



An evaluation of the methods used for removal of components and cement in revision hip arthroplasty

Revizyon kalça artroplastisinde komponentlerin ve çimentonun çıkartılmasında kullanılan yöntemlerin değerlendirilmesi

Bülent ERDEMLİ

Department of Orthopaedics and Traumatology, Medical Faculty of Ankara University

Amaç: Revizyon kalça artroplastisinde komponentlerin ve çimentonun çıkartılmasında kullanılan yöntemler değerlendirildi.

Çalışma planı: Revizyon kalça artroplastisi uygulanan 37 hasta (ort. yaş 65.6; dağılım 18-78) retrospektif olarak incelendi. Kalça artroplastisi 13 kalçada çimentosuz, 16 kalçada hibrid şeklinde, beş kalçada çimentolu, üç kalçada parsiyel uygulanmıştı. Dört hastada sadece asetabular kap, üç hastada sadece femoral komponent revize edilirken, diğer hastalarda tüm komponentler revize edildi. Revize edilen asetabular kapların beşi çimentolu, 28'i çimentosuz (10 ekspanse, 18 poroz kaplı press-fit); femoral stemlerin 22'si çimentolu, 11'i çimentosuzdu. Revizyon cerrahisi ilk ameliyattan ortalama 7.3 yıl (dağılım 1.5-13 yıl) sonra yapıldı. Yirmi sekiz kalçada (%84.9) uzatılmış proksimal femoral osteotomi (UPFO) uygulandı. Bunların 10'unda (%35.7) yüksek devirli kesici uçlar (YDKU) kullanıldı. Kalçalar revizyon öncesi ve sonrasında Merle d'Aubigne ve Postel'in Charnley tarafından modifiye edilmiş ölçütlerine göre değerlendirildi. Ortalama izlem süresi 36.3 ay (dağılım 2-48 ay) idi.

Sonuçlar: Çimentolu kapların çıkartılmasında bir zorlukla karşılaşmadı. Çimentosuz kaplarda, ekspanse olan yaprakların osteotomla periferden merkeze doğru bükülmesiyle kolayca çıkartılabildikleri görüldü. Press-fit poroz kaplı kapların sekinde (%44.4) kap etrafındaki kemik ilişkiyi çözebilmek için YDKU kullanıldı. Bunların ikisinde (%25) metal kesici uç kullanılarak kap parçalara bölünerek çıkartılabildi. Bir kalçada ameliyat sırasında UPFO'nun distaline uzanan spiral kırık gelişti. Son kontrollerde kalçaların %92'si klinik olarak mükemmel veya iyi olarak değerlendirildi.

Çıkarımlar: Revizyon kalça artroplastisinde komponentlerin ve çimentonun çıkartılması standart aletlerin yanı sıra özel aletler ya da yaklaşımlar gerektirebilir.

Anahtar sözcükler: Artroplasti; kemik çimentosu; femur/cerrahi; kalça protezi/yöntem; osteotomi/yöntem; ameliyat sonrası komplikasyon; protez ve implant; protez başarısızlığı; yeniden ameliyat.

Objectives: This study was designed to evaluate the methods that we used for removal of components and cement in revision hip arthroplasty (RHA).

Methods: Thirty-seven patients (mean age 65.6 years; range 18 to 78 years) who underwent RHA were retrospectively evaluated. Arthroplasty had been cementless, hybrid, cemented, and partial in 13, 16, 5, and 3 hips, respectively. Revision included only acetabular cup in four patients, femoral component in three, and all components in the remaining patients. Of the acetabular cups revised, five were cemented, 28 were cementless (10 expanded, 18 porous-coated); of the femoral components, 22 were cemented and 11 were cementless. The mean time to revision was 7.3 years (range 1.5 to 13 years). Extended proximal femoral osteotomy (EPFO) was performed in 28 hips (84.9%), of which 10 hips (35.7%) required the use of high speed cutting heads. All the patients were evaluated before and after revision according to the criteria of Merle d'Aubigne and Postel which were modified by Charnley. The mean follow-up period was 36.3 months (range 2 to 48 months).

Results: There were no difficulties in the removal of cemented acetabular cups. Expanded cementless cups were readily removed by bending their expanded leaves. However, high speed cutting heads were used to resolve the bone-cup integration in eight porous-coated cups (44.4%); of these, two cups (25%) even required the use of high speed metal cutting heads to split several parts apart. In one patient, a spiral fracture occurred extending to the distal end of EPFO. On final follow-ups, the results were evaluated as perfect or good in 92% of the hips.

Conclusion: The removal of components and cement during RHA may require the use of more complex methods and device in addition to standard ones.

Key words: Arthroplasty; bone cements; femur/surgery; hip prosthesis/methods; osteotomy/methods; postoperative complications; prostheses and implants; prosthesis failure; reoperation.

The primary hip arthroplasty is widely used almost in all hospitals in our country, and consequently the number of patients requiring revision hip arthroplasty is gradually increasing. The revision surgery has different characteristics than the primary surgery. It consists of several alternatives ranging from the approach on hip joint to the type of prosthesis, even to the type of graft to be used. [1] There are enhanced approaches like extended proximal femoral osteotomy (EPFO) as well as tools like simple plain and curved osteotomes, Gigli wires, thin and long T-, V-shaped osteotomes, hooks, high speed cutting heads (HSCHs) and instead of ultrasonic cement tool removers. [1-9] It is hard to achieve a successful total hip prosthesis revision surgery without using the efficient number of tools. And, given the circumstances in our country, it is essential to perform as much atraumatic as possible in order to succeed in revision surgery.

In this study, we evaluated the methods that we used to remove the components and cement in revision hip surgery.

Patients and method

We retrospectively evaluated 37 patients (mean age 65.6 years; range 18 to 78 years) who underwent revision hip arthroplasty for different reasons between December 1998 and December 2002. The hip arthroplasty was cementless in 13 hips; hybrid in 16 hips; cemented in five hips; and partial in three hips. Revision included only acetabular cup in four patients, only femoral component in three patients, and all components in the remaining patients. Of the

revised acetabular cups, five were cemented, and 28 were cementless while of femoral stems, 22 were cemented and 11 were cementless.

Revision surgery took place at mean 7.3 years (range 1.5 to 13 years) after the first surgery. EPFO was carried out in twenty-eight hips. The final point of the osteotomy was extended instead of the distal end of the prosthesis for each patient.

The osteotomy area was fixed using circlage wire, screw and circlage wire and locked cable systems in seven, two and nineteen hips, respectively. The hips were evaluated before and after the revision according to the criteria of Merle d'Aubigne and Postel as modified by Charnley. [10] Presence of any complications was radiographically examined in the osteotomy area. The mean follow up period was 36.3 months (range 2 to 48 months).

Results

The causes of revision were aseptic loosening, infection, and acetabular component position and consequent corrosion in the polyethylene component in 22, 11 and 4 cases, respectively. No difficulty was experienced in the removal of cemented acetabular cups (n=5).

Ten (n=28) of the cementless acetabular cups were expanded while 18 were porous coated press-fit. No special tool was required in the removal of the expanded type of cups; it was easy to remove them by bending the expanded leaves toward the center from the periphery by means of an osteotome. HSCH was used in order to resolve the

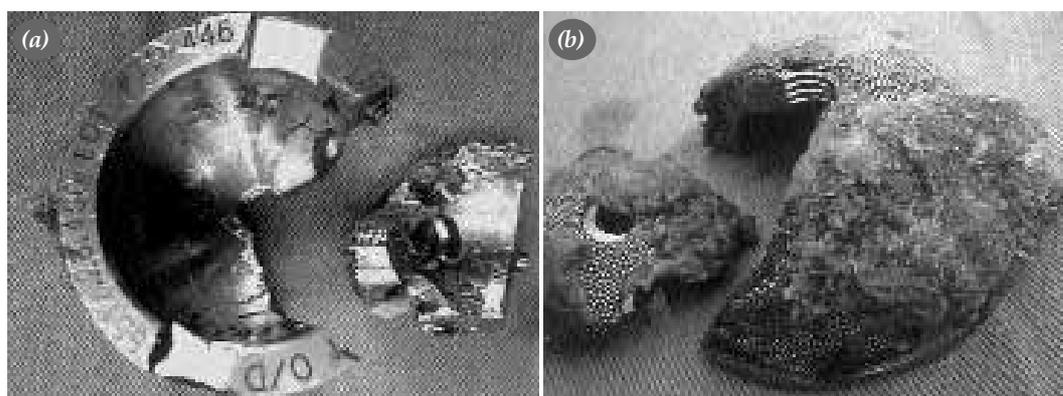


Figure 1. (a) The status of the revised cementless cup after cutting it like a slice of cake using a high-speed metal cutting head. (b) An osseous ingrowth from the host bone toward the cup is evident on the back surface of the cup. If such a cup were to be removed by force, the damage to the host bone would be much greater.

bone ingrowth around the cup in eight (44.4%) of the porous coated press-fit cups, where in two of these cases high speed metal cutting heads were used due to the overgrowth on the porous surface of the bone (mean osseous ingrowth 40%; range 20 to 55%), and the cup was removed after splitting the parts. In one of these two cases, a quarter part of the cup was cut and the rest was removed by osteotome and loosening with high-speed heads (Figure 1a, b) while in the other case, the cup was removed after cutting it into seven pieces using a high-speed metal cutting head (Figure 2a, b).

In order to remove the revised 33 femoral components (22 cemented, 11 cementless), 28 underwent EPFO (84.9%) (Figure 3a, b). The osteotomy levels were extended up to the distal end of the prosthesis. The components and cements were removed after the osteotomy by using simple osteotomes, curettes and Gigli wires. However, 10 hips (35.7%) (7 cemented, 3 cementless) also required use of HSCH. A spiral fracture extending 5 cm distal of the osteotomy developed in one of the hips due to the

failure to resolve the osseous interface efficiently during the removal of the cementless femoral component following the osteotomy.

According to the criteria of Merle d' Aubigne and Postel as modified by Charnley, the preoperative and postoperative mean scores were 3.7 and 5.6 for mobilization, 3.18 and 5.3 for walking and 2.6 and 5.0 for pain, respectively.

92% of the patients were found to be clinically excellent or good at the end of the follow-up period. The radiographical controls revealed that the osteotomy area was joined in a mean period of three months (range 2 to 4 months). In spite of the use of various fixation methods, non-union was experienced in none of the cases. The case with fracture development was also joined without any problem. No neural damage or heterotopic ossification was observed in any of the cases.

Discussion

One of the most important factors underlying the success in total hip prosthesis revision surgery is the



Figure 2. (a) An early corrosion in the polyethylene component as a result of the misplacement of the cup in the first surgery is evident in this patient who underwent total hip prosthesis when he was 18 years old due to diagnosis of chronic renal failure and femoral headed avascular necrosis. Only revision of the acetabular component was considered in this patient. (b) Since the angle of the cup was out of the appropriate degrees, changing only the polyethylene component was avoided, and the cup was removed from the host bone only after splitting it into seven pieces using high-speed metal cutting heads.

use of the least traumatic method for the removal of prostheses and cements installed during the operation. The intention here is to prevent an atmosphere, which would disrupt the fixation of new components.^[1,4]

The preoperative planning is as much important as the technique to be used for the removal of component or cement. A cup with cementless screw should be evaluated by views taken from several angles before the operation. The presence of broken screws can be previously detected in such cases (Figure 4). An intense evaluation of the bone integration requires availability of high-speed, even metal cutting, heads. In the femoral part, the projection of the lower part of the prostheses before the surgery, the presence of a mediator and stopper, and the evaluation of how far the cement extends will determine the length of osteotomy.

The removal of the polyethylene component of the cup is usually not difficult in the revision hip surgery, and it is the easiest stage of the revision. The essential idea here is to destroy the locking

mechanism of the polyethylene component. The least traumatic way to do this is to drill into the polyethylene slightly off center with a 3.2 mm drill, and then inserting a 4.5 mm cortical screw of 30-34 mm long.^[1] As the screw is driven deeper, it will detach from the polyethylene component since it's locking mechanism has been damaged. If only the polyethylene component is changed and the metal component would be maintained, then great care is needed to protect the locking elements of the metal component; otherwise, inserting the new polyethylene into the cup and its locking would be problematic.

The target while removing the all-polyethylene, i.e. cemented cups should be to disrupt the cement-bone interface.^[1,4] At first, the cup is removed, disrupting the distance between the prosthesis and cement. Then, the cement should be cleared by curved osteotomes, curettes or HSCH. We easily removed the cemented cups in our study. No tools other than osteotome or curette were needed during the removal since there were aseptic loosening and migration in all cups.



Figure 3. (a) Extensive osteolysis developed in the cemented femoral stem during the early postoperative period. (b) Only the patient for whom revision for femoral component was considered underwent extended trochanteric osteotomy. Long stem prosthesis was placed by removing all cements and the stopper from the channel.

The removal of cementless acetabular cups is very difficult. At first, the metal cup must be entirely exposed. The osteotomes and curettes that are used routinely may not be sufficient to resolve the bone integration toward the surface of the cup. The major problem here is the emergence of a severe loss in the structure of the host bone if the bone-prosthesis interface is not well resolved.^[4] Therefore, the bone integration around the cup should be roundly loosened by metal tip cutters fitted into high-speed powers. Following the loosening, the cup should be removed by applying strength in the axial direction if it has its own insertion system. If the bone integration toward the surface of the cup is high then the cup should be removed by cutting it with metal cutting tips in order to avoid severe bone damage. We experienced no difficulty in the removal of the

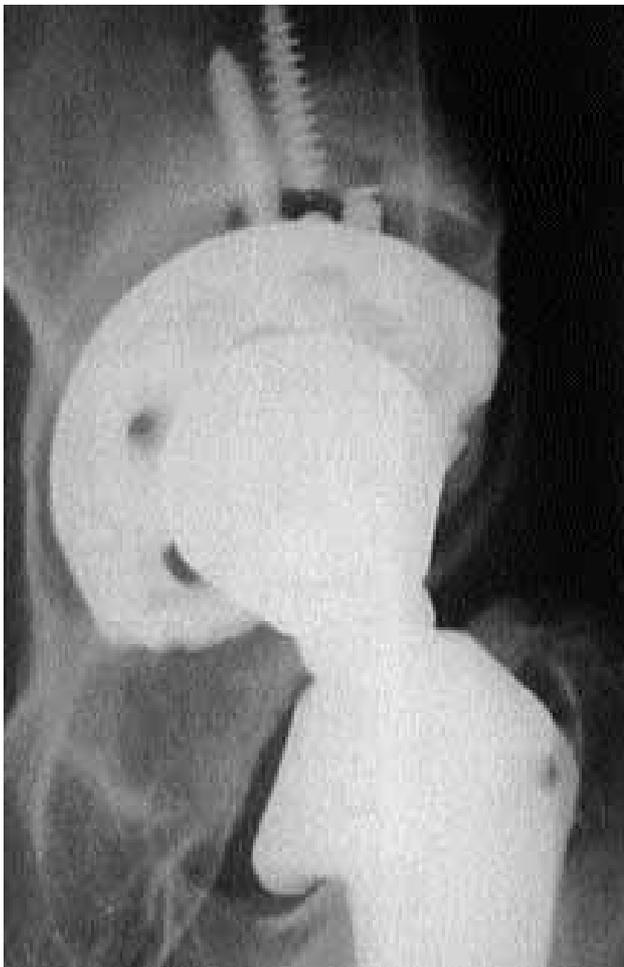


Figure 4. The preoperative planning has its own hints. Even detection of a broken screw will contribute to the determination of tools that may be required during the operation and building a strategy.

revised cementless cups, particularly the expanded ones, which resulted from the loose bone integration particularly on the cup and consequent aseptic loosening.

However, two of the porous coated cementless cups were removed only by cutting, where in one of them the cup was removed by cutting the area between the holes of the cup like cake slices; and in the other only after by splitting it into seven pieces. Consequently, HSCH was needed in almost 44% of the porous coated acetabular cups as apposed to metal cutting tips in 10%.

The interface between prosthesis-cement and cement-bone should be loosened during the removal of the cemented femoral stems, which is usually easier, particularly in the trochanteric area, whereas it is both challenging and insufficient to perform this procedure in the far distal, even in the area where the stopper is. Although there are several studies indicating that the revision can be performed without removing the cement mantle [5,6], it should not be preferred except in occasional cases. For the removal of cement mantle, osteotomes, curettes, hooks, ultrasonic tools and HCSH are used.^[7,8,11] However, most of them, e.g. ultrasonic tools, are not available under the present circumstances in our country. And high-speed cutting tips are only used in

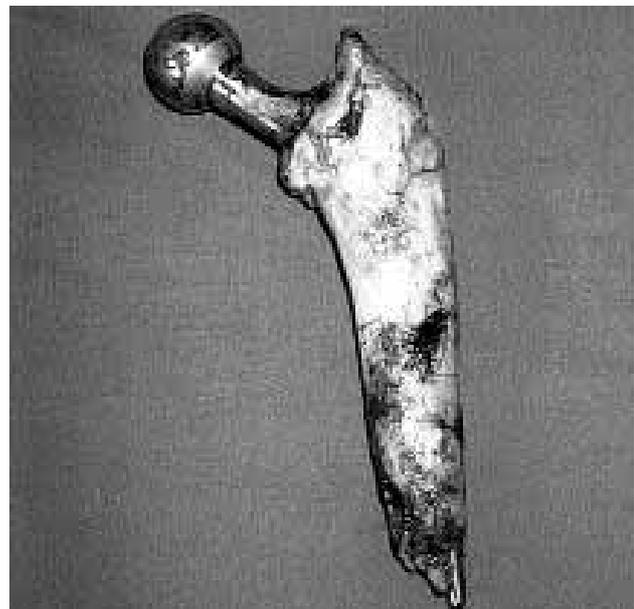


Figure 5. This figure shows entirely removed cement pile during the removal of a cemented stem, which is in fact very rare.

a number of centers due to their high costs. Special osteotomes and hooks designed for cement removal are not available in many hospitals. In cases where the cement-bone interface was completely damaged, the entire cement can be removed as a pile while removing the prosthesis as it was seen in one of our cases (Figure 5). However, even though most of the time the prosthesis is removed with a little cement, most of it remains inside the channel. The most effective method is to perform EPFO and check the whole channel in order to clear the cement, neocortex and debris successfully.^[4,12] The distal level of the osteotomy should be determined before the operation. Especially when we assume that the mediator and stopper have been used in most of the cemented stems in the last decade in our country, it appears that the level of osteotomy should extend at least 1-2 cm distal end of the prosthesis. Following the osteotomy, the prosthesis is usually removed by disrupting the prosthesis-cement interface by simple osteotomes. If the osteotomy level is within the proximal of the stopper, the stopper is drilled and removed by driving a corkscrew or grooved Schanz screw. In some situations, even enhanced approaches like EPFO are insufficient to completely clear the cement from the bone, and high-speed tips are used. In our study, in order to remove the 33 revised femoral components, we used EPHO in 28 cases, where for 10 of these HSCH was used (7 cemented, 3 cementless stem). So, approximately 10% of the osteotomy cases required the use of special tools.

Extended proximal femoral osteotomy has no impact on the postoperative clinical and radiographic results of the hip joint.^[4,12] In a study using the above mentioned method, it has been reported that no non-union, malunion or migration was observed, but fracture in the fragment only in four cases who underwent osteotomy in the revision of 142 cases.^[4] Togrul et al.^[12] reported that they didn't experience any non-union problem during the follow-up period of mean 14 months for the 24 hip revision on which they had performed extended trochanteric osteotomy; and that this method should be preferred for shortening the operation time as well as providing an excellent view. Two or three circlage wires or a locked cable system are enough for the fixation.^[9] Osteotomy, being a kind of musculoosseous flap, increases the potential of the union.^[9] No complica-

tion was observed during the follow-up of 28 hips on which we had performed osteotomy; the union occurred at mean three months. The osteotomy didn't have a negative influence on the postoperative rehabilitation program of the patients or the clinical results.

The removal of cementless femoral components is more difficult than the cemented component. Since the amount of bone ingrowth is going to change depending on the geometry of the stem and the quantity of the porous coating used. The removal strategies will be distinctive too.^[1,4] If there is loosening in all areas, the prosthesis should be removed by pulling the axial from the proximal. But, if there exists bone integration, then special tools would be needed. Particularly following the EPFO, osseous ingrowth should be disrupted with the help of HSCH. The length of osteotomy may not be extended until the distal end of the prosthesis. The level of osteotomy can be kept shorter due to metaphyseal surface characteristics in most of the cementless stem or a window can be opened.^[2,8,9] The osseous ingrowth can be disrupted with the help of a Gigli wire or high-speed tip looking like a nib. If a femoral component, which is entirely porous coated and particularly well fixed in the distal is removed, then the stem should be cut by metal cutting tips and the component in the far distal should be removed by special tools.^[8]

In our study, 28.5% of the all revised cementless acetabular cups (44.4% of the cementless porous cups) required HSCH while 84.9% of the femoral stems required EPFO, and 35.7% of these stems required HSCH. 70% of such cases had cemented stem. The revision surgery is always unpredictable; for the removal of a component which is considered to be easily removed, various and complex tools may be required. The main principle is to use the least traumatic and most effective method.

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