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REVISION HIP ARTHROPLASTY AFTER ACETABULAR CUP PROTRUSION

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Abstract: *Acetabular protrusion after total hip arthroplasty is considered to be produced by an acetabular defect resulting from the displacement of the acetabular cup medially. The most frequent cause, a fractured medial wall, can lead to important impediments in performing revision total hip arthroplasty (RTHA). When it comes to an anterior hip replacement that requires revision, it may need a different approach. This case suggests an intersting alternative in the management of these rare and problematic pathologies.*

We would like to present the case of an acetabular fracture with a protrusion at the level of the acetabulum in a 52-year-old patient following a falling trauma from the same level and which presented itself one year after the trauma. The surgical intervention consisted in extracting the acetabular cup and reaming the acetabular fossa, filling the remaining defect with bone graft and bone cement, and then applying a semi-retentive cemented cup. The recovery was complete and uneventful. Thus, although it is known that acetabular protrusion can occur in rarer cases in people with a total hip prosthesis, we want to increase attention to this complication. A thorough initial assessment must be performed to identify the patients who may require stabilization of the pelvic ring.

Key words: *acetabular cup protrusion, total hip prosthesis, intrapelvic migration, case report.*

1. Introduction

The acetabular protrusion is considered to be produced by an acetabular defect resulting from the displacement of the acetabular cup medially. From an etiological point of view, the condition can be primary or secondary. The idiopathic form, also known as Otto pelvis, affects the female sex more, manifesting at young

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ages with a preponderance in both hips. The secondary type may appear as a result of underlying pathologies. Among the most important we can list bacterial infections (gonococcal, streptococcal, staphylococcal, parasitic), inflammatory conditions (rheumatoid arthritis, spondylo-arthropathies, primary chondrolysis), metabolic conditions (Paget's disease, osteomalacia, hyperparathyroidism), genetic conditions (Marfan syndrome, Ehler Danlos syndrome, trisomy 18, Stickler syndrome, osteogenesis imperfecta, homocystinuria, sickle cell disease), neoplastic conditions (hemangioma, metastases or radio-induced osteonecrosis) and, last but not least, trauma. On the anteroposterior (AP) radiograph, the femoral head can be seen to be located medially to the Köhler ilioischial line.

A particular dramatic situation is the occurrence of acetabular protrusion after total hip arthroplasty through medial wall fracture. The fractured medial wall can lead to important impediments in performing revision total hip arthroplasty (RTHA).

This carries an increased risk of injury to visceral organs, blood vessels and nerve structures adjacent to the displaced acetabular component. It requires skill to deal with the anatomical impact on vital anatomic structures within the pelvis, such as the iliac artery and femoral nerve. Due to bone loss, anatomical markers can be absent or difficult to locate, which may lead to challenging surgical reconstruction. When it comes to an anterior hip replacement that requires revision, there may be additional impediments to restoring the function of the prosthesis and the stabilization of the joint. The most used approaches for acetabular fixation are Letournel`s ilioinguinal approach, the iliofemoral approach (variation of Smith Peterson approach) and the intrapelvic approach.

Some authors have described reconstruction methods of the acetabular fossa to find a solution in such situations. These methods are the Ganz reinforcing ring [1] and the modular reconstruction stem femoral prosthesis [2]. There are also additional techniques such as the use of a bone graft [3], the use of cemented coxo-femoral structures or the artificial replacement of the acetabulum [4].

Periprosthetic fractures of the acetabulum have a large spectrum, from unstable and acute to chronic fractures. Each variant necessitates a personalized method of treatment, based on the type of fracture and the experience and skills of the surgeons. A traumatic unstable fracture requires complex techniques performed by well-prepared surgeons. For treating this kind of fracture, it may be used impaction bone grafting, posterior column plating, bicolumnar fixation etc. On the other hand, undisplaced and stable fractures may benefit from more conservative handling. The orthopaedic surgeon waits until the columns unite and, after a thorough examination, RTHA is performed if the acetabular component becomes loose.

That is why we want to present this case to come up with an interesting alternative in the management of these interesting and problematic pathologies. All methods performed in this study took ethical measures into account. For the publication of this paper, confidential images and written informed consent was given by the patient.

2. Detailed Case Description

A 52-year-old patient with right THA, weight 110 kg, height 1.80 m, presents to the hospital, complaining of pain in the right hip and total functional impotence in the right lower limb, following an accidental fall from at the same level by sliding.

The patient underwent three surgeries in the last 4 years on the right hip because of avascular necrosis. After two drilling attempts, THA is chosen as the best treatment option. Furthermore, the patient's medical history shows relevant other diagnoses such as diabetes, obesity, dyslipidemia and high blood pressure. Radiographic images reported an acetabular protrusion of the prosthesis cup with a fracture of the acetabulum and mobilization of the prosthesis (Fig. 1-2).

Fig. 1. *Made on 08.05.2015. Avascular necrosis at the level of the right femoral head. Drilling at this level*

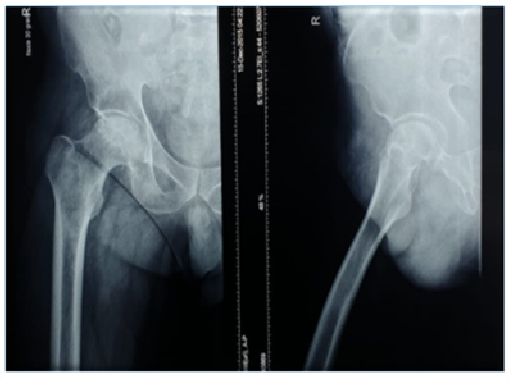

Fig. 2. *Made on 15.12.2015. Repetition of drilling at the level of the head and right femoral neck .*

After thorough anamnesis, the patient admits that approximately 1 year before presenting to our clinic suffered a fall from the same level by slipping. The pain in the right hip and functional impotence of the right lower limb has been persistent and aggravating after the fall until the moment of presentation (Fig. 3-4).

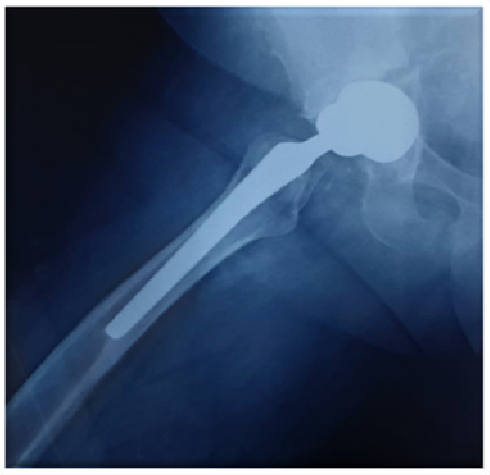

Fig. 3. *Made on 12.11.2020. Right acetabular fracture with dislocation of the acetabular cup*

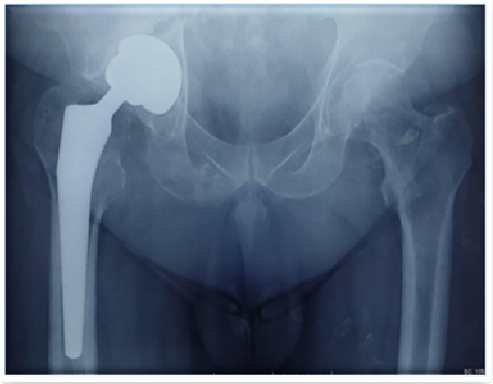

Fig. 4. *Right acetabular fracture with dislocation of the acetabular cup.*

The clinical examination reports a shortening of the right lower limb of approximately 4 cm with external rotation and joint swelling of the right hip. Radiographic images show a protrusion of the acetabular cup with acetabular fracture and mobilization of the prosthesis.

Surgical intervention is decided to restore the functionality of the right coxo-femoral joint. After general anaesthesia, the patient is placed in a supine position with the right hip slightly rotated superiorly. Through the modified Hardinge-type lateral approach, the right acetabulum is penetrated and a dislocation of the femoral head and a protrusion of the acetabular cup are identified. The acetabular cup is extracted, and the acetabular fossa is reamed, filling the remaining defect with bone graft in the depth of the medial wall, while bone cement is added to fill the remaining space. The aim of this combination of bone graft and cement is to apply the semi-retentive cup in an anatomic position and to maintain the centre of rotation. The choice of using cemented cup has been made because of the low bone quality at the level of acetabulum. The dislocation was reduced and the suture was performed in the anatomical planes (Fig. 5-6).

Fig. *5. X-ray taken postoperatively on 04.06.2021 . Total hip reconstruction after acetabular cup protrusion.*

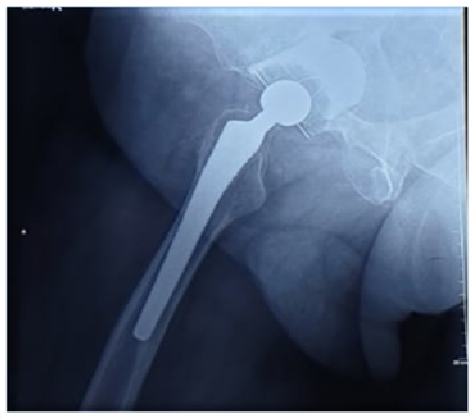

Fig. 6. *X-ray taken on 08.05.2022 , approximately 1 year and 6 months postoperatively*

Postoperative radiographic images reported proper fixation of the cup and bony stabilization of the acetabulum, which is why the patient was encouraged to walk (with the aid of a walking frame) from the first postoperative day.

The radiographic control image taken at three months shows us the same good stabilization of the cup and acetabulum and the patient is encouraged to continue a normal life. After the radiographic check-up carried out one year later, no changes can be detected, everything being the same as on the first postoperative day, with the patient having a normal life without any deficit in the lower limbs.

3. Discussions

Total hip arthroplasty is used with increasing success worldwide. The various materials used have the role of prolonging the survival of the prosthetic components while increasing human life expectancy. Materials used in hip arthroplasty procedures are increasingly using the ceramic head and ceramic liner. By using this procedure, it has been shown that the survival of the prosthetic can be increased, and the wear of the implant is reduced while the onset of osteolysis can be delayed.

The acrylic polymer polymethyl methacrylate (PMMA) has been widely used for THR since the late 1950s. PMMA is obtained by mixing liquid methyl methacrylate (MMA) monomer with PMMA and MMA-styrene copolymer powder. The powder also contains an initiator (benzoyl peroxide), a radio-opaque agent (barium sulfate) and antibiotics. The liquid includes an activator (dimethylparatoluidine), an inhibitor (hydroquinone) and a monomer. As the powdered polymer dissolves into the monomer, the initiator reacts with the activator to form free radicals. They break the C double C covalent bonds of the monomer, allowing them to bind into chains or polymers. There are four stages: mixing stages, waiting stage, working stage and curing stage.

Normally cement does not have adhesive properties, but instead, as a result of its viscoelastic properties, PMMA acts as a dynamic cement, filling the implant/host gap, and provides stability and facilitates load transfer from the implant to the bone. Successful use of cement is achieved due to cement/bone interdigitation and establishment of mechanical interlocking with cancellous bone, which is essential for primary stability, implant longevity, and to prevent bone resorption [5].

The purpose of using this procedure was to achieve a solid mechanical interlock with a wide area of fixation between the cement and the host bone.

After the preparation of the acetabular bone surface followed the preparation of the cement. Three mixes of 40 g were sufficient. The curing time was 8- 10 minutes. While mixing the cement, a small amount of bone reaming can be collected on the floor of the acetabulum and pushed under the transverse acetabular ligament to reduce cement leakage. When the cement is in the working phase and ready for insertion, the acetabulum is filled with cement by applying a constant pressure strong enough to overcome the resistance to the flow of the cement through the cancellous bone and to resist the forces of capillary blood pressure that displace it. Once the cement has begun to set, the pressurizer is removed, and the surface of the cement is dried for cup insertion. The cup is inserted at approximately 20° of anteversion and in a slightly overclosed position. Extruded cement is removed from the periphery while constant light axial pressure is applied. The final position of the cup can

be adjusted until the cement has completely hardened. Care must be taken to ensure that the edge of the component is flush with the edge of the acetabulum, excluding osteophytes. This would lead to a lateralization or medialization of the alveolus, which would not be right. This would lead to an increase in joint reaction force and reduce superolateral support, resulting in exposure of the cementum to increased shear forces leading to a risk of early failure.

Accidents and THA at a young age, as in our case, are the main cause of protrusion [6],[7]. Other causes include obesity, sepsis, rheumatoid arthritis, material wear, repeated revisions, and low bone density.

The protrusion of a coxo-femoral prosthesis is a rare and difficult surgical problem as the reconstruction of the articulation should take into consideration also the healing and stability of the fracture, among factors to consider for RTHA. An extensive approach is frequently used to stabilize the acetabulum. Few cases present partial consolidation of the fracture at the moment of presentation. These are the patients who wait for a long time before coming to the hospital. For them, the classic approach (e.g. Hardinge lateral approach) may be considered. Thus, in the case of our patient, we proceeded to choose a semi-retentive cemented prosthesis through a modified Hardinge type lateral approach.

All this requires the use of multiple strategies to control the occurrence of displacement of adjacent components. The initial examination should be done by three-dimensional imaging to evaluate the bone and infection should not be present. Many authors insist on the importance of positioning the centre of the new articulation as close as possible to the centre of the original acetabulum. We also proceeded in this way, we believe it is a good approach, with spectacular results.

Ranawat found prosthetic implant damage in 16 of 17 cases where the centre of the neo-joint was more than 1 cm medially from the centre of the original joint [8]. This conclusion was independently reached by Gates and Bayley [9], [10].

After THA complicated with acetabular fracture and protrusion, restoration of the joint is difficult because of the modified anatomy of the acetabulum and the fracture`s impact on the stability of the region. Regarding the filling of the defect between the acetabular component and the acetabular wall, MacCollum considered the use of a morcellated bone graft to be effective, leading to the lateral placement of the cup in a position as close as possible to the anatomical one. Moreover, it increases the bone capital of the acetabular [11], [12]. Rosenberg et al used this technique for patients with rheumatoid arthritis, obtaining great results [13]. Ranawat and Zahn in a study of 27 cases postulate the use of bone graft only in cases with protrusion over 5 mm with minimal bony deficiency of the medial cotyloid wall and the addition of a fixation device (e.g. ring) when this deficiency is important [14]. In cases with protrusion below 5 mm, these authors did not use a bone graft.

The particularity of this case is given by the way the patient has been managed, taking into consideration all the factors as bone displacement of more than 5mm medially and the local stability altered by the fracture. Furthermore, the degradation of the bone that occurred following the implant negatively

influenced the bone quality. We succeeded to fortify the acetabulum and offer stability to the new implant by using a cemented THA with a semi-retentive cup. We positioned the cement to restore the original biomechanics as correctly as possible. Compared to the literature, we used an unchallenging technique, requiring a moderate skill level and the same amount of equipment as for the THA. Restoring the centre of rotation by cementing the acetabulum was a key factor in our case. The patient has been asked to partially bear weight, beginning on the second day after surgery, while he started walking. The follow-up of 12 months showed that the result is excellent as the patient recovered completely after the procedure.

4. Conclusions

In conclusion, this case should highlight a rare complication of THA, which can be overlooked sometimes and increased attention is necessary for the evaluation of those patients. The described method showed an efficient surgery of the reconstructed hip joint, and the final stability of the prosthesis was impeccable despite the initial pathological conditions. The case shows that acetabular protrusion can be sometimes managed without being necessary use of complex reinforcing cups for the acetabular fracture (especially for the patients who went to the hospital after some time since the fracture happened).

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