CASE REPORT

Distal femoral replacement in periprosthetic knee fractures. A hybrid fixation, using trabecular metal cones, to improve the survival implant.


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Abstract

Introduction: Periprosthetic knee fractures have a devastating effect on patients who suffer from them. Its death rate resembles that of patients affected by a hip fracture and the therapeutic options must follow the same principles.

Presentation of the case: We present the clinical case of a 79-year-old lady with a type III periprosthetic knee fracture according to Su’s classification after an accidental fall. Before cleaning and reaming the femoral canal, a titanium band was used as a preventive cerclage. Then the available diaphyseal cones were tested to select the correct size implant after confirming that the femoral cemented stem passed through its interior. Part of the extruded cement was used as an interphase to avoid metallic friction, between the tantalum cone and the proximal ring of the femoral distal prosthesis.

Discussion: When treating periprosthetic fractures, the results of the distal femoral replacement have higher complication rates. One of the causes for the early failure (loosening of femoral stem) is the poor bone quality, and on the other hand, the forces that the tumoral-type implants transmit to the bone-cement and cement-stem interphases during implantation.

Conclusion: The use of tantalum cones to fill defects at the remaining femoral bone (hybrid fixation) may increase the torsional stability with a higher resistance to subside, improving the mid and long-term implant survival rates.

Keywords

Periprosthetic Knee fractures, Distal femoral replacement, Aseptic loosening, Hybrid fixation, Trabecular metal cones.

Introduction

Periprosthetic knee fractures have a devastating effect on patients who suffer from them. The incidence ranges between 0.3 and 2.5% (1) and are a surgical challenge for surgeons, especially when they occur in old, multipathological patients, with bad bone quality, that are very vulnerable to immobilisation and often incapable to do partial weight bearing of the affected limb (2). These fractures have a death rate that ranges between 17% after 6 months and 30% during the first year, very superior to distal femur fractures or after total knee prostheses (3). It resembles the death rate of patients affected by a hip fracture (4), so therapeutic options must follow the same principles: early mobilisation, weight bearing and early deambulation with a stable knee and acceptable range of movement for daily life activities (3).

Distal femoral replacement is an interesting option for the treatment of this type of fractures when performed by experimented surgeons in specialized centres (5). However, the use of tumour prostheses in non-oncological patients.
presents a high number of complications (6), with elevated revision rates due to septic or mechanical failure (about 50%) and a rate of survival of 76% during 44 months (7).

We present the clinical case of a patient operated in our Hospital, with a hybrid fixation technique at the femoral part (cemented and non-cemented) with a tantalum cone (Zimmer, Inc., USA) placed at the distal part of the femur, and a distal femoral reconstruction stem (Megasystem-C, Waldemar Link) cemented through the tantalum cone.

Case Report

This is the case of a 79-year-old lady that had a medical background of cardiac insufficiency, multifactorial respiratory insufficiency, acute renal insufficiency, intrinsic asthma and obesity. She presented with a type III periprosthetic knee fracture of Su’s classification (8, Fig 1) after an accidental fall.

She was operated under general anaesthesia in the supine position with the usual supports for a knee arthroplasty. Preoperative medication consisted on 800 mg intravenous teicoplanin + 1 g intravenous tranexamic acid bolus. Ischemia cuff was not employed considering the possibility of having to expand the approach.

With a distal femoral excision estimated lower than 10 cm we performed a direct anterior approach and a standard parapatellar medial arthrotomy. Once the fracture pattern was identified, the distal femoral segment was en bloc resected. Then the polyethylene and tibial tray were removed. Samples obtained from articular fluid and peri-implant tissues were sent to Microbiology laboratory for culture.

Before cleaning and reaming the femoral canal, a titanium band was used as a preventive cerclage (Königsee Implantate GmbH) (Fig 2). Then the available diaphyseal cones were tested to select the correct size implant (Fig. 3). A L-sized
diaphyseal cone was chosen after confirming than the spherical Endomodel system reamers (Waldemar Link) passed through its interior and also the 130 cm in-length chosen stem.

As happens with hinged-type prosthesis, in which liberating all femorotibial ligamentous connections needs soft tissues to be tightened to avoid articular hyperextension (a cause for mechanical implant failure), the length of the distal femoral substitution (75 mm) didn’t fit with the applied bone excision (55 mm).

For the tibial component, the S Endomodel system’s tibial plateau was used along with a 120 cm cemented stem. Tests were then made to check the correct rotation, patellar tracking and correct joint line to proceed to mark the position of the definitive components (length and rotation).

Intramedullary plugs were inserted at both tibial and femoral sides, pulsatile lavage was done and then the femoral canal was soaked with a saline/hydrogen peroxide mix under constant intramedullary aspiration. Two high-viscosity 75 mg PALACOS cement packages containing gentamicin were used, one for each medullar canal. Part of the extruded cement was used as an interphase between the tantalum cone and the proximal ring of the femoral distal prosthesis to avoid metallic friction between both components (Fig 4,5).

Figure 4. Cemented technique in the femoral side.

Figure 5. A Intraoperative image showing the distal femoral replacement assembly; B and C Postoperative radiology of the case; D Radiologic result at 1 month follow-up
Discussion

Tumoral prostheses were developed by the end of the 40s, as a method of limb salvage for extensive bone excisions in oncological pathologies, and were first implanted on 1949 (Stanmore). As the implants have evolved, the indications have been extended to other pathologies like peri-implant fractures, non-union, massive bone loss and complex prosthetic revisions. However, the complication rates are high, exceeding the 60% in some cases (9), being infection the most frequent, followed by mechanical loosening. The survival rate of this type of implants is 91.5% at one year, 80% at 2 years and around 70% at five years (3).

The employed surgical technique depends on different factors: the existence of prosthetic infection, the correct fixation of the implants, the kind of fracture and its comminution, the bone quality and the existence of a femoral stem at the ipsilateral hip because it may compromise the length and fixation of the selected implants (10). The combination of hip and knee arthroplasties is getting more frequent in our environment with the progressive increase of the lifespan.

As well as in knee surgery, we have to pay special attention at the implant fixation areas (11). In the distal femoral replacement surgery, there is only a fixation area in zone 3 (diaphysis), with a termino-terminal contact between the remaining femur and the metallic prosthetic device with a good support for axial load allowing early deambulation, but transmitting all the torsional resistance to the cemented stem (12) (Fig 6).

We believe that one of the causes of the early mechanical failure of these kind of fractures (loosening of femoral stem) is a consequence of the poor bone quality on one hand and, on the other hand, to the applied forces that the hinge-type implants transmit to the bone-cement-stem interphases. According to the philosophy of achieving at least 2 areas of fixation in knee revision surgery, we think that the tantalum cone at the level of the distal femur could act as a zone 2 fixation area (metaphyseal) increasing the stability of the construct. It would increase the torsional resistance by its tapered shape, with osseointegration of the outer surface to the host bone and cement fixation in the inner surface. It would also prevent the sinking of the stem (Fig 7).

Cottino et al (13), after analysing 408 rotational hinges in non-oncological pathologies, established a possible relationship between the decrease of revision rates due to aseptic loosening (4.5% in 10 years) to the use of metaphyseal uncemented stems, that could minimize the stress at the bone-cement-implant interphases.

The use of tantalum, in its different variants, such as cones or pillars, has been widely used in knee and hip revision surgery with excellent results for more than 10 years (14). Technically, the diversity of shapes and sizes facilitates revision surgery, making it easier, minimizing the duration of surgery and the risk of infection (15). Its three-dimensional
structure, its porosity and friction surface favours bone integration even in the context of severe bone loss (16). The use of custom-made tantalum cones for its femoral level application is not new, being used by various authors in mechanical loosening of oncological and non-oncological prosthetic surgery, allowing for a better fixation of the surgical construct, with good short-term results (17,18). We think that the great variety of the available cones in the market, along with the possibility of drilling and cutting them when needed, allows to assure fixation and optimal anchorage to the distal femur remnant, facilitating the surgery and reducing the cost of the surgery itself.

We consider that the ideal fixation for the selected implants in periprosthetic fractures in old patients is cemented. When treating periprosthetic fractures, the results of the distal femoral replacement after osteosynthesis failure are worse than when used primarily, with a higher complication rates (12). The surgical team that performs this type of fracture must have experience in using distal femoral replacement as well as osteosynthesis techniques in order to chose the best option based on the intraoperative findings.

According to some authors, this type of surgery must be restricted to specialized centres and made by experimented surgeons sue to the high complication and mortality rate (30% on the first year) (3,5).

Conclusions

Distal femoral replacement prosthesis must be a part of our therapeutic arsenal and we must be prepared to use them at the time of the surgery. The use of tantalum cones at the remaining femoral bone (hybrid fixation) may increase the torsional stability with a higher subsidence resistance and may improve the mid and long-term implant survival rates.

References


