Case report

The "wall-socket" technique. Proposal of a new surgical procedure for revision acetabular arthroplasty

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Abstract. Prosthetic socket revisions are always difficult and affected by problems such as possible bone-stock losses, leading to an increase in morbidity associated with surgery. These aspects are more important in elderly patients due to their frequently poor health. The bone deficit may be filled in different ways, with techniques that are nevertheless technically demanding and at risk of complications. In the opinion of the Author it is possible to leave a migrated but well-fixed cup/shell in place, simply by loading through the insertion of a second cemented cup alongside. We considered two cases of verticalized sockets: a cemented socket and a non-cemented one which, by demonstrating stability in removal attempts, forced the surgeon to leave them in place and to place a second cemented polyethylene cup alongside. This cheap surgical choice allows to shorten surgical times, to diminish blood losses and to achieve an immediate rigid fixation, aspect of utmost importance in elderly patients, allowing them to walk with a 100% load by the second post-operative day. The unremoved prosthetic cup, that is even better stabilized by the new cement, works as a "support wall" in DeLee and Charnley's zone 3, an acetabular X-ray sector notoriously subordinated to damaging tensile forces which may cause loosening of the original prosthetic cup. Because of the positive clinical and radiographic results demonstrated over time by this "enforced" revision solution, the author proposes to name it as the "Wall-Socket" technique. (www.actabiomedica.it)

Key words: Hip, hip prosthesis revision, arthroplasty, socket, acetabulum, prosthetic cup, THR, prosthesis, revision, cement

Introduction

The revision procedure of both cemented and uncemented acetabular cups gives the orthopaedic surgeon different technical challenges (1, 2). When the cup is firmly set into the acetabular bone, its removal could result in significant damage and loss of the surrounding bone and therefore loss of column integrity or pelvic discontinuity (3). This increases morbidity due to the surgical act itself and affects the fitting of a new prosthetic cup (4). The resulting bone deficit may be nevertheless overcome through the adoption of the bone impaction grafting technique (namely the packing of cavitary defects with compressed particulate graft) together with a new cemented or cementless cup (5) or with an acetabular cage. The long term results of this technique are satisfactory, but the procedure is demanding (5, 6), at risk of complications (5) and the remodelling and resorption of the allograft causes the acetabular cage to loose structural support, leading to

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fatigue and failure (7). A particular reconstruction ring named Octopus (8) has been reported for the restoration of the center of rotation as well as for achieving primary mechanical stability for the new implant, but it requires a wide area of approach (9) and therefore may increase blood loss as well as surgical times. Lastly, the implantation of a Jumbo cup (10) as well as the Oblong cup does not provide restoration of the bone stock (11) and both may therefore affect long-term fixation. To overcome these drawbacks, the "Double-Socket" method has recently been proposed: it leaves in place a well-fixed cementless acetabular cup (4) in such a way that if the version to be revised is modular, it is possible to exchange only the worn polyethylene liner, maintaining the stable acetabular cup (12, 13). The previous liner is then replaced by a new liner that is cemented inside the prosthetic shell (14, 15) in order to overcome problems due to a deficient locking mechanism of the new matching liner or to the unavailability of the matching liner (4). However, this technique should be only suggested when the prosthetic shell is not only stable, but is still in a suitable position for loading [namely: antiversion included between 5°-25° and tilt (the angle of abduction in relation to the horizontal) between 30° - 50°] (16). In the opinion of the author in certain cases, with the exception of cases involving intrapelvic cup migration, it is possible to successfully extend the method above described by leaving the cup/shell in place, that has undergone inferomedial migration but is well-fixed, and then loading it by using a second cemented cup. This opinion is based on an analysis of two clinical cases where the cup was verticalized and resistant to removal attempts. This meant that the operators were forced to leave both the cups in position, installing a second cemented polyethylene cup alongside. The author proposes to name this new revision procedure the "Wall-Socket" technique.

Material and methods

Case 1

A male patient (y.o.b. 1956) with a body weight of approximately 120 kg who suffered from a fracture of the neck of the right femur in November 1988, which was treated with a blade-plate with 1 hole and 2 long spongiosa screws with washers. He underwent a total right hip prosthesis in 1989 following the failure of this treatment. The lateral border of the prosthetic cup, a cementless model with screws, was initially unsuccessfully positioned with cephalad rotation of its lateral edge (Fig. 1). After 4 years, in 1993, the patient attended the Orthopaedics and Traumatology Division of the Civil Hospital of Chiari (Brescia, Italy) complaining of a serious functional impotence and severe pain on every attempt to move and to bear weight on the right hip. The cup therefore underwent a revision procedure carried out using a modified Watson-Jones approach. This revealed that the ceramic head was broken in several parts and a pseudo-acetabulum located above the prosthetic acetabulum was formed by the grinding action of the dislocated head. The polyethylene liner was removed and the screws were removed from the acetabular bed. Following unsuccessful attempts to remove the cup, whose stability was considerable, it was left in place and a new polyethylene cup and a new prosthetic head were positioned (Fig. 2). The polyethylene cup was subsequent-

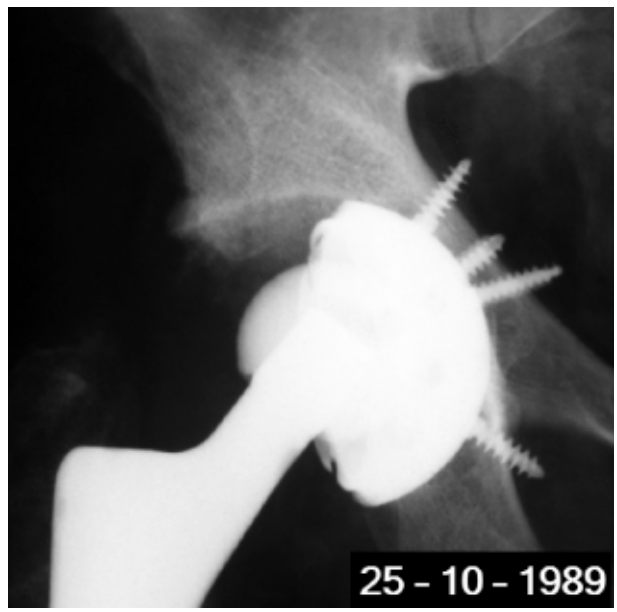

Figure 1. The unsuccessfully positioned uncemented prosthetic cup. The cephalad rotation of its lateral border is observed (verticalization of the prosthetic cup)

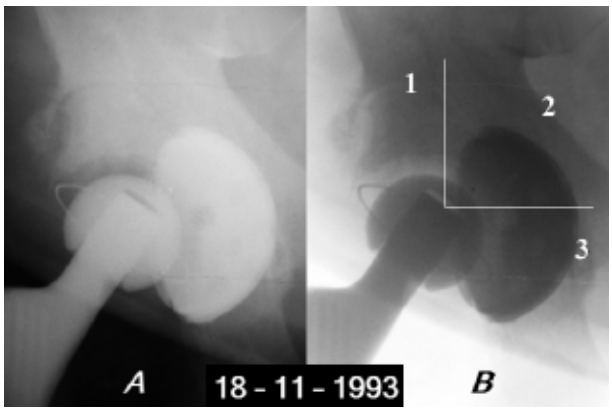

Figure 2. First revision of the uncemented prosthetic cup using the "Wall-Socket" method. The lack of stabilisation screws and the addition of a new cemented polyethylene cup is observed (A). The same figure in negative (B) shows the location of the previous cup in DeLee and Charnley's zone 3

ly revised in December 2000 with a new cemented polyethylene cup (follow-up of 7 years). Three years later, namely 10 years after the first revision procedure, the cup was revised at another Orthopaedic Department, removing both cups using a Muller acetabular cage (Fig. 3).

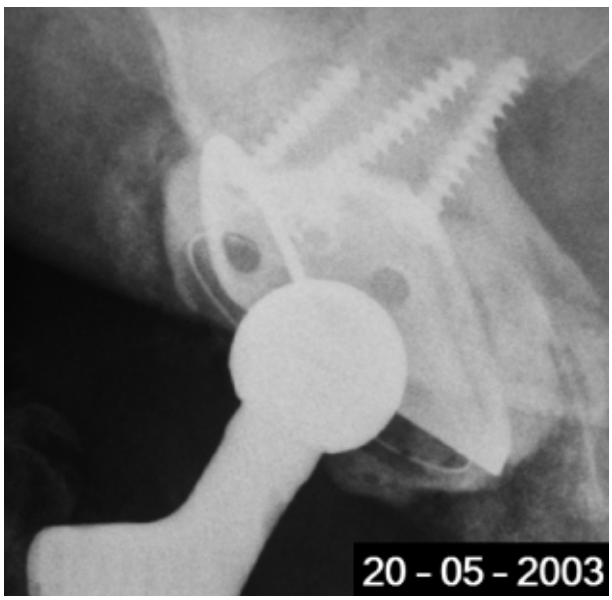

Figure 3. Third and final cup revision. The Muller's acetabular cage with 3 mounting screws and a new cemented polyethylene cup are observed

Case 2

A female patient (y.o.b. 1919) with a body weight of approximately 50 kg who had underwent surgery due to arthritis of the right hip with a total hip prosthesis in 1989. A clinical and X-ray check up carried out in 1994 revealed the correct positioning of the cup and the prosthetic stem, with reattachment of the greater trochanter with cerclage wire through the Watson-Jones approach. During the period between 1994 and 2002 the patient, who did not remember the year of the event, fell from her bicycle and suffered from an injury but decided not to attend the Accident and Emergency Department. In 2002, the patient came to our attention at the Orthopaedics and Traumatology Division of the Civil Hospital of Iseo (Brescia, Italy) due to pain during walking and also during the night when she layed on the operated hip side. The prosthetic cup, a cemented polyethylene model, was found to have undergone cephalad rotation of its lateral edge with dislocation of the femoral prosthetic head, which ground out a pseudo-acetabulum in the iliac bone (Fig. 4), indicating the length of time between the dislocation and the examination. It is assumed that the dislocation took place during her fall from the bicycle. The

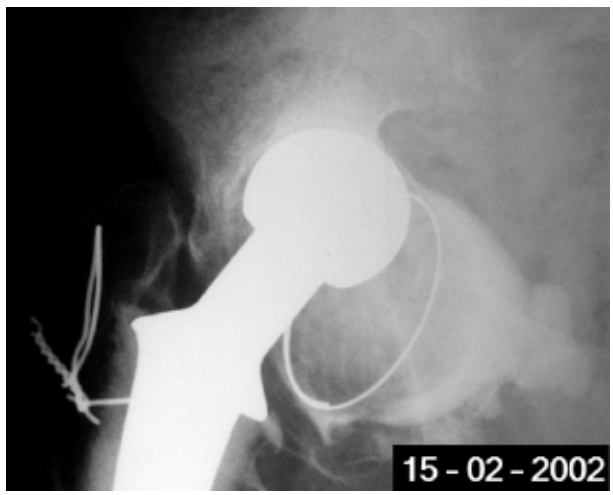

Figure 4. Cephalad rotation with inferior migration of the cemented polyethylene cup (verticalization of the prosthetic cup) and dislocation of the femoral prosthetic head. The presence of a pseudo-acetabulum produced by the grinding action of the metal head on the acetabular roof is observed

Figure 5. Revision of the cemented polyethylene cup using the "Wall-Socket" method and replacement of the femoral stem (A). The presence of a new cemented polyethylene cup is shown. The same figure in negative (B) reveals the presence of the previous cup in DeLee and Charnley's zone 3

Figure 6. The radiographic follow-up 3 years after the revision procedure with the "Wall-Socket" method. The good stability of the new acetabular component is pointed out

cup and the prosthetic stem underwent revision using the Hardinge-McFarland-Osborne approach. Considering the possible risks that cup removal could involve and given its stability, the surgeon decided to leave it in place and to position a second cemented polyethylene cup beside it (Fig. 5). A radiological control carried out 3 years after surgery (follow-up of more than 3 years) revealed that the new cup had remained in place with no manifest signs of mobilisation or radiolucency (Fig. 6). Since July 2007 the patient, aged 88 yrs., loads the joint freely without pain.

Discussion and conclusions

Acetabular arthroplasty revision surgery can be challenging due to the extent of bone deficiency which may be severe enough to compromise reconstruction. Restoration of the bone stock is essential to give a suitable support for the new acetabular component and to restore the acetabular anatomy (17). Hence two problems may be considered during a cup revision procedure, such as bone deficiency (carried out by the primary socket removal) and the necessity for restoration of the bone stock. In fact, if destruction of the acetabular bone has occurred, it may be difficult to firmly anchor a new prosthetic cup. (18). Therefore structural femoral head allografts are often needed to fill the cavitary acetabular defects (19). Nevertheless, although accurate and valid, this procedure may be time-consuming, may cause significant amount of blood loss, and in addition, impacted morcellized bone-grafts must be protected for some time from load bearing, often by means of an acetabular reinforcement ring. All these features should be avoided in elderly patients, since they need a quick surgical revision technique, limited blood loss and rapid full weight-bearing. The decision to leave the primary verticalized cup in place, after its stability has been carefully evaluated by the surgeon, avoids important blood loss and shortens surgical times, therefore decreasing the risk of onset of pneumonias, ARDS (Acute Respiratory Distress Syndrome), cardiovascular complications and thromboemboly, which may occur in elderly patients, as well as the tendency to develop depression under prolonged recovery times (20). Furthermore, supporting the primary cup in the two reported cases with a cemented version allowed to achieve immediate rigid fixation of the new polyethylene acetabular component. This allows to walk at an early stage with a 100% load by the second post-operative day (21), another aspect of utmost importance in elderly patients. The "Wall-Socket" technique shows the same advantages as the "Double-Socket" technique, namely a procedural simplicity with reduced surgical morbidity and a significant saving in bone-stock (4). In our opinion, this makes up for the disadvantages, namely the limited ability of changing liner orientation and the creation of two new interfaces (one between the

shell and the cement and the other one between the cement and the liner) (4). In fact the proposed method does not require the presence of a correctly positioned prosthetic cup/shell that is used in the same way as in the "Double-Socket" method. On the contrary the original cup is adopted as a stable support "wall" in DeLee and Charnley's zone 3 (22), an acetabular X-ray sector notoriously subject to damaging tensile forces due to the pelvis bending on the femur, which may cause loosening of the original cup (and probably also the loosening of a new acetabular revision cup). An entire double interface between both the cup-cement and the cement-liner interfaces is not present, which could increase the possibility of component mobilisation, but only a partial double interface is present which is represented by the acetabular surface occupied by the cephalad rotated original cup. Due to the specific configuration of the primary cup (Fig. 7), the cement acquires an anti-rotational and asymmetrical morphology and tends to further stabilise this cup, to the point that it acts as a non-protruding and non-detachable "wall" (Fig. 8). The primary cup thus becomes an additional fastening element, returning partially to the single bone-cement interface, represented by the bony acetabular area covered the cement plus the new polyethylene cup. The first case previously described indicates the usefulness and effectiveness of the proposed method, due to the young age of the patient (namely the revised hip is frequently used)

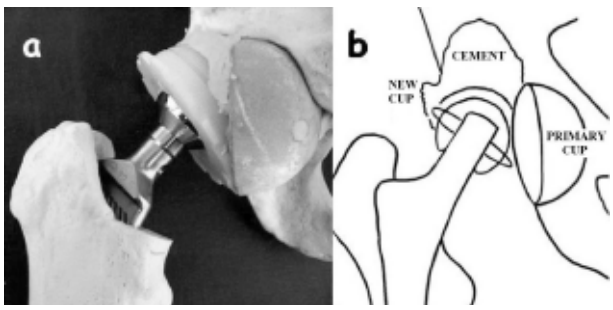

Figure 7. Sawbone model (a) and schematic rendering (b) of the "Wall-Socket" technique. The primary cup/shell, further stabilized with the cement, acts as a "wall" in the DeLee and Charnley's zone 3. The presence of the primary cup does not prevent from inserting a second, new cemented polyethylene cup alongside, oriented according to the required tilt and anteversion parameters

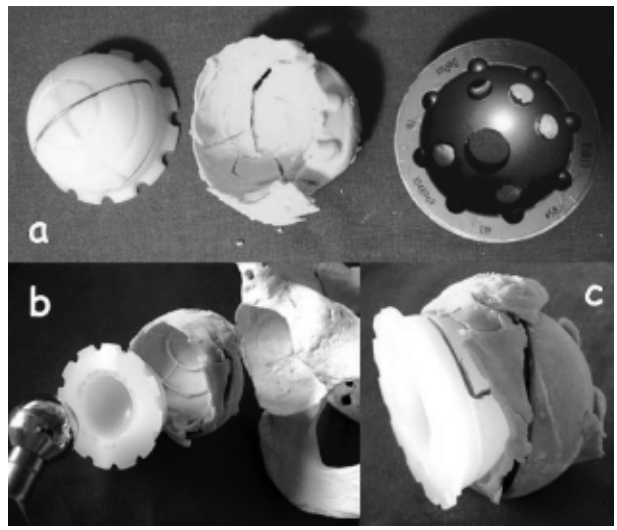

Figure 8. The elements of the "monoblock" (made of the new polyethylene cup plus the new cement and the primary cup/shell) are observed both in a distinctly separated manner (a and b) and in an assembled way (c). The cemented block takes an asymmetrical form that guarantees greater protection against rotational forces acting on the new polyethylene cup. Moreover the new cement allows the primary cup to become an additional fastening element that works as a "support wall" in DeLee and Charnley's zone 3

and also due to his significant body weight (namely the revised hip is subject to considerable load). The key point of the technique is to check the stability of the original cup that some authors carry out applying direct pressure to the edges of the socket in four quadrants by means of a metallic pusher (4, 23). Consequently, the stability of the primary cup was also very high, as evidenced by its resistance to the maximum pressure exerted on the rim of the acetabular component, that was manually carried out by the surgeon with a hammer instead of using only a metallic pusher and through a traction exerted onto the rim of the acetabular component by mean of a wire holding forcep. The subsequent revision procedure with a new cemented polyethylene cup was found to last for a reasonably long time, considering the young age and the considerable body weight of the patient. This should be weighed against the recommendation to prefer a cementless implant in the revision of the cup (24), therefore carrying out the revision by removing the original cup. In the opinion of the author, the "Wall-Socket" technique may be interpreted as an "inverted

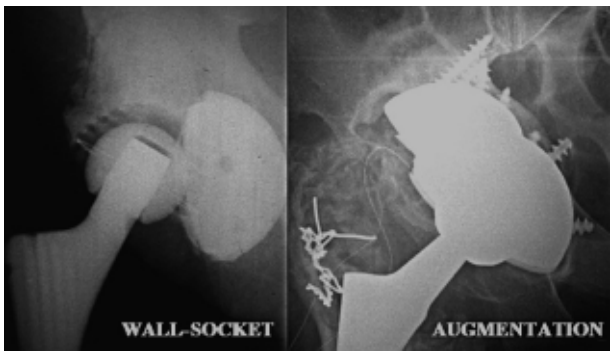

Figure 9. X-rays of a patient treated with the "Wall-Socket" technique (on the left) and of a patient treated with an Artificial Trabecular Metal Acetabular Augment (on the right). The "Wall-Socket" technique could be interpreted as an "Inverted Augment" located in DeLee and Charnley's zone 3. Instead of an Acetabular Augment, the forces that primary prosthetic socket of the "Wall-Socket" is subjected to, are tensile instead of compressive ones

augment" that is located in DeLee and Charnley's zone 3 instead of DeLee and Charnley's zone 1 (Fig. 9). Thus, whereas the acetabular augment acts as a scaffold subject to compressive forces, allowing the bone to grow along it, the maintained original prosthetic socket acts as an augment in an acetabular district that is subject to tensile forces rather than to compressive ones. We think that in the light of the peculiar features previously illustrated, this cup revision technique should be recommended for elderly patients.

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