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CASE REPORT

Reconstruction of severe uncontained bone defects in revision total knee arthroplasty in a patient with rheumatoid arthritis

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We report on a 54-year-old rheumatoid arthritic female patient with uncontained type-III tibial and femoral bone defects at the time of revision total knee arthroplasty (TKA). The knee was reconstructed using a structural distal femoral allograft and a stemmed, semi-constrained knee prosthesis. We achieved the re-alignment of a severe preoperative valgus deformity of 40 degrees. Due to postoperative wound complications we had to perform a gastrocnemius muscle flap. At two-year follow-up the patient was free of pain and the Knee Society Score improved from 18 to 156 ($p < 0.01$). Radiographs revealed no loosening of the prosthetic components and progressive incorporation of the graft. Reconstruction of extensive uncontained bone defects in revision of TKA in rheumatoid arthritis can be managed by structural allografts ; however, wound complications in those patients might necessitate soft tissue techniques.

Keywords : revision ; total knee arthroplasty ; bone defects ; allograft reconstruction ; rheumatoid arthritis ; wound complications.

INTRODUCTION

Failure of total knee arthroplasty (TKA) is often associated with bone loss on the femoral and/or tibial side, which is a difficult problem to handle in revision TKA. The classification of bone defects and treatment modalities in revision TKA by Engh and Parks *(4)* is a practical system to use. Dependent on the defect size, reconstruction of the bone stock can be achieved by cement filling, metal augmentation, custom-made TKA's, bone blocks, morsellised bone grafts or bulk structural allografts *(12)*. Revision TKA with reconstruction of bone defects can be even more demanding in patients with rheumatoid arthritis because these patients have poor bone quality, are at greater risk for wound complications and have higher rates of prosthetic joint infection *(6,7,10)*. We present the case of a 54-year-old rheumatoid arthritic female patient with uncontained type-III tibial and femoral bone defects at the time of revision total knee arthroplasty (TKA). We performed the reconstruction with a structural distal femoral allograft and a semiconstrained fixed-bearing revision knee implant and the salvage of wound complications with a soft tissue procedure.

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CASE REPORT

A 54-year-old female patient with rheumatoid arthritis underwent revision TKA on the right side in our department. Index surgery was performed 14 years previously. She had had arthroplasties on both hips and on the contralateral left knee. At the time of revision surgery the patient presented with a swollen and painful, unstable right knee with severe valgus deformity and recurvatum. Range of motion was limited to extension/flexion of 40/10/0 degrees. The skin revealed delicate scar tissue on the lateral side of the knee due to secondary wound healing after primary TKA 14 years previously. Radiographs demonstrated a valgus deformity of 40° and severe bone loss at the lateral side (fig 1). We decided to reconstruct the knee with a structural distal femoral allograft and a semiconstrained fixed-bearing revision knee implant (Innex SC FIXSC, Zimmer, Winterthur, Switzerland).

In view of the critical skin situation we chose a medial approach with sufficient distance to the lateral scar, despite the massive valgus deformity. An osteotomy of the tibial tuberosity was performed on a length of about 8 cm. We removed much necrotic, granulomatous tissue due to extensive polyethylene wear. After debridement the lateral tibial plateau presented a massive uncontained bone defect, classified as type-III with use of the system described by Engh and Parks (*4*). Bone defects in the medial plateau were classified as type-II (fig 2). The tibial component was still fixed at the area of the stem, so chiselling was required for its removal. During the preparation a partial tibial fracture (medial distal) occurred which was temporarily fixed with two Weber-forceps. The tibia was then prepared for a stemmed tibial revision component (size 3, 13 × 135 mm stem).

The femoral component, only yet fixed at the medial side, was removed by chiselling. A severe uncontained type-III bone defect involving the lateral condyle appeared (fig 3). The medial condyle was relatively well preserved and was directly prepared for the stemmed femoral revision component (size M, 19 × 135 mm stem). We processed the allograft so that the lateral cortex of the graft was overlaying the lateral femoral cortex of the host and the allograft-condyle became a substitute-condyle (fig 4). This situation was temporarily fixed by a 1.5 mm cerclage and the substituted lateral condyle was prepared for the femoral component which was subsequently cemented. An additional 3.5 mm screw was placed for fixation. A bone-block was created with the remaining medial part of the allograft which could adequately cover the uncontained tibial bone defect. Autologous cancellous bone from the iliac crest was plugged into residual

Fig. 1. — At the time of revision surgery the radiographs showed a valgus deformity of about 40 degrees and severe periprosthetic bone defects, particularly of the lateral compartment. Index knee arthroplasty was 14 years ago. The patient suffered from rheumatoid arthritis and had had arthroplasties on both hips and the contralateral knee.

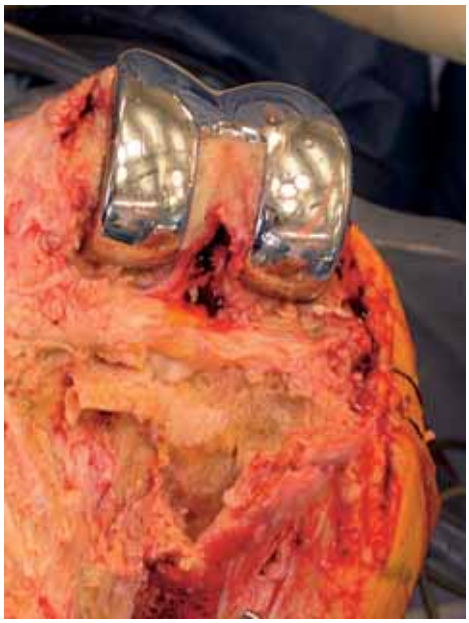

Fig. 2. — After removal of the tibial component a severe uncontained type-III bone defect was obvious.

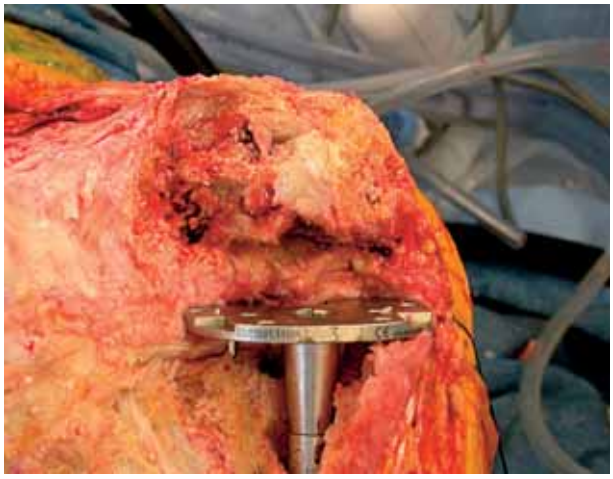

Fig. 3. — After removal of the femoral component the lateral condyle presented severe type-III bone defects.

defects (fig 5). The tibial component was cemented and the allograft additionally fixed by a 3.5 mm screw. We achieved a satisfactory prosthetic alignment (fig 6). The extensor mechanism was re-centred, the tuberosity refixed with two screws and the wound closed in layers. The correct alignment was checked by radiographs.

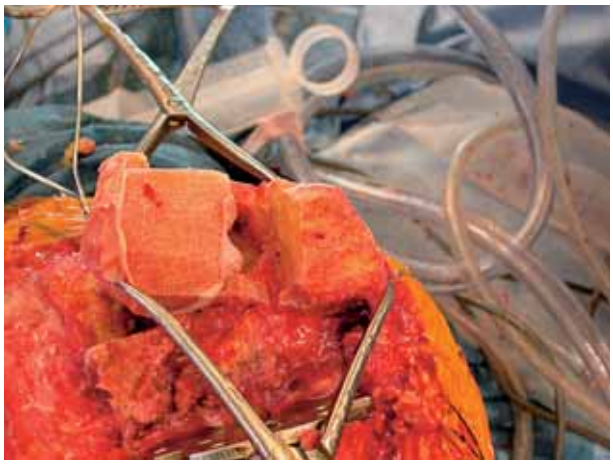

Fig. 4. — For the femoral reconstruction we processed the allograft so that just the lateral cortex of the allograft overlapped the lateral femoral cortex of the host. The allograft-condyle became a substitute-condyle at the distal side. This situation was temporarily fixed by cerclage and Weber-forceps.

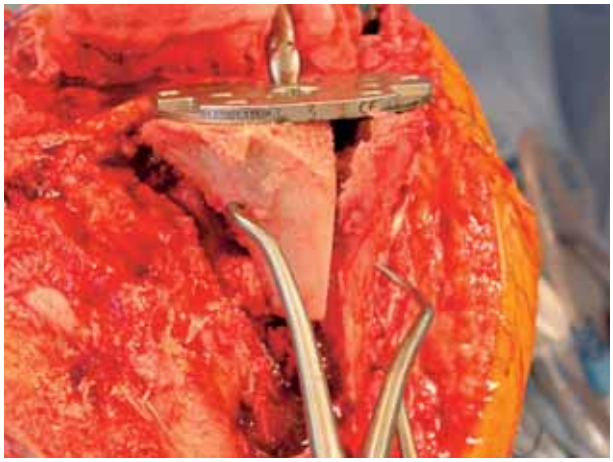

Fig. 5. — With the remaining medial part of the allograft we created a bone-block which served as a substitute lateral tibial plateau. Autologous cancellous bone from of the iliac crest was plugged into the remaining defects.

Delayed wound healing complicated the postoperative progression and a necrotic area of about 2×3 cm occurred around the suprapatellar part of the wound. The necrosis remained unchanged and the patient was discharged on the 28th postoperative day without additional surgery. Ten days later she was readmitted because of an increased bloody secretion from the tibial part of the wound. This wound area, distal to the necrosis that occurred dur-

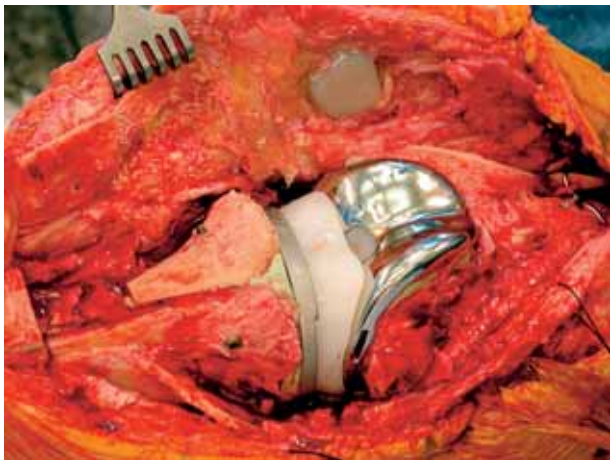

Fig. 6. — Final intraoperative result after bone reconstruction, allograft fixation and prosthesis implantation

Fig. 7. — Ten days after discharge the patient was hospitalized again due to a tibial skin necrosis. To avoid deep infection and a possible consecutive amputation in this critical case a medial gastrocnemius muscle flap was performed after failure of conservative measures.

ing the first postoperative days, revealed initial skin necrosis as well. We tried to induce and accelerate the wound healing with vacuum-therapy and conservative approaches, without success. We therefore decided to perform a surgical wound debridement and to cover the defect by a medial gastrocnemius muscle flap and a mesh-graft transplant (fig 7). Twenty-two days after this procedure the patient could be discharged with a healed wound.

Fig. 8. — Two years after revision surgery the patient was very pleased with the overall outcome. Skin condition was satisfactory.

At the six- and twelve-week controls we could see progressive wound healing and an improved range of motion (flexion/extension 80/0/0 degrees). Radiographically, no signs of component loosening or graft resorption were detectable. At the last follow-up, two years after revision surgery, the patient was completely pain-free and the skin condition was satisfactory (fig 8). The patient had no extension deficiency and flexion had improved to 90° (fig 8). The Knee Society Score improved from 18 (Knee Score 18 and Function Score 0) preoperatively to 156 (Knee Score 86 and Function Score 70) at follow-up ($p < 0.01$). Radiographs demonstrated progressive incorporation of the graft, no component loosening and correct leg alignment (fig 9). The patient was very satisfied with the result and gave us permission to report on her case (informed consent).

DISCUSSION

Bone loss due to implant loosening, stress shielding or wear is often encountered at the time of revision total knee arthroplasty (*12*). The reconstruction of such defects is difficult and sometimes requires bone allografts. However, allografts still entail an infection risk and results regarding outcome and graft incorporation are somewhat controversial (*2,3,8,13*). There is concern that allografts may resorb or collapse over time, maybe as a result

Fig. 9. — Radiograph one year after revision total knee arthroplasty with stemmed revision implants and structural allograft reconstruction of the severe bone defects show no loosening and a good incorporation of the graft. The leg alignment is correct.

of revascularisation (*13*). Failure rates of 8% only due to resorption have been reported (*2*). These facts have to be taken into account especially in patients with rheumatoid arthritis, as the chronic inflammatory process could result in a delay or even failure of graft incorporation. Bone resorption with joint instability is commonly seen in rheumatoid arthritis (*1*). Moreover patients with rheumatoid arthritis are at greater risk for wound complications (*6,7*), as seen in the present case, and have higher rates of prosthetic joint infection (*10*). Therefore the delayed wound healing and local skin necrosis in our patient was critical, because nonvascularised allografts serve as an excellent nest for bacterial colonisation (*11*). To avoid amputation in such critical cases, deep infection has to be prevented and early soft tissue coverage should be undertaken, e. g. using a medial gastrocnemius muscle flap. In retrospect, the muscle flap should have been performed even earlier in the present case. Regarding the allograft placement, some authors have supported invagination of the graft (*2,5*). We believe it is important to maintain contact between the host bone and the revision implant or its stem by any means, even though it is cemented and not inserted in press-fit. We therefore positioned the graft at the outer femoral side, fixed by cerclage, screw and the cemented implant. We did not use morsellised graft bone or chunks because a structural allograft decreases the dependence of the prosthetic stem for axial load transmission and stability (*9*). By now, two years after initial revision surgery, the clinical and radiographic outcome is satisfactory and the patient is highly pleased with the result. We conclude that severe uncontained bone defects in revision knee arthroplasty can be managed using structural allografts and stemmed revision prostheses in patients suffering from rheumatoid arthritis. An outstanding attention has to be given to wound healing and prevention of infection in those cases. This can necessitate early soft tissue reconstruction procedures like wound coverage using a gastrocnemius muscle flap. However, long-term results have to demonstrate if there is no graft deterioration due to local and systemic effects of the rheumatoid arthritis.

REFERENCES

1. **Bogoch ER, Moran EL.** Bone abnormalities in the surgical treatment of patients with rheumatoid arthritis. *Clin Orthop* 1999 ; 366 : 8-21.
2. **Clatworthy MG, Ballance J, Brick GW *et al.*** The use of structural allograft for uncontained defects in revision total knee arthroplasty : A minimum five-year review. *J Bone Joint Surg* 2001 ; 83-A : 404-411.

3. **Engh GA, Herzwurm PJ, Parks NL.** Treatment of major defects of bone with bulk allografts and stemmed components during total knee arthroplasty. *J Bone Joint Surg* 1997 ; 79-A : 1030-1039.
4. **Engh GA, Parks NL.** The use of a bone defect classification system in revision total knee arthroplasty. *Orthop Trans* 1995 ; 18 : 1138-1139.
5. **Harris AI, Poddar S, Gitelis S *et al.*** Arthroplasty with a composite of an allograft and a prosthesis for knees with severe deficiency of bone. *J Bone Joint Surg* 1995 ; 77-A : 373-386.
6. **Hemphill ES, Ebert FR, Muench AG.** The medial gastrocnemius muscle flap in the treatment of wound complications following total knee arthroplasty. *Orthopedics* 1992 ; 15 : 477-480.
7. **Lian G, Cracchiolo A 3rd, Lesavoy M.** Treatment of major wound necrosis following total knee arthroplasty. *J Arthroplasty* 1989 ; 4 Suppl : S23-S32.
8. **Mnaymneh W, Emerson RH, Borja F *et al.*** Massive allografts in salvage revisions of failed total knee arthroplasties. *Clin Orthop* 1990 ; 260 : 144-153.
9. **Parks NL, Engh GA.** The Ranawat Award. Histology of nine structural bone grafts used in total knee arthroplasty. *Clin Orthop* 1997 ; 345 : 17-23.
10. **Poss R, Thornhill TS, Ewald FC *et al.*** Factors influencing the incidence and outcome of infection following total joint arthroplasty. *Clin Orthop* 1984 ; 182 : 117-126.
11. **Stockley I, McAuley JP, Gross AE.** Allograft reconstruction in total knee arthroplasty. *J Bone Joint Surg* 1992 ; 74-B : 393-397.
12. **van Loon CJ, de Waal Malefijt MC, Buma P *et al.*** Femoral bone loss in total knee arthroplasty. A review. *Acta Orthop Belg* 1999 ; 65 : 154-63.
13. **Wheeler DL, Enneking WF.** Allograft bone decreases in strength in vivo over time. *Clin Orthop* 2005 ; 435 : 36-42.