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A 3-dimensional Printed Molding Technique for the Management of Humeral Head Osteomyelitis

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There are many methods of making cement spacer in patients who require a two-staged operation for humeral head osteomyelitis. However, limitation of motion after the first surgery—due to inadequate size and insufficient intra-articular space for second surgery—remain to be an issue. To mitigate this issue, we made a cement spacer with the same size and shape of the patient humeral head. Four patients with humeral head osteomyelitis were enrolled in this study. To make the cement spacer, we used the Mimics program, and designed the molding box by a reverse engineering technique. We evaluated the range of motion and pain using a Constant score. The mean abduction was 50° (40°–60°), forward flexion was 50° (30°–70°), and average Constant score was 47.75 (44–52). Three-dimensional printed molding technique is one of the effective methods for humeral head osteomyelitis allowing for daily activities prior to the second surgery.
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Key Words: Cement spacer; 3-dimensional print; Osteomyelitis

Introduction

To improve the results for patients with humeral head osteomyelitis who require a two-staged operation, we used a cement spacer to control infection and prevent contracture of the soft tissue and muscles using PROSTALAC (prosthesis of antibiotic-loaded acrylic cement) spacer.[1-5] To make a cement spacer with a similar size to the humeral head of patients, we shaped the PROSTALAC cement spacer like hemispherical mold.[6] However, the cement spacer was inadequate in size and placement, compared with the real humeral head, and the remaining intra-articular space can result in instability, pain, and limitation of motion. To improve this, we attempted a more precise method.

Technique

From December 2014 to March 2016, a total of four patients, three male and one female, with humeral head osteomyelitis that required a two-staged operation were enrolled in this study. The mean age was 63 years (53–78 years). We acquired the 3-dimensional (3D) images based on the computed tomography of the ipsilateral or opposite humeral head and put in the data to the Mimics program to make a 3D model of the patient humeral head (Fig. 1A). To make a mold of the casting patient humeral head, we used a reverse engineering technique (Fig. 1B). On the basis of these results, we produced a precise mold of the patient humeral head (Fig. 1C). For the operation, sterilized molds were taken in the operation room. With a beach-chair position, using the deltopectoral approach, we medially retracted the deltoid muscle, and the insertion portion of the pectoralis muscle was excised, exposing the artificial surface of the humeral head, giving attention of axillary nerve. With humerus flexioned and external rotationed, the humeral head was dislocated anteriorly, and we resected the humeral head, in which the level was checked before performing the surgery using the 3D model. We applied an antibiotics-mixed cement on the sterilized mold

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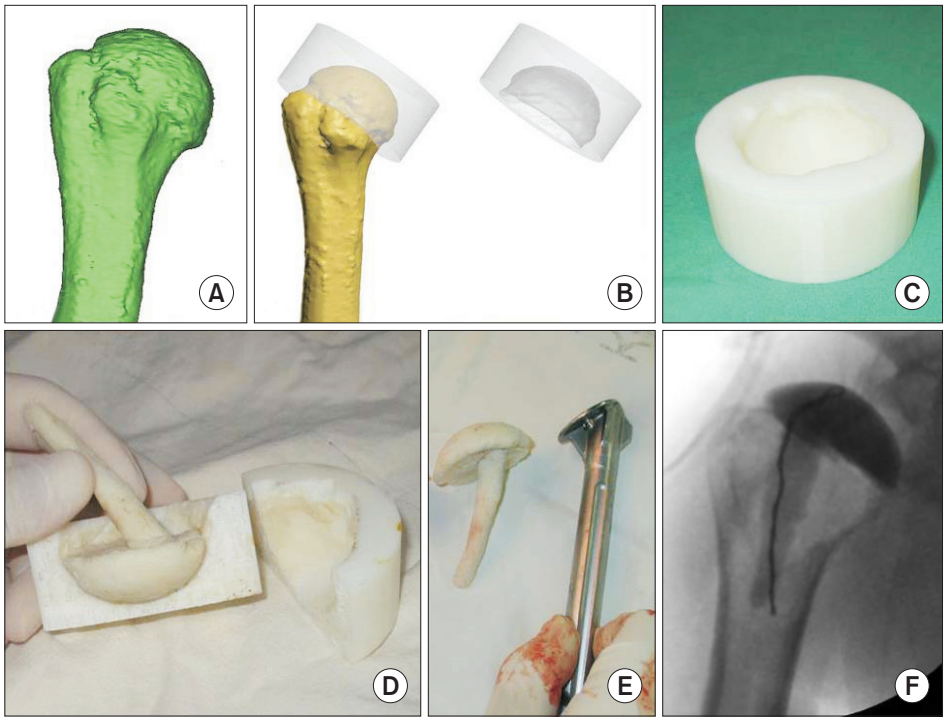

Fig. 1. (A) Three-dimensional image reconstructed by Mimics. (B) Reverse engineering technique. (C) Mold for spacer. (D) Antibiotics mixed cement spacer. (E) Similar angle to arthroplasty stem. (F) Intraoperative C-arm photo.

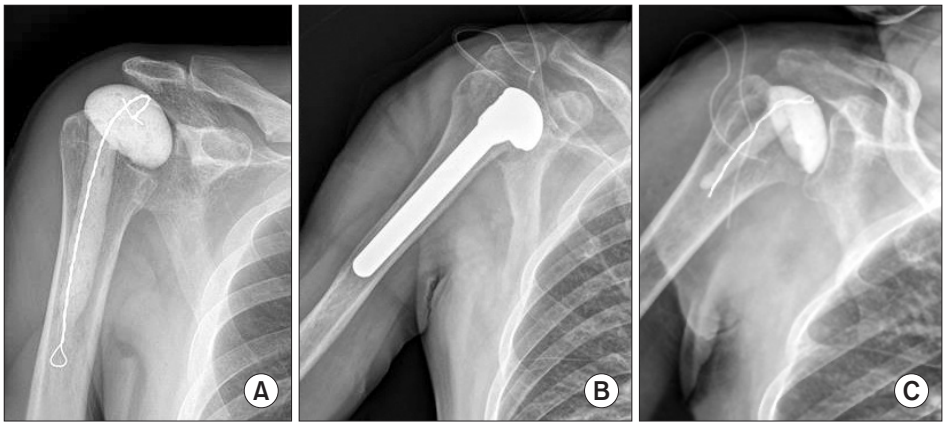

Fig. 2. (A) Postoperative X-ray after the first operation. (B) Postoperative X-ray after the second operation. (C) Patient that does not want a second operation.

on an early dough phase, and before the cement hardened, we made a stem with K-wire fixation on the dough at an angle of humeral stem angle, which will be used in the second stage operation with the cement (Fig. 1D-F). We evaluated the range of motion and pain using the Constant score. The mean abduction was 50° (40°–60°), forward flexion was 50° (30°–70°), and average Constant score was 47.75 (44–52). Three patients underwent hemiarthroplasty, and one patient rejected the 2nd operation due to discomfort during daily activity (Fig. 2).

Discussion

According to a previous study, the second stage operation with a cement spacer or PROSTALAC showed good results from infection treatment. However, patients still experienced discomfort, including pain and minimal range of motion. Therefore, we tried to make a more precise spacer; our study showed a higher constant score than other studies that included patients with infected shoulder prosthesis (mean score=38).[4] The shoulder range of motion was limited, but patients showed reasonable activity of daily living, and pain was relatively tolerable. This study has a value of individual making system for patients and produced good results in daily life by improving the range of motion and pain before the second operation. The 3D printed molding technique is one of the effective methods for humeral head osteomyelitis.

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