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Infected Gustilo IIIB open knee joint fracture treated with an antimicrobial iodine-supported megaprosthesis: a case report

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Conflict-of-Interest Policy

Conflicts of interest: none.

Introduction

In the orthopedic field, implant-related infection is a serious complication that is often difficult to treat with intravenous antibiotics alone. Therefore, care is required when planning implant insertion, choosing a method that best avoids implant-related infection. One method proposed to reduce the incidence of implant-related infection is to use an implant whose surface has been treated with a biomaterial. We report a case in which an iodine-supported implant was used successfully to treat post-traumatic infection and an extensive bone defect that had resulted from an open comminuted knee fracture.

Case Report

The patient was a 60-year-old man who had a history of coronary heart disease and diabetes mellitus (HbA1c 5.6–6.7%), and he had smoked one pack of cigarettes per day from age 18 years until the injury. The injury occurred when he fell from a height of 5 m while at work. The patient was taken by ambulance to a local hospital, where he was diagnosed with an open left knee joint fracture with severe soft tissue damage (Fig. 1). The open comminuted fracture was fixed externally after debridement of the damaged soft tissue and bone fragments. On the fourth day after the injury, the wound exhibited a purulent discharge (Fig. 2). As the infection could not be controlled, he was transferred to our hospital for more specialized treatment, leaving the wound open.

The patient was informed of the options for treatment, including bone transport, a vascularized fibular graft, the Masquelet technique, and megaprosthesis insertion (Fig. 3). Although these various treatment options are available, arthroplasty (e.g., megaprosthesis insertion) must be considered separately because it significantly increases the risk of re-infection. It is likely, however, to provide better walking ability than the other surgical options. Faced with this conundrum, we spent a great amount of time explaining the pros and cons to the patient. Finally, he decided to undergo megaprosthesis treatment, taking into consideration his lifestyle and occupation. His occupation is desk work.

Surgical debridement and cement spacer insertion were performed three times, and a latissimus dorsi flap was created to cover the soft tissue defect (Fig. 4). At 10 months after the injury, and after confirming that the bone and soft tissue infection had completely resolved (proved by blood tests, knee joint fluid cultures, contrast-enhanced MRI, and bone scintigraphy), a megaprosthesis with iodine coating was inserted (Figs. 4, 5).

At 5 years postoperatively, there had been no complications such as infection recurrence or adverse effects due to the iodine. Blood tests had been repeated yearly up to 5 years postoperatively and showed that the white blood cell count and C-reactive protein concentration had returned to normal. In addition, his thyroid-stimulating hormone, free thyroxine, and free triiodothyronine levels were within the normal range. Clinical examination revealed that the range of motion of the operated knee was 100° (Fig. 6). The patient could walk unaided and had returned to work.

Discussion

The incidence of implant-related infection is increasing and remains a serious complication. Despite strict antiseptic operative procedures and systemic prophylaxis, the infection rate is still as high as 2.2% after primary total hip arthroplasty [1]. Furthermore, the incidence of infection after endoprosthetic replacement of large bone defects after tumor resection is 13%, which increases to 70% for cases requiring external fixation [2,3]. The present patient had a large bone defect that extended from 15 cm distal to the femur to 7 cm proximal to the tibia and was infected. Thus, there was a very high risk of re-infection after implant insertion.

The suggested treatment options were bone transport, a vascularized fibular graft, the Masquelet technique, and megaprosthesis insertion. Generally, biological reconstruction is recommended in cases of significant infection. However, except when using a megaprosthesis, biological reconstruction requires arthrodesis of the knee joint, resulting in loss of function. Furthermore, bone transport, the Masquelet technique, and vascularized fibular grafts require long-term external fixation, and treatment continues for at least several years. In contrast, although the

risk of infection is relatively high, using a megaprosthesis can maintain knee function and may require a shorter treatment period than other choices. In our case, the patient was a self-employed person, still at an age to continue working, and considering his social factors, he desired an early return to society. The patient understood the advantages and disadvantages of a megaprosthesis and strongly desired its insertion.

Originally designed to treat oncological bone loss, the megaprosthesis is now generally used to reconstruct large skeletal defects. However, the indications for this device have expanded to include complex trauma, multiply failed osteosynthesis, and infection [4,5]. Systemic antibiotics are often insufficient to treat implant-related infection effectively. Thus, in the present case, it was desirable for the implant to have a coating that exhibited local antibacterial activity. Several biomaterial surface treatments have been proposed to reduce the incidence of implant-related infection. Particularly, silver has been investigated because of its good antimicrobial effect [6-8], although it has toxic effects on human cells [9,10]. Therefore, an iodine-supported implant was chosen as the method of infection control in the present case.

Previous research has shown that the iodine coating has several advantages for clinical use. First, the antibacterial spectrum of iodine is broad. It acts not only on general bacteria but also on certain viruses, tubercle bacilli, and fungi [11-13]. Second, iodine does not induce the drug resistance that occurs after administration of antibiotics [11,12]. Third, iodine is a traceable metal and an essential component of thyroid hormone [11,12]. Iodine released from the implant is biologically safe because it can be excreted by the kidneys [12,14]. Fourth, the duration of the antibiotic effect of iodine is relatively long. There are reports that 20–40% of the iodine on titanium pins used for external fixation was still present 1 year postoperatively [12,13]. During the 5 years of follow-up in the present case, the megaprosthesis was free from complications, with no recurrence of the infection or adverse effects due to the iodine.

The present case highlights the feasibility of iodine-supported implants for treating post-traumatic infection without causing cytotoxicity or other adverse effects. An iodine-supported megaprosthesis may be a useful option for treating severe bone defects with infection.

Disclosures

Conflict of interest: None.

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Figure legends

Figure 1 Images of the left knee on the day of the injury. (A) Photograph shows the open left knee joint fracture with severe soft tissue damage. (B) Three-dimensional computed tomography image shows a severe comminuted fracture.

Figure 2 Photograph taken on the fourth day after the injury shows purulent discharge oozing from the wound.

Figure 3 Photograph of the iodine-supported megaprosthesis.

Figure 4 Radiographs in the left knee: (A) after placing the first cement spacer, (B) before joint replacement, and (C) after joint replacement.

Figure 5 Photograph taken during surgery shows insertion of the iodine-supported megaprosthesis.

Figure 6 Follow-up images of the left knee joint. (A, B) Photographs show the range of motion of the left knee at 5 years postoperatively.

Consent

Each patient and/or the family was informed that data from the case would be submitted for publication, and each gave written consent.

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Figure 1

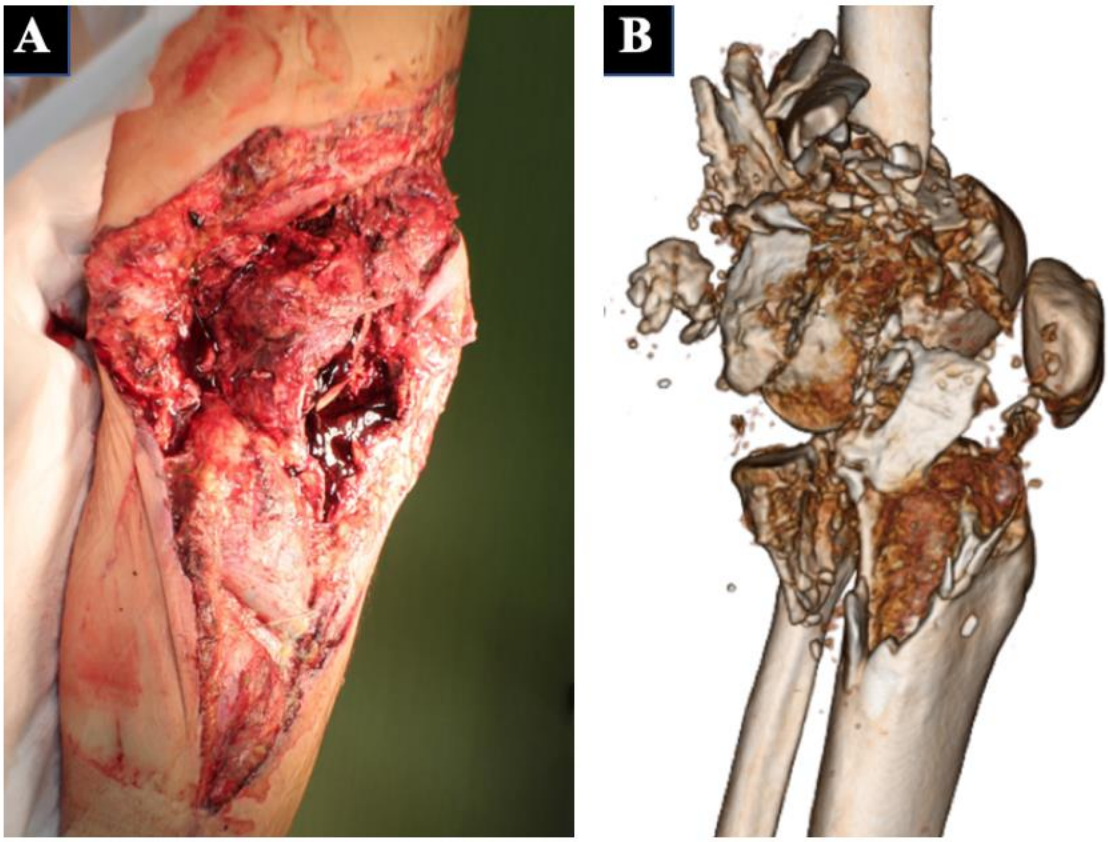

Figure 2

Figure 3

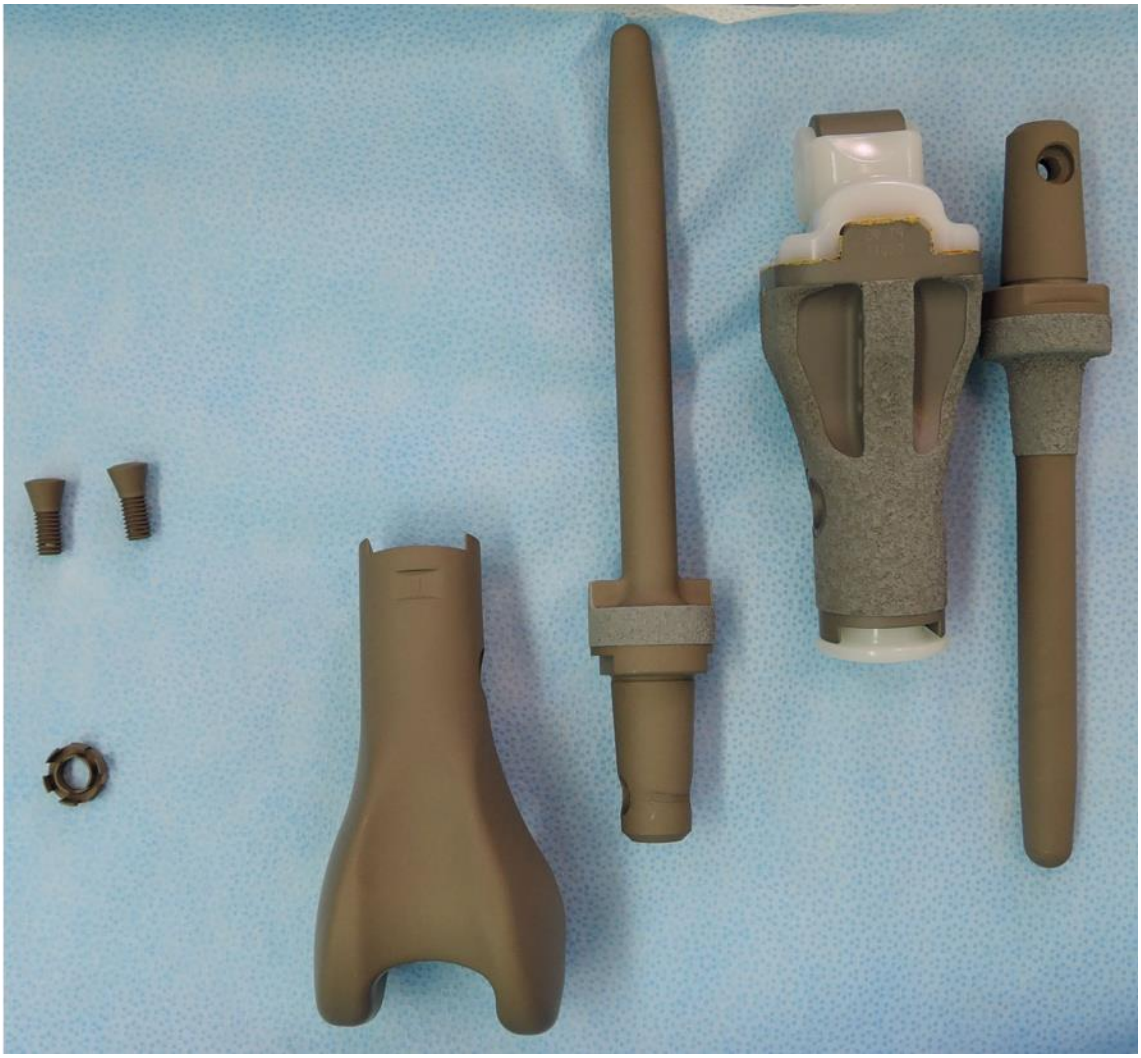

Figure 4

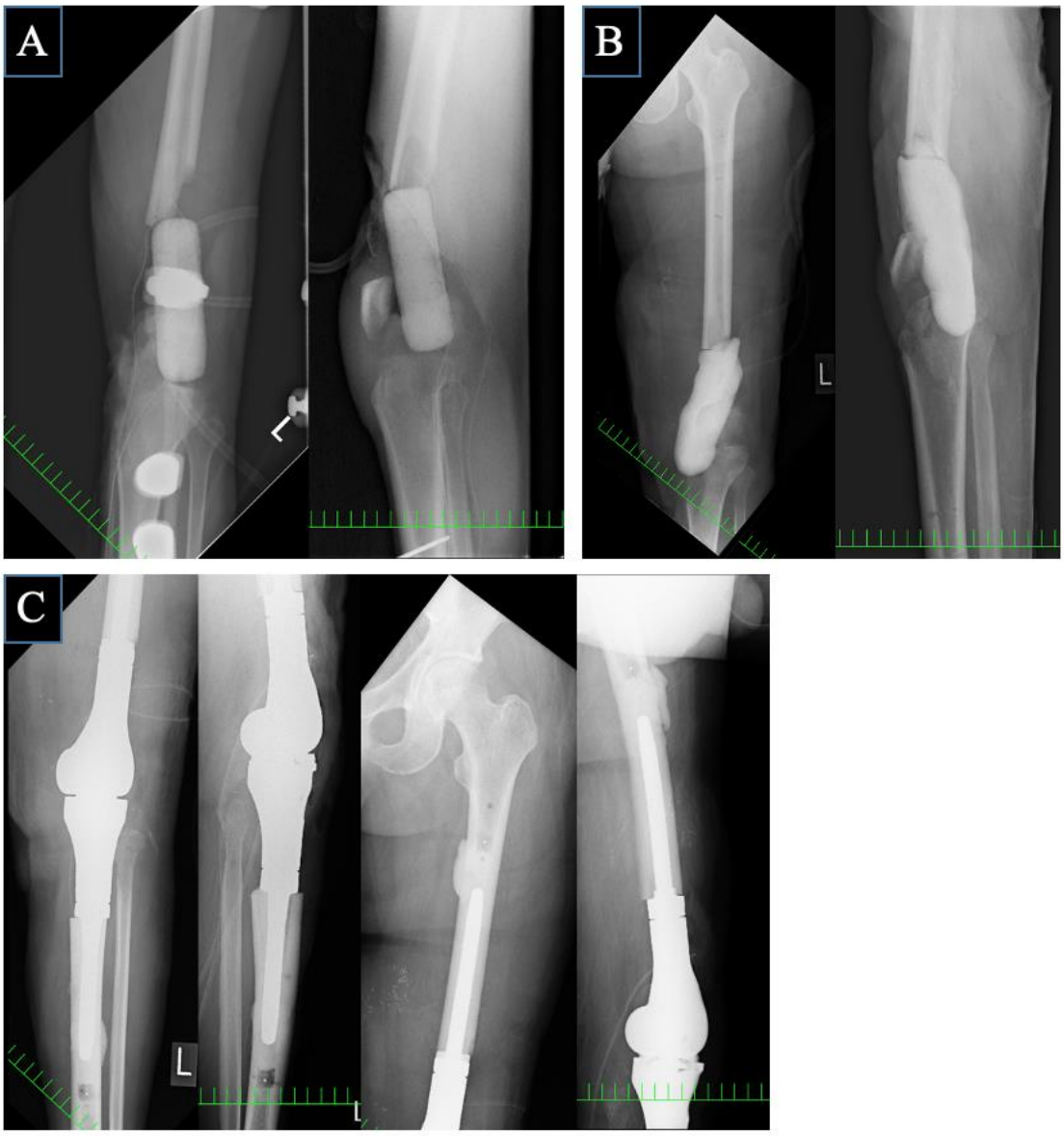

Figure 5

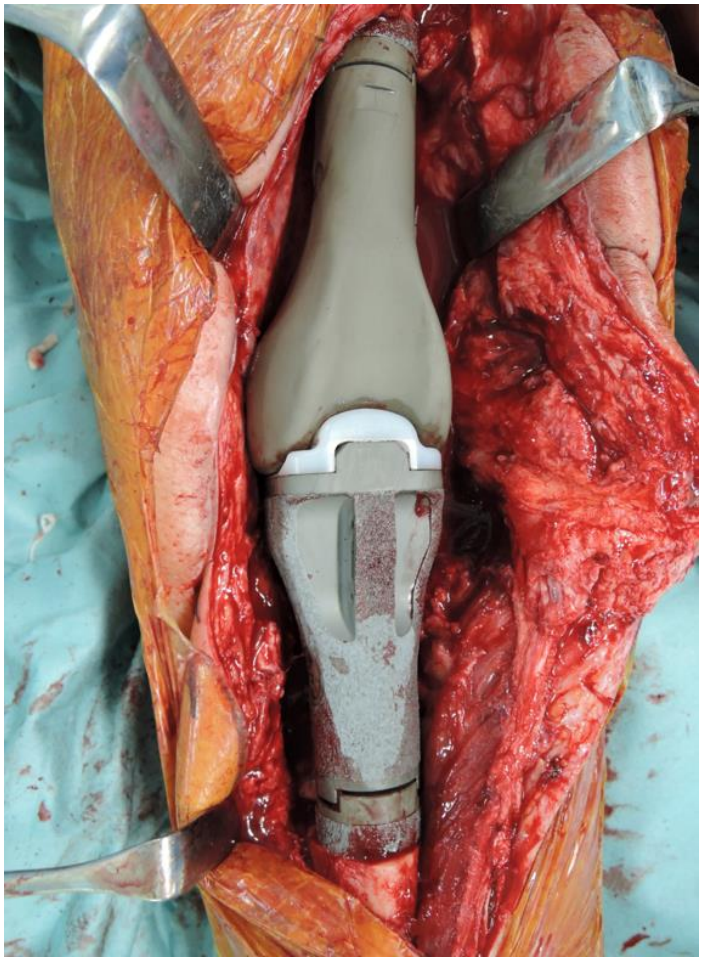

Figure 6