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Case Report

Novel Technique for Removing a Well-Fixed Cemented Cup with a Dedicated Original Device during Revision Total Hip Arthroplasty: Surgical Technique

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The improved cemented cup technique has attained excellent long-term results in primary total hip arthroplasty. When cup revision surgery was performed, the cemented cup, which was loosened at the bone-cement interface, was easily removed. However, with a well-fixed bone-cement interface, it remains difficult to remove the cemented cup for a revision in the event of a recurring dislocation. In addition, protrusions in the cement can cause unpredictable bone defects. A new removal device was created and used successfully to remove a well-fixed cemented cup safely and efficiently. This report introduces the device and the technique used in cemented cup removal.

Key words: total hip arthroplasty, revision surgery, well-fixed, cemented cup

In the cemented total hip arthroplasty procedure, the techniques used for cementing the acetabular component of the bone have been improved in recent years [1-3]. The cemented cup is still regarded as the gold standard, with good long-term results reported in the literature [4,5]. However, a well-fixed cemented all-polyethylene acetabular component, in the case of a recurrent dislocation or eccentric wear of the polyethylene, requires special techniques for removal. Several articles have described the method of removing a well-fixed cemented cup. In the present report, we propose a new device for performing well-fixed cement cup removal and describe the technique for its efficient use in revision surgery.

A New Device for the Removal of a Well-fixed Polyethylene Cup. We propose a new device for the removal of all-polyethylene acetabular components. The device is composed of two parts, the osteotome and the claw (Fig. 1), as well as a hinged screw that is used to connect the two parts. The screw can be tightened to hold the cup (Fig. 2). We can easily and safely remove the polyethylene cup using a "back-out" motion without bone loss. Our technique involving this device has been successful in over 20 well-fixed cemented cup revision surgeries. This device was invented by the author and is manufactured by Kyocera Corporation (Osaka, Japan).

Case

A 73-year-old woman was treated for idiopathic osteonecrosis with a Charnley cemented total hip arthroplasty 15 years previously. She presented recurrent dislocation of the well-fixed prosthesis (Figs. 3 and 4).

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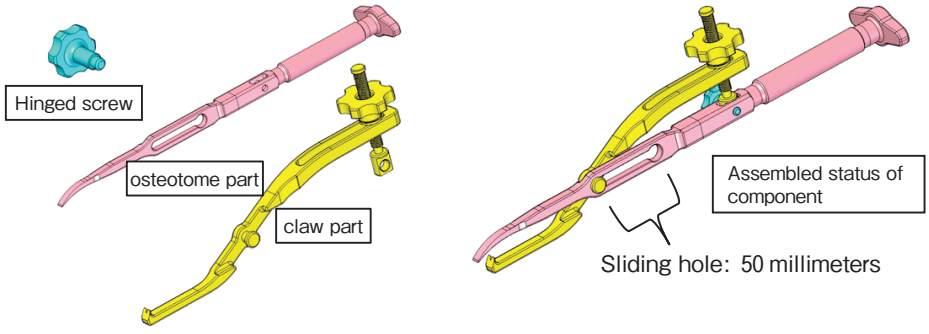

Fig. 1 The removal device is composed of 3 component, osteotome part and claw part and hinged screw, and all three parts are made of stainless alloy (SUS630). The osteotome part weighs 400 grams, the claw part weighs 260 grams, and the hinged screw weighs 20 grams. Thus, the total weight is 680 grams. The length of the osteotome is 105 mm from the hinge joint, and the width is 6.5 mm. The length of the claw is 96 mm from the hinge joint and can be extended 50 mm by sliding.

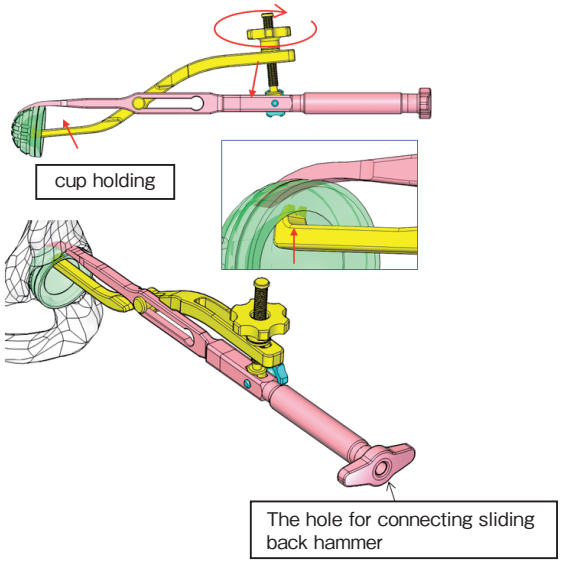

Fig. 2 The polyethylene cup is held by the osteotome part and the sliding claw. A sliding back hammer can be connected to the end of the device.

Fig. 3 X-rays of both hips at 15 years after Charnley total hip replacement. No clear zone can be observed in the cemented cup.

Fig. 4 The third dislocation occurred within 3 months.

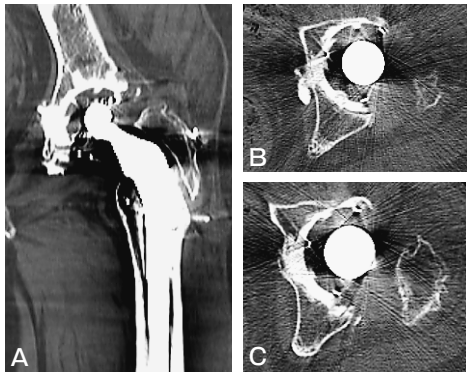

Fig. 5 The computed tomography image of the left hip showed abnormal protrusion in the coronal view (**A**) and axial view (**B**, **C**).

Revision surgery was needed in order to re-orient the cup to correct the anteversion, followed by exchanging the previous head for one with a larger diameter head. There was no radiolucent line surrounding the cemented cup on the computed tomography. (Fig. 5)

Operation technique. Initially, the cement-component interface was exposed circumferentially by sep-

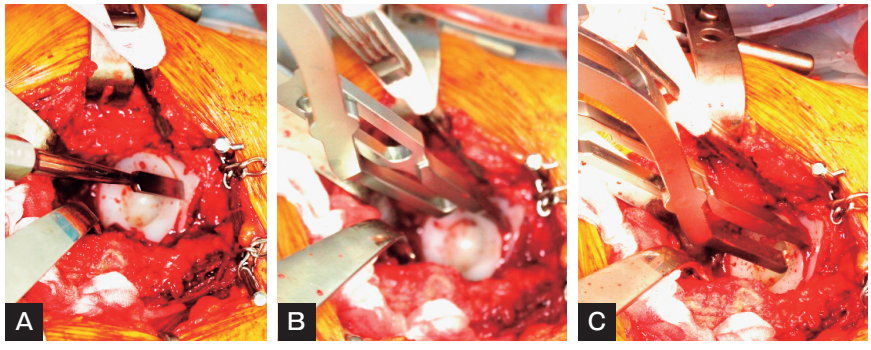

Fig. 6 Intra-operative photographs. A 10-mm-wide osteotome was inserted into the flange part of the polyethylene cup (A). The osteotome part was inserted deeply into the previous hole (B). The claw was slid into the inside of the cup and clamped with the osteotome part (C).

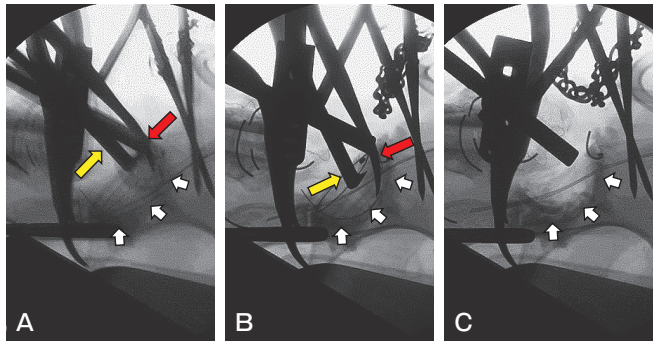

Fig. 7 The view of the intraoperative image intensifier showing the cement layer (white arrow), osteotome part (red arrow), and claw part (yellow arrow). The osteotome part was inserted into the periphery polyethylene cup (A). The cup was clutched by sliding the claw part with the osteotome part (B). The cup was de-bonded and pulled out from the cement layer (C).

arating it from the surrounding scar tissue and unnecessary bone in order to avoid bone loss. Next, the 10 mm wide osteotome was inserted at the cement-polyethylene interface (Fig. 6A). The osteotome was inserted deeply enough to grasp the cup into the same opening (Fig. 6B, 7A). Next, the claw was inserted into the inside of the polyethylene cup, and the hinged screw was tightened in order to hold the cup (Fig. 6C, 7B). The sliding hammer was connected to the end of the device (Fig. 8A). The polyethylene cup alone was easily and safely removed within a short time period using the same backing-out motion used for the removal of the intramedullary nail (Figs. 7C, 8B). Then, the remaining well-fixed cemented layer was divided using a chisel and easily removed without any bone loss (Fig. 9A, B). No bone graft was needed in this case. The revision surgery was performed using a cementless multi-hole cup, and the stem was changed using the cement-in-cement technique (Fig. 10). There were no intra- or post-operative complications, including re-dislocation.

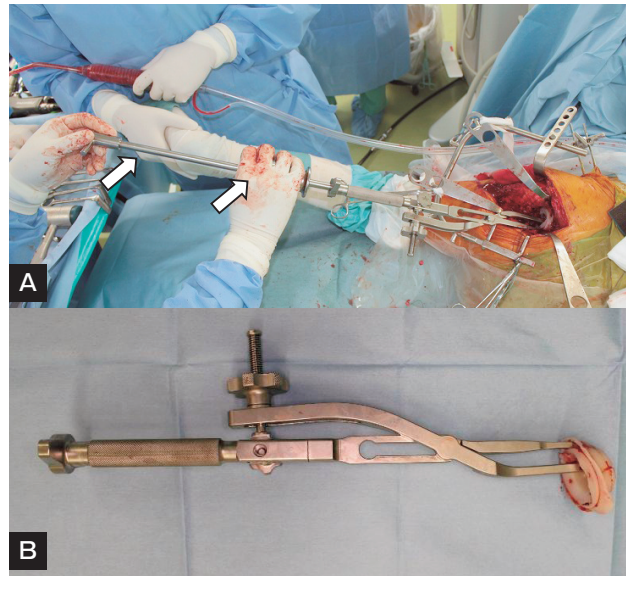

Fig. 8 The author used a sliding hammer (white arrow) connected to the device to remove the cup (A). The device and a removed polyethylene cup (B).

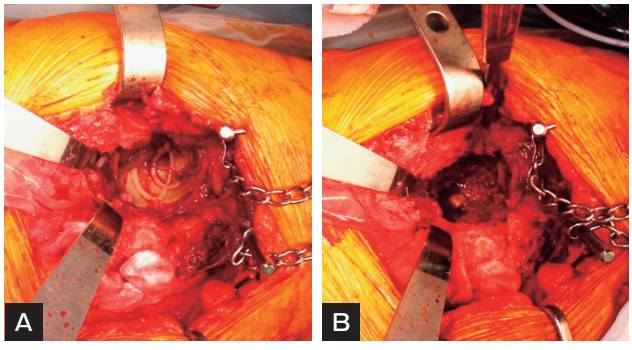

Fig. 9 Intra-operative photographs. A well-fixed cement layer remained (**A**). No bone defect was observed in the acetabulum after the cement was removed (**B**).

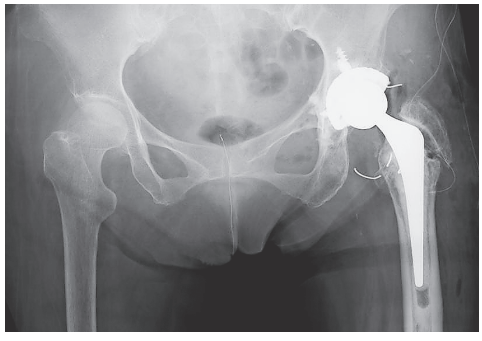

Fig. 10 Post-operative radiograph of both hips.

Discussion

Several techniques for the removal of a well-fixed cemented cup have been reported [6-9]. To divide the cement-polyethylene interface, a threaded extractor has been used [6]. The screw extraction technique using multiple screws is also useful [7]. It should be noted that there is a risk of penetration when drilling through the thin polyethylene cup and thin cement layer when using these techniques. The "reaming out" technique can also be used for easy removal of the polyethylene cup [8]. On the other hand, in this technique, quantities of small polyethylene debris are discharged, and the torque exerted on the surrounding well-fixed cup may have a risk of causing a bone defect. Stevens *et al.* described a technique for removing a quarter of the cup in which the polyethylene is levered away from the cement in a rotatory motion [9]. However, with this technique, the acetabulum and the cement layer must have sufficient integrity against the de-bonding force. When used in the revision of elderly osteoporotic bone, this method has a risk of causing bone fracture. This technique described by Stevens *et al.* was also a novel technique [9]. First, multiple drill holes into the cup were made. An acetabular cutting tip osteotome was utilized to section the polyethylene. Next, a straight osteotome was positioned 1 cm deep from the cup surface, and the cup was gripped by the oseotome. Finally, the cup was de-bonded safely from the cement with a brisk rotating motion.

The novel technique that we have presented in this report is superior to the previous techniques described above. Our new device has been shown to produce no debris. The cup was removed safely and quickly. In this procedure, the well-fixed cup was de-bonded from the cement mantle and backed out straight from the acetabulum. If the first attempt to cut out the polyethylene fails, a second attempt can be made to remove the remaining polyethylene liner. In cases where large well-fixed cement anchors exist and the cement-bone interface is not loosened, the well-fixed base part of the cement anchor can be separated from the main cement layers connected with the polyethylene liner by this device. Thus, the cup revision was successfully performed without any bone defect.

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