revision surgery following TKA.

The current study has several limitations that need to be considered. First, it describes a single case, but considering the exceptionally complex clinical situation and technical constraints presented by the patient, this is noteworthy. Second, the follow-up period, currently at a medium term but close to 10 years, requires a longer follow-up period to rule out complications such as implant loosening or wear, issues related to the pedicled vascularized fibular graft, or reactivation of infection.

4. Conclusions

Lateral UKA is presented as an alternative treatment option for a voluminous osteochondral defect following inadequately treated lateral tibial plateau fracture sequela in a young patient with a previous pedicled vascularized fibular graft and free microvascularized latissimus dorsi flap in the same limb.

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