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Femoral component retention in Rorabeck type III periprosthetic knee fracture with plating fixation and bone cement augmentation. A new surgical technique and four cases reported

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ABSTRACT

Although dual implant constructs have recently been explored with promising results in very distal periprosthetic femur fractures (PPKF), the gold standard treatment of Rorabeck and Taylor type III PPKF remains a distal femur replacement or a highly constrained rotating hinge implant. However, this surgery is very aggressive and expensive for functionally low-demanding elderly patients. A new surgical technique using locking plates with polymethyl methacrylate cement augmentation is described to retain the femoral component avoiding its replacement. Four patients were treated and followed up for more than one year postoperative without any complications, their femoral component was retained without any loosening and the mobility in the Barthel Index remained unchanged.

Introduction

The Rorabeck and Tylor type III periprosthetic knee fracture (PPKF) is described as a non-displaced or displaced fracture with the prosthesis loose or failing, constituting a patient group with problematic treatment and management. Most authors accept joint replacement in this case, so an unstable prosthesis with excellent or poor bone quality is always treated with a revision of the previous prosthesis [1,2].

The treatment of periprosthetic fractures should aim to achieve, as soon as possible, a painless and stable knee with the proper alignment restoration, adequate patellofemoral function, mantained prosthesis fixation, and an early range of motion. This allows patients to return to their usual lifestyle with the same capabilities as before the fracture.

No studies in the literature on treatment protocols pay special attention to a pluripathological elderly, low functional demand, or non-ambulant patients with Rorabeck and Tylor type III PPKF and considering that neither orthopaedic treatment nor a prosthesis replacement are optimal procedures for this patients, we designed a surgical technique to provide a stable prosthesis refixation retaining the prosthesis.

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Surgical technique

Patients were placed in a supine position and an ischemia cuff was applied to the thigh with a sterile pad under the knee; a double approach was made in all cases, working simultaneously. The first step, through a medial approach, the medial fragment was reduced and fixed with a 4.5/5 mm proximal tibial T Locking Compression Plate (LCP) (DpS® USA). After the reduction of the fracture, the axial alignment was checked, and definitive fixation was performed with locking head screw (LHS) (Fig. 1).

Second, through a lateral knee approach to the distal femur the prosthesis component was exposed to assess the bone defect caused by fracture comminution around the anterolateral aspect of the loose prosthesis. Another 4.5/5 mm LCP tibial T-plate was used to fix the lateral epicondyle but without full insertion of the distal LHS. Loose periprosthetic fragments were removed with a curette, and the bone defect was washed thoroughly with normal saline. After vacuum mixing the Polymethyl methacrylate (PMMA) (Tobramicine Simplex® Stryker) cement for the standardized times recommended by the manufacturer, the anterolateral defect was filled with the syringe and then packed. In the last step, the distal LHS of the lateral and medial LCP T-plate was inserted into the defect within the PMMA before it set. The excess cement was then removed before it harden, under direct visualization through both approaches, during this procedure it is checked that the cement has not entered the prosthetic joint or remove it just in case. Finally, the mediolateral stability of the knee, the implant, and the femoro-patellar tracking were checked. A 10 mm redon vacuum drain was inserted laterally and a compressive bandage was placed after wounds closure. The drain was removed 24 h later, and standard knee postoperative physiotherapy protocol allowing full weight-bearing as tolerated (Fig. 2).

Cases report

Four patients over70 yo with a Rorabeck and Tylor type III PPKF were selected for this salvage procedure due to low functional demand and high anaesthesia risk (ASA III). The degree of dependency varied: one has total (20 points), one has severe dependency (20–35 points), and two had slight dependency (65 points). In all cases the Barthel index was less than 65, with a low mobility index of

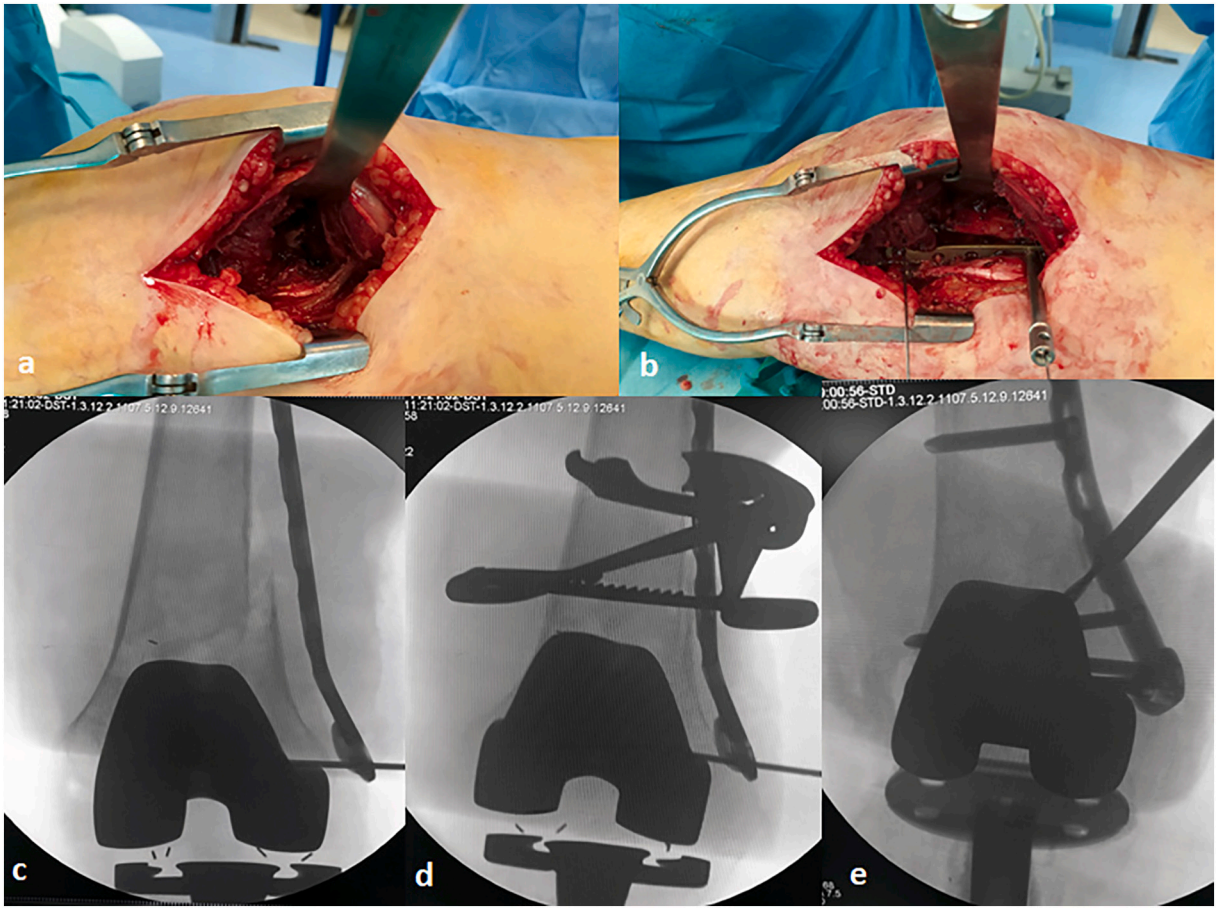

Fig. 1. A medial approach, below the vastus medialis, was used to access the distal femur (a and b). A 4.5/5 mm LCP proximal tibial T plate (DpS USA) was placed fixed distally with a K wire (c). Indirect reduction of the medial fragment was achieved with a Verbrugge forceps (d),followed by the placement of the screws (e).

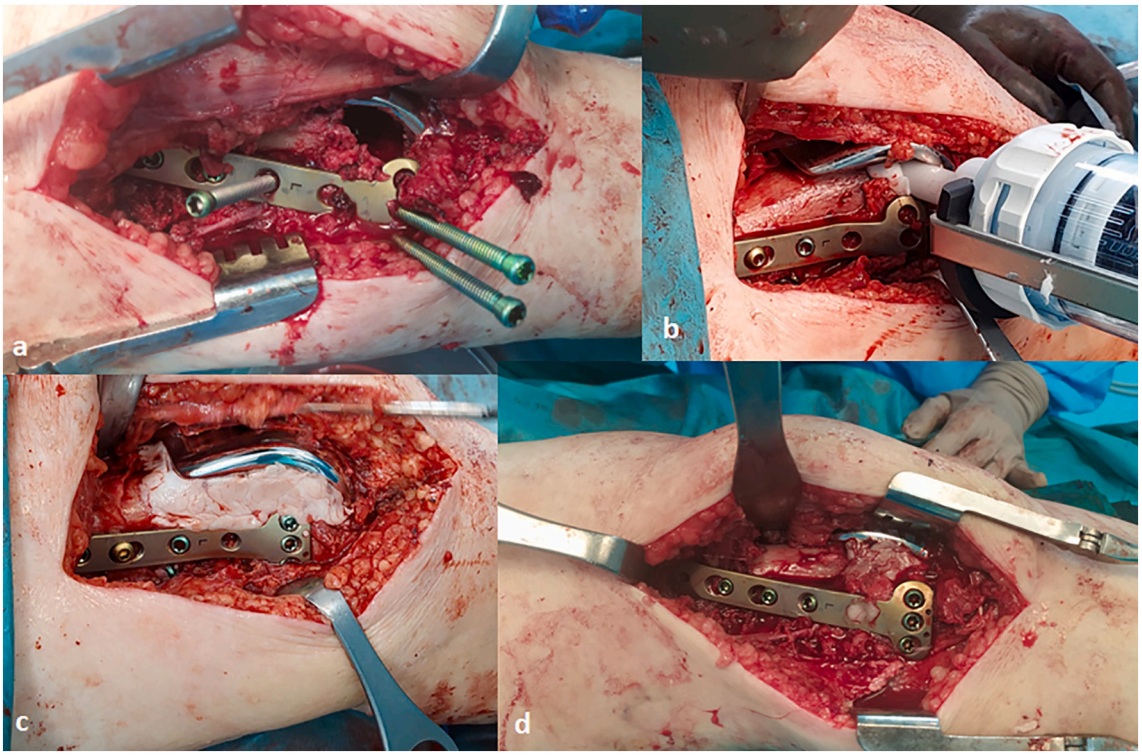

Fig. 2. View of the loose prosthesis and bone defect after loose bone fragments were removed. A 4.5/5 mm LCP proximal tibial T plate (DpS USA) was placed to fix the lateral epicondyle fragment, and drilling and placing the epiphyseal screws before cementing to check metal-work conflict (a), filling. The defect was then filled with the PMMA Syringe (b) the distal LS was placed again before packing the PMMA (c). The redundant cement was removed, and the final aspect after the cement was set is shown (d).

10 points or less, defined as being unable to walk independently on uneven surface >for more than 50 meters. The study was approved by the hospital's ethical committee and all signed a consent form before surgery. In all the selected cases the medial condylar bone was attached to the prosthesis as it was shown in the CT-Scan. The aetiology of the fractures was low energy, two falls whilst walking, one during transfer, and one slip from a wheelchair. Mean surgical time was 1 h 23 min (1 h 5 m-1 h 45 m).The mean postoperative hospital stay was 4,25 days (ranging from 5 to 4), and mean blood loss by drainage was 177,5 ml (ranging from 300 to 100). Only one patient required a transfusion of 2 units of concentrated blood cells. No wound complication was observed. In the three cases who came to the revision clinic the fracture was healed radiologically at three months. At one and a half year postoperatively, the mobility points in the Barthel Index were assessed by the co-authors and remains unchanged (Table 1). No complication such as infection, non-union, or breakage of plates, screws, or bone cement were observed during the review period. No revision surgery was required during the study period as there was no mobilization of the femoral component. Clinical and radiologic result of patient n° 4 are shown in Fig. 3.

Discussion

Internal fixation is difficult to achieve in very distal fractures, such as type III in the Su classification; several authors support that adding a medial LCP enables doubling the number of proximal and distal screws thus resisting medialized impact [3]. Adding a medial LCP has been shown to be more effective providing excellent stability in biomechanical studies, than a simple lateral one in fractures with scant distal bone stock [4]. In their study, Hakan Çiçek et al. [5] proposed considering autograft or allograft insertion, where necessary, to achieve union in 21 patients with Su type III in combination with titanium double locking plates and screws.

Polymethylmethacrylate (PMMA) osteosynthesis augmented screws are widely used in osteoporotic bone to improve a fixation

Table 1
Patient characteristics and outcomes.

Case	Gender	Age	Barthel index	ASA	Surg. time (min)	Post. hospital stay	blood loss (ml)	Complications	Postop Barthel index
1	F	81	60	3	125	4	190	No	Unchanged
2	F	83	20	3	120	4	300	No	Unchanged
3	F	73	35	3	108	5	130	No	Unchanged
4	F	84	65	3	145	4	100	No	Unchanged

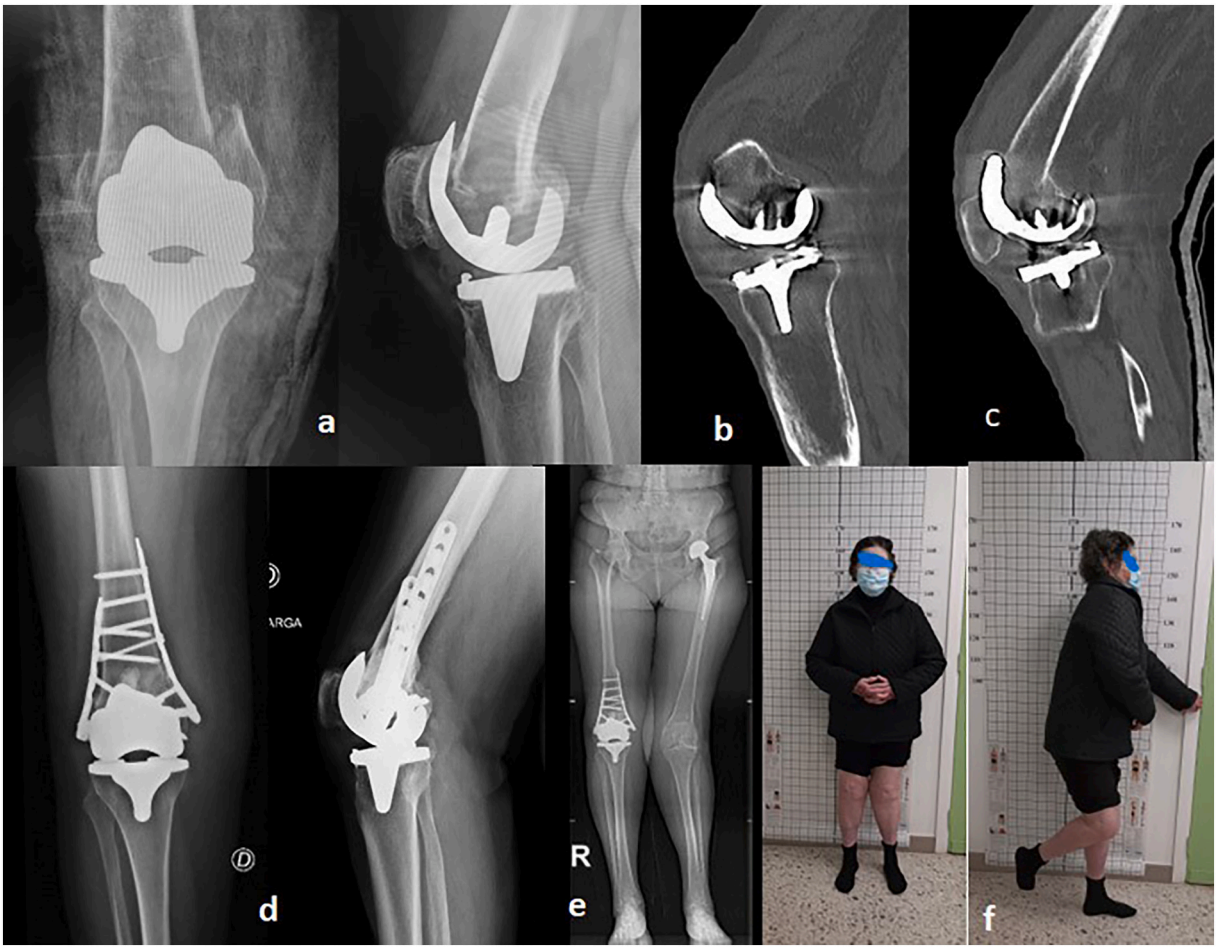

Fig. 3. Case example. Distal femoral periprosthetic fracture after a fall at home in an 84-year-old female patient. Preoperative knee AP, and lateral radiographs shows a Lewis and Rorabeck type III knee PPF (a). A CT-Scan distal bone stock confirms the presence of bone attached to the medial condyle to the femoral component (b) and fracture comminution of the lateral condyle, which causes loosening of the femoral component iof this lateral (C). Postoperative x-ray and clinical results show good function and no pain at 18 months after surgery.

construct [6]. Other studies have shown that cement augmentation enhances angular-stable screw purchase in the osteoporotic periprosthetic distal femur, especially if plate fixation with a well-fixed femoral component, cement augmentation of the locking screws increases construct stability and reduces the failure rate [7].

Until now augmentation of distal femur PPKF has been used only in well-fixed femoral component. In Lewis and Rorabeck type III there is a consensus that is a best option is a distal femur replacement (DFR) or highly constrained rotating hinge implants (RHK). However, these procedures have significant complications due to being more aggressive surgeries. In the Australian Joint Replacement Registry, the rate of new prosthetic revision is 8.8 % (27 of 306), most frequently due to infection [8]. Both procedures entail high costs for the hospital (>12.000$/patient) [9], and are associated with a mortality rate ranging from 6 % to 35 %, a higher risk of reoperations, and prosthetic joint infection [9,10].

In conclusion, we present a new technique to retain the femoral components in Lewis and Rorabeck type III PPKF.This technique involves a double approach, locking plates and screws, plus cement augmentation to fill the bone defect, thereby avoiding knee revisions and providing the same advantages in postoperative rehabilitation due to rigid fixation obtained. This surgical technique was initially indicated for low functionally demanding or non-ambulant elderly patients. We consider that a good result has been obtained since the prosthesis's femoral components was not compromised after more than one year in these four cases Although the costs were not measured compared to a DFR or RHK the authors recommend this technique for this type of patients. Further studies will determine if can be extended to other.

CRediT authorship contribution statement

Alfonso Queipo-de-Llano: Writing – original draft, Data curation, Conceptualization. **Jorge Mariscal Lara:** Methodology. **Antonio Leiva Gea:** Methodology, Investigation. **Borja Delgado-Rufino:** Supervision, Resources.

Declaration of competing interest

None.

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