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Case Report

Usual and Original Treatment of Cup Instability in Hip Revision Surgery

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Abstract

The objectives of a complex revision hip replacement are to restore the pelvic bone stock as much as possible and to achieve the maximum possible joint stability of the cup implant. The bone loss in revision THAs is always a challenge for orthopaedic surgeons, especially in case of pelvic discontinuity. Therefore, a preoperative planning, larger or custom-made acetabular components and top-quality bores are necessary in complex acetabular defects. Nevertheless, this can alter the hip rotation centre and biomechanics, causing failure of the gluteal muscles and increased risk of dislocation between the components due to impingement. In this paper, we describe a case of multiple revisions, stabilised thanks to an original and unusual solution that, for now, has proved to be effective and accepted by the elderly patient. This has implications for the rehabilitation of these patients after surgery too.

Keywords: *Hip Revision; Bone Graft; Reconstructive Surgical Procedure*

Introduction

The surgical solutions and prostheses used in revision hip replacement are different, and they are to be chosen on the basis of the residual bone stock from the previous (primary or revision) implant [1]. Reduction or disruption of the quadrilateral plate, intrapelvic and/or intrailiac protrusion, excessive enlargement with loss of the anterior and/or posterior wall are the intraoperative data to take into consideration in order to provide mechanical and anatomical accuracy, stability and functionality [2] to the revised hip. For the loss of femoral bone mass and for muscle-tendon and fascial formations, the problem is easier to solve. The experience of the surgeon in complex revisions is crucial to the ability to assess the acetabular bone damage and to choose the best solution. Sometimes, in multiple revisions, the x-ray of the reimplanted prosthesis can appear original and inusual: it is the result of a difficult and unpredictable intraoperative path, even after an accurate preoperative planning. In this paper, we describe the case of an uncommon and original surgical choice for a patient who had already undergone multiple complex revisions.

Case Report

The patient, an 80-year-old woman, underwent hip replacement surgery for avascular necrosis of the femoral head at the age of 54.13 years later, due to mobilisation of the cup and Paprosky type 3B acetabular defect (pelvic discontinuity, anterior wall defect and iliac enlargement) [3], the first cup revision was carried out, using Ganz reinforcement ring, cemented Müller straight stem and heterologous massive equine-derived bone graft. After the surgery, the patient started walking again with two sticks and then with one, without pain and with functional autonomy.

18 months after the first revision, getting up from the chair, the prosthesis dislocated and was treated non-surgically, with hip brace, for 4 months, with subsequent resumption of walking and daily life without pain.

One year later, due to the mobilisation of the acetabular construct, the second cup revision was carried out, with tantalum augmentation (Zimmer), reinforcement ring, screws and dual-mobility cup (Smith and Nephew). The patient has a functional and walking recovery with one support without pain within two months, with the well-being that lasts for 7 years.

After 7 years of apparent well-being, pain, functional limitation and an infectious state appear for which the 3 revision is performed; the third cup revision was carried out because of a periprosthetic infection, with explantation and use of antibiotic loaded PMMA phantom (stage 1). The phantom removed after 4 months (stage 2) for the simultaneous implant, in the large acetabular cavity, of two non-cemented Trilogy cups (Zimmer), with screws, polyethylene inserts and MegaSystem-C femoral stem with a 28 - 3.5 mm head (Link) (Figure 1).

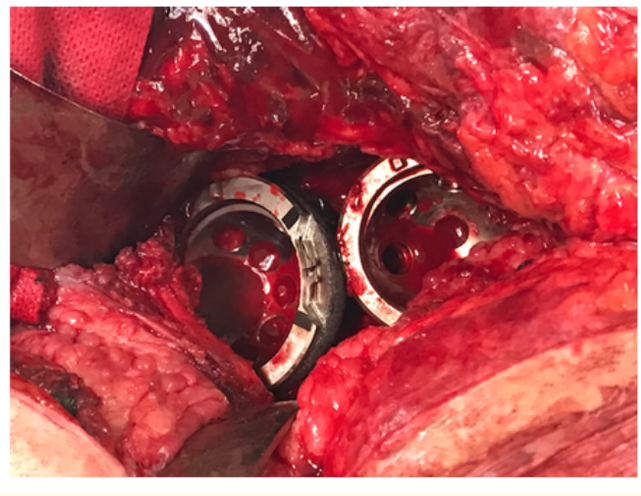

Figure 1: *Implantation of the two overlapping cups.*

In the postoperative period, a non-traumatic dislocation was treated with reduction and brace and with functional recovery and walking with one support (Figure 2). After one year of complete well-being, following another dislocation not bloodlessly resolved, the patient underwent the fourth cup revision, with retention insert (Zimmer) and reorientation of the retention ring (at 9 and 3 o'clock).

Figure 2: *X-ray after implantation of the two overlapping cups.*

After six months a new pseudo-dislocation, with head migration in the upper acetabulum, occurred after 6 months. The fifth cup revision was carried out repositioning the retention insert, modifying the orientation of the ring, fixed at 7 and 1 o'clock, with a 28+0 mm head.

After 3 months, during the rehabilitation it happens a new dislocation with prosthetic head migration in the upper acetabulum occurred, with evident hypometria of the lower limb, accepted by the patient despite the severe functional limitation (Figure 3).

Figure 3: *X-ray after dislocation and lodging in the proximal cup.*

In the next months hypometria got worse over time because of an increase in the intrailiac migration, with a 7 mm shortening of the lower limb. After about 9 months, we proceed with the sixth revision of the implant; for the acetabular side the sixth cup revision was carried out: as regards the acetabulum, the retention insert was substituted with a dual-mobility acetabular cup (Mathys), cemented in the shell of the previous implant; as regards the femur, the modular stem (Link) was repositioned to reduce the anteversion and increase the limb length by 10 mm. Recovery after the 6 surgery was more difficult, also due to an incomplete paresis of the SPE, which resolved spontaneously after one month. Currently the patient has a compensated hypometry of 2 cm, walks with two supports and, after a very complex surgical procedure, carries out her home activities with the help of a caregiver.

Discussion

In prosthesis revisions, the main objective is the achievement of the maximum primary mechanical stability, with osteometabolic conditions that are compromised both in terms of quantity (bone loss) and quality (osteoporosis). Both technical (with revision or custom-made components) and metabolic (growth factors, mesenchymal cells, autologous or homologous grafts, acrylic cement) solutions are searched for in the revision [4]. Despite all the possible solutions, the secondary biological stability of the bone is unpredictable, because of the micro- or macro-movements of the components, which can cause dislocations or load instability, and the limited function of the muscles. Indeed, in the case described above, the repeated postero-lateral and direct-lateral approaches, together with the resorption of the proximal femoral metaphysis, have weakened the gluteal and external rotation muscles, to the benefit of the abductor and flexor muscles [5]. In the presence of a Paprosky type 3B acetabular bone loss [3], the literature refers to jumbo cups, cement, bone grafts, mixed solutions [6,7] or, for example, 3D printed titanium alloy trabecular cups and pads, that have good bio-identity, so that the cells are easy to

attach and grow on the surface of the prosthesis, which is beneficial to the osteogenic differentiation of stem cells. In this study, 3D printed titanium alloy trabecular metal cups and pads were used to repair the hip joint [8]. The acetabular filling was our surgical choice, using, in the post-infection two-stage revision, two overlapping components made of tantalum, that is easier to adapt and attach to the bone. The second cup was chosen to create a covering, provide an immediate stability and allow an early load bearing; the tantalum grip was used to anchor the lower acetabulum, the main one, to a quantitatively and qualitatively unstable bone, stabilising the upper part with perimeter screws and cement, in the impossibility to use a dual mobility insert [9,10]. For an 80 years old patient affected by severe osteoporosis, who had undergone multiple revisions, the positioning of the two adjacent cups represented a real vertical filling, stable and lightweight, with the possibility of an early load bearing, after 2 days. The different dislocations have marked the surgical steps for the patient, who was used to these complications because of the severe lack of gluteal muscles and for the important mechanical lever represented by the tumour resection stem. The retention rings, associated with the TMT acetabular component in the last two revisions, did not provide guarantees for stability over time [11]. Our choice was valid and a guarantee of mechanical stability and immediate loading. The retention inserts (Zimmer), with orientation of the ring from 9 and 3 o'clock to 7 and 1 o'clock, and the use of a longer head, to reduce the conflict with the neck of the stem, did not prevent a further dislocation while sitting, 15 months after the two respective revisions [12]. After the two dislocations, the stem migrated in the upper cup, which turned out to be the most stable refuge. The torsions of the lower limb, cause of the dislocations, were of such an extent to overcome the retentive effect of the polyethylene inserts and to intensify the displacement effect of the head by the tumour resection stem. However, the dislocation did not compromise the stability of the two acetabular cups, which remained attached *in situ*. The lack of muscles, due to the multiple revisions, represented the cause of joint instability [5]. The additional upper cup has allowed the vicarious accommodation of the prosthesis head and it is a guarantee for the patient, who got used to the shortening.

Conclusion

In conclusion, the technical choice made for an elderly, complex patient affected by osteoporosis, who underwent multiple revisions, was improvised but dictated by the severe bone loss and, in similar circumstances, it can be considered a spare surgical solution. A further 42 mm shell, cemented, with a 40 mm internal diameter, was implanted in the 52 mm metal shell, properly osseointegrated. This has allowed a reorientation of the new acetabulum in neutral position, the repositioning of the modular stem at a 0° neutral position and the use of a 22 mm head. The clinical result of this last surgical procedure is, at present, very good.

Each surgical revision was followed by rehabilitation for walking, recovery of joint movement and muscle tone. The first three episodes of dislocation were treated bloodlessly with reduction in narcosis and application of a temporary brace and rehabilitation. The fourth episode required surgical revision of the implant with subsequent rehabilitation. The fifth episode of dislocation-migration in the upper cup required revision with repositioning of the head in the lower cup. The sixth and final episode of dislocation-migration in the upper cup led to the last revision of the implant. No subsequent surgery was necessary; the patient assisted by a caregiver lives at home but is autonomous with two supports and is satisfied with the current functional result.

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