Surgical Technique

Surgical Technique of a Cement-On-Cement Removal System for Hip and Knee Arthroplasty Revision Surgery

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Abstract

Cement removal during hip or knee arthroplasty revision surgery is technically demanding and prone to severe complications such as periprosthetic fractures, incomplete cement removal, or perforations. Several alternative techniques have been developed to enable complete, accurate, and safe removal of cement from bone, including osteotomies and cortical windows, endoscopic instruments, ultrasound devices, lithotripsy, and laser-assisted removal. We describe a cement-on-cement technique with a sterile, single-use tool for cement removal. The cement is removed piece by piece using a specifically designed device, without osteotomies or cortical windows.

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Introduction

The number of hip and knee arthroplasties is increasing worldwide. It is estimated that in 10 years, the number of primary total hip arthroplasty interventions will grow by 71% to 635,000 procedures, and primary total knee arthroplasties (TKAs) will undergo an 85% increase, totaling 1.26 million procedures in the United States [1]. Consequently, total hip and total knee revisions are projected to grow by 137% and 601%, respectively, between 2005 and 2030. Such growth may pose a significant increase in the burden placed on health systems, as the estimated cost of this intervention is 60,000 US dollars for aseptic removals and 100,000 US dollars in septic revisions [2].

Cement removal is one of the most technically demanding steps during hip and knee arthroplasty revision and can be associated with severe complications, such as periprosthetic fractures, perforations, or incomplete cement extraction [3]. Owing to the potential risks of extraction, cement-in-cement techniques have been proposed, and excellent results have been reported in aseptic revisions [4]. An alternative technique consisting of removing the old and new segments of cement together with the use of a specifically designed extractor based on the cement-on-cement technique was first described by Ekelund [5] and later by Cordonnier et al. [6] in small sample series of hip arthroplasty revisions, both with promising results. To the best of our knowledge, no reports on the use of this technique in knee revisions have appeared in the literature to date. We have used a cement-on-cement surgical technique using a sterile single-use cement-on-cement extraction device in both cemented hip and knee arthroplasties revisions. The technique is safe, simple, and reliable and is described in detail.

Material and methods

Surgical technique

Metal Cemover (Tecres, Verona, Italy) is a sterile, single-use device designed for cement removal in arthroplasty revisions. It is made of metal metamers connected to each other in 3 different lengths (120, 150, and 180 mm). With the use of this tool, cement is removed piece by piece using a specifically designed device, without osteotomies or cortical windows. The device is based on the rationale that the
cement–cement interface strength is greater than that of bone–cement.

Prosthetic stems should be removed before cement extraction (Fig. 1). The cement mantle is then roughened with a custom-designed 8-mm drill, creating an appropriate bed for new cement interdigitation. If necessary, a 10-mm ball reamer can also be used for this purpose. Containment of the distal plug should be verified, and a new plug inserted if it is found to be unsuitable. It is highly recommended to check if a cementing cannula fits the canal and reaches the distal plug. New ultra-low-viscosity cement is then prepared, and as soon as it is mixed, it is inserted into the femoral or tibial canal using the specific cementing gun and aspiration tube, which is retrogradely removed while introducing new cement (Fig. 2). Cement must be liquid enough to completely and easily fill the entire canal. Immediately after the medullary canal has been filled with cement, metamers engaged in a single one are inserted centrally in the diaphysis (Fig. 3). It is crucial not to move the device until new cement is cured. Intraoperative radiographs can be used to check the device's position centered in the diaphysis. When the new cement has completely solidified, the hammer extraction device is connected. With every retrograde blow, a metal metamer surrounded by new and old cement is extracted, repeating this process with every metamer (Figs. 4 and 5). Finally, the cement plug is perforated with the 8-mm drill, screwed, and removed (Fig. 6).

In case of removal of a cemented stem in total knee arthroplasty, special care should be taken to avoid any lateralization or medialization of the device during cement extraction to prevent potential damage of the femoral condyles (Figs. 7 and 8).

Figure 1. Polished stem removal in total hip arthroplasty revision.

Figure 2. Introduction of new ultra-low-viscosity cement in bone diaphysis.

Figure 3. Metamers engaged in a single one, being introduced in bone diaphysis immediately after new cement.
Discussion

Complete and safe cement removal in protheses revisions is a challenging problem with multiple alternatives, but none of them has showed to solve it better over others. This surgical technique avoids more aggressive approaches such as extended osteotomies, which require the use of wires or plates for fixation [7]. Miner et al. show that extended trochanteric osteotomy for implant and cement removal had a complication rate of 24% in 166 patients, although the authors state that not all complications were attributable to the osteotomy [8]. Flexible endoscopes and ultrasonic devices are effective complementary tools than can improve visualization and assist in cement removal, reducing the risk of complications (eg, cortical perforations) and eliminating the need for osteotomy. In spite of these potential advantages, the reported rate of complications in the literature when endoscopes and ultrasonic devices were used in hip revisions is between 4% and 20% [9,10].

The fact that cement-on-cement systems do not require extended osteotomy permits early weight-bearing, which accelerates patient recovery.

Similar devices and techniques have been previously published with good results. Ekelund managed to extract all the cement in 16 of 20 cases of revision hip arthroplasty surgery in an average time of 35 minutes [5]. Cordonnier et al. reported 11 cases; in all of them, cement mantles were successfully removed without major complications [6]. Schurman and Maloney achieved complete cement removal in 12 of 15 cemented hip stem revisions, reporting no complications [11]. Laing et al. reported on 25 femoral revisions using a similar segmental cement extraction method, which succeeded in 88% of cases with no perforations or fractures [12]. Gianotti et al. recently published satisfactory results of this technique, reporting complete cement removal in a small series of shoulder arthroplasty revision surgeries [13]; however, there are no reports containing surgical tips of this technique in knee revision surgery.

Further investigations are required to study safety and effectiveness of this surgical technique not only in aseptic loosening but also in septic ones. Clinical outcomes might be studied to identify advantages and disadvantages of this surgical procedure.

Summary

Cement-on-cement removal technique using the Metal Cemover system is a valid alternative to traditional procedures for complete and accurate bone-cement removal in hip and knee revision arthroplasty surgeries.
Figure 6. Hip surgical technique. (a) Stem removal. (b) Old cement roughened. (c) Extraction of debris. (d) New ultra-low cement introduction. (e) Metamers assembled introduction. (f) Extractor plugged. (g) Extraction of every single metamer with new and old cement linked. (h) Distal plug drilling. (i) Distal plug extraction with special threaded device.
Figure 7. Intraoperative sample of a total knee revision with both, femur and knee, Metal Cemover devices prepared to be extracted.

Figure 8. Knee surgical technique. Extraction of components and Metal Cemover device application in femur and tibia.
Conflicts of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this article.

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