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The use of calcium carbonate beads containing gentamicin in the second stage septic revision of total knee arthroplasty reduces reinfection rate

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ABSTRACT

Background: The aim of the study was to analyze effectiveness and safety of packing the medullary canal of the tibia and femur with Herafill (Heraeus Medical GmbH, Wehrheim, Germany), a void filler and antibiotic carrier, during second stage revision total knee arthroplasty (TKA) for periprosthetic joint infection (PJI).
Methods: Two groups were formed of 28 consecutive patients during second stage revision TKA, comparable for gender and age. The study group received Herafill, while the control group did not. The average follow-up was 52 months (minimum 36 months).
Results: No reinfections were observed in the study group, while five were seen in the control group. No other differences were observed between the study and control groups, including mean clinical KSS (Knee Society score) (67.4 and 68.4 points, respectively) and functional score (72.5 and 70.5 points respectively). No side effects related to the use of Herafill beads were noted.
Conclusions: Herafill packed into the tibial and femoral intramedullary canal during second stage of septic revision TKA is a reliable bone substitute, may reduce recurrence of infection and incorporates well with host bone. However, results after PJI treatment are less than optimal measured by KSSs as compared to patients who do not require revision.

1. Introduction

Bacterial infection following total knee arthroplasty (TKA) is a challenging problem, as it can progress to a chronic stage and lead to osteitis, osteonecrosis, sepsis or even amputation. The aim of treatment is to eradicate the bacterial infection, restore or promote the biological repair of skeletal defects and restore knee function. The standard management of chronic knee infection after TKA is one- or two-stage revision. For restoration of bone, metal augments, calcium sulfate, calcium phosphate, demineralized bone matrix and allografts are usually sufficient [1]. Eradication of periprosthetic joint infection (PJI) is possible with surgical debridement, and the use of local and systemic antibiotics. However, the efficacy of systemic antibiotics is limited due to impaired blood supply, low penetration rate at the site of infection [2] and the possibility of side effects associated with the treatment. Another solution may be local antibiotic-impregnated bone void fillers such as bioabsorbable bone substitute (BBS), or bone cement, which fill the dead space after surgical debridement and deliver high antibiotic concentrations without increasing serum antibiotic levels [3]. The ideal bone void filler should not require removal, unlike polymethylmethacrylate (PMMA) chains, could integrate with the host bone or stimulate new bone formation, be a good antibiotic carrier, have advantageous biomechanical properties and be non-immunogenic. Unlike bioabsorbable materials PMMA chains need to be removed as they act as a nidus for infection if left in place, hence the significance of using BBS [4].

Herafill beads G (Heraeus Medical GmbH, Wehrheim, Germany) seem to meet most of these requirements. The six-millimeters spherical beads contain calcium sulfate and calcium carbonate, with glycerin tripalmitate as a bonding additive, and one percent gentamicin sulfate (2.5 mg gentamicin base) as an antibacterial agent. Although a literature review revealed the initial results of its use to be rather promising [3,5], no publication was found addressing the use of Herafill or any other antibiotic bone substitute in controlling PJI in revision TKA.

Hence, the aim of the study was to analyze the effectiveness and safety of Herafill as a void filler and antibiotic carrier to prevent PJI when packed into the medullary canal of the tibia and femur during second-stage revision TKA (Fig. 1).

2. Materials and methods

This retrospective study included a series of 56 patients (56 knees) treated for PJI during second stage revision TKA performed in the years 2008 to 2012 by two surgeons. The average follow-up was

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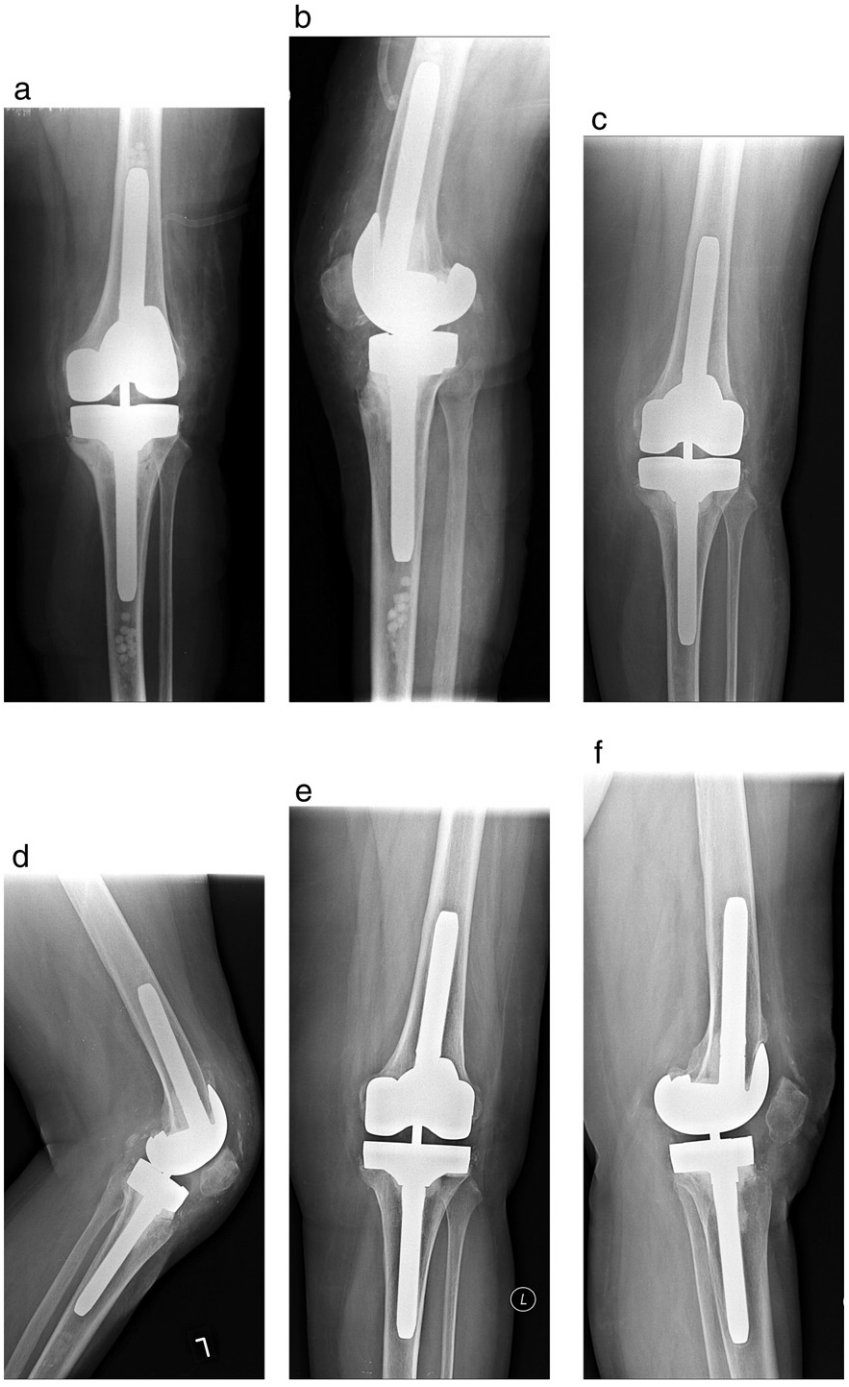

Fig. 1. Radiographs of patient after revision TKA for PJI. No postoperative XR beads of Herafill can be easily seen (a and b). At three months there is some resorption (c and d). At last follow-up, Herafill beads are integrated with the host bone.

52 months (range, 36 to 77 months). Two equal groups of 28 consecutive patients were formed. The study group consisted patients for whom TKA Herafill was used during second-stage revision, and who had been operated on by one surgeon (senior author — JK). The second group, composed of patients who had not received Herafill treatment and whom had been operated by another surgeon experienced in TKA, was used as a control group. Both sets of patients had been treated at the same medical center and had undergone the same treatment protocol.

The members of the groups were comparable in terms of age, gender, type of implant, time period from primary TKA to first stage revision and time period from first stage revision to second stage revision TKA (Table 1). The demographic and clinical data of the patients is presented in Table 1.

The standard treatment of infection after TKA in the institution of the senior author is two-stage revision. During the first stage, from three to six tissue samples are taken for analysis after approaching the knee. Old implants from infected knees are removed. Next, debridement of the cement and infected tissues and washout are performed with the use of copious quantities of normal saline and Betadine. Finally, Spacer (Tecres, Italy) is implanted with the use of antibiotic-impregnated bone cement. One patient from the first group received no spacer implantation. He was referred from another orthopedic center after first stage revision. Another one, also from Herafill group required additional revision for