Cementation of a Dual Mobility Cup in a Fixed Uncemented Cup for the Treatment of Recurrent Dislocation. Short-term Results

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ABSTRACT

Introduction. Total hip replacement (THR) is the most successful arthroplasty to date, but it is not exempt from complications, such as prosthetic instability. Dual mobility (DM) cups are a treatment option in the resolution of THR with recurrent dislocations due to instability. The objective of the study was to evaluate the results of cementing a DM component in a previous, stable uncemented cup, in a patient with recurrent dislocation undergoing revision THR. A patient with uncemented THR with distal fixation after failed osteosynthesis, who presented episodes of recurrent dislocations, was treated by revision with a cemented DM implant inside a fixed uncemented primary cup and a proximal femoral module with extended offset, preserving tension, length and reducibility of the prosthesis. Resolution of the prosthetic instability was achieved and the patient did not present any episodes of dislocation, obtaining good outcomes in the short term. The Harris Hip Score went from 4/80 preoperatively to 61/80, 73/80, and 76/80 at 3, 6, and 9 months after surgery, respectively. **Conclusion:** Cementation of a DM cup in a previously stable cup appears to be a viable option to treat and prevent instability after revision THR.

Keywords: Dual mobility, total hip replacement, recurrent dislocation.

Level of evidence: IV

Cementado de una copa de doble movilidad dentro de un cotilo no cementado fijo para el tratamiento de una luxación recurrente. Resultados a corto plazo

RESUMEN

Introducción: El reemplazo total de cadera (RTC) es la artroplastia más exitosa hasta el momento, no exenta de complicaciones, como la inestabilidad protésica. Las copas de doble movilidad (DM) constituyen una opción de tratamiento en la resolución del RTC con luxaciones recidivantes por inestabilidad. Se presenta el caso de una paciente a la que se le había practicado un RTC no cementado de fijación distal, después de una osteosíntesis fallida. Debido a que la paciente presentó episodios de luxaciones recurrentes, se decidió tratarla mediante revisión con implante de DM cementado dentro de un cotilo primario no cementado fijo y el uso de un módulo femoral proximal con offset extendido, preservando la tensión, la longitud y la reductibilidad de la prótesis. Se logró la resolución de la inestabilidad protésica y la paciente no presentó más episodios de luxación, con buenos resultados a corto plazo. El score de Harris pasó de 4/80 en el prequirúrgico a 61/80, 73/80 y 76/80 a los 3, 6 y 9 meses del posoperatorio, respectivamente. **Conclusión**: La cementación de un cotilo DM en una copa previamente bien fijada parece una opción viable para tratar y prevenir la inestabilidad después del RTC de revisión.

Palabras clave: doble movilidad, reemplazo total de cadera, luxación recurrente.

Nivel de Evidencia: IV

INTRODUCTION

Total hip replacement (THR) was described as "the operation of the century" in an article published in 2007 by the medical journal *The Lancet*[1] due to its impact on the patient's quality of life. However, this procedure is

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not exempt from possible complications that are difficult to resolve; one of them is prosthetic instability with recurrent dislocations. The incidence of dislocation after primary total hip replacement has been reported from 0.4% to 5.8%, and this rate is even higher after prosthetic revision, from 4% to 30%.[2] Dislocation has become the main reason for revision in the first year after a hip replacement.[3] Several risk factors for dislocation have been recognized, including previous surgeries, tissue damage, advanced age, neuromuscular diseases, cognitive impairment, prior instability, component malpositioning, abnormalities in the abductor apparatus, and rigid lower spine.[4,5] In patients at high risk of recurrent instability, proper management remains controversial. Although large femoral heads or constrained inserts are surgical options to manage this problem, high failure rates have been reported.[6,7]

Dual mobility (DM) cups are useful devices that allow for a large head-to-neck ratio and effective head size that increases jump distance, allowing for a greater range of motion than conventional femoral heads. Several studies have suggested the use of DM components as a tool to prevent the risk of dislocation in revision surgery, with successful results.[8,9] The risk of dislocations is significantly reduced by using a DM cup.[10] The greatest concern about this type of implant was polyethylene wear in the long-term follow-up, but recent studies concluded that polyethylene wear was comparable to standard expectations.[11]

The aim of this case report is to evaluate the short-term results of cementing a DM cup within a previously fixed uncemented cup for the treatment of recurrent dislocation.

CLINICAL CASE

We present the case of a 66-year-old woman with a history of alcoholism, hypertension and failed osteosynthesis with a cephalomedullary nail due to an intertrochanteric fracture of the right hip (AO 31-A3.1), performed in 2017 (Figure 1).

Figure 1. Osteosynthesis failure in hip fracture.

This complication was treated with a cementless total hip replacement with a modular distal fixation prosthesis in 2019 (Figure 2), due to the loss of the fixation area in the proximal femur.

Figure 2. Total cementless hip replacement with modular distal fixation prosthesis.

After this last operation, the patient presented recurrent episodes of prosthetic dislocation from the second postoperative month, a total of 4 episodes, the first 3 treated with closed reduction. In the fourth episode of dislocation, bloodless reduction was not possible (Figure 3), and the joint remained dislocated until the prosthetic revision, which was carried out 9 months after the operation. The preservation of the osseointegrated uncemented cup was verified and a dual mobility cup was cemented in it. In turn, the proximal module of the femoral component was replaced, which gave us the possibility of a greater offset–an advantage linked to the modularity of the stem–preserving the tension, length, and reducibility of the prosthesis.

Figure 3. Irreducible prosthetic dislocation. R: right.

With the first revision, the offset of the contralateral hip was reproduced and a length discrepancy of 4 mm was observed, predominantly in the operated hip. Regarding the acetabular cup, an inclination of 42.5° and an anteversion of 16.7° were found, evidenced by Liaw's method.[12] In addition, no signs of loosening were seen in any of the components (Figure 4). A rigid spine was ruled out by radiography of the lumbosacral spine with the patient standing and sitting, measuring the sacral inclination.

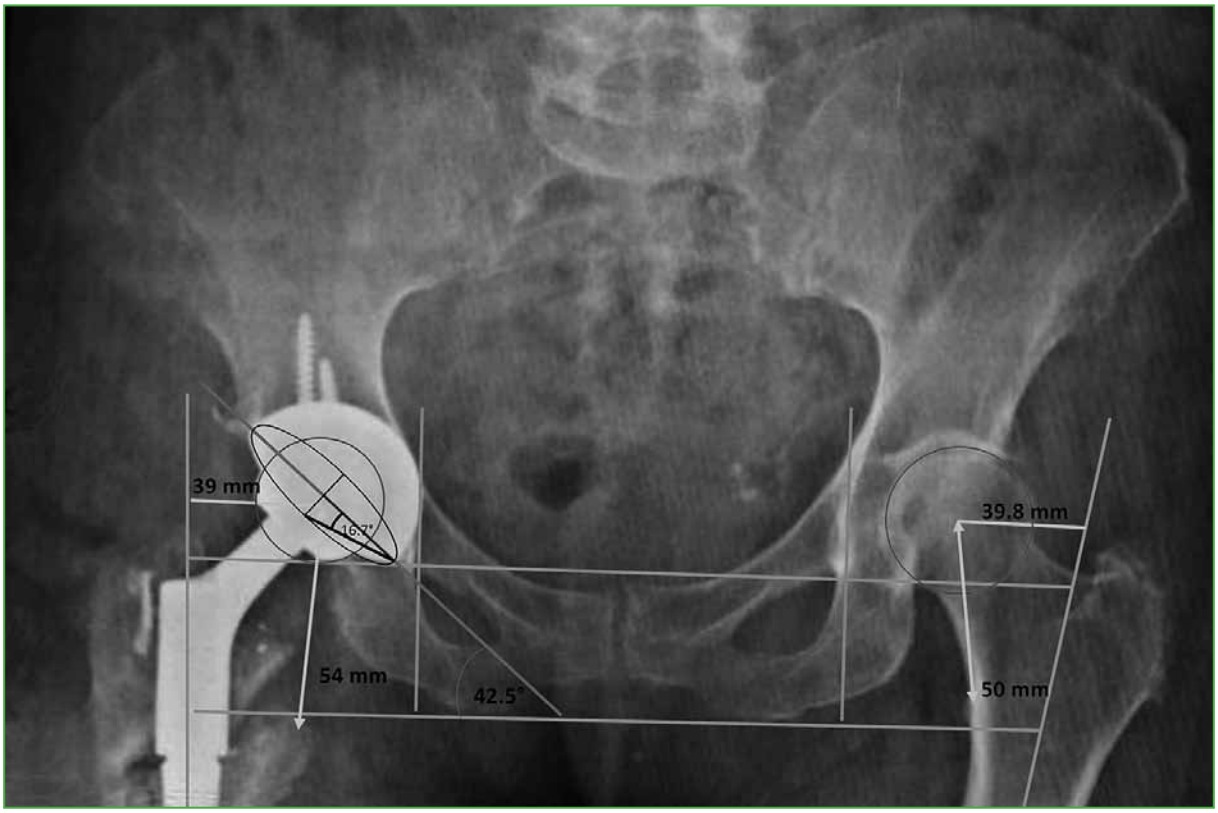

Figure 4. Preoperative radiographic analysis.

Preoperative antibiotic prophylaxis was indicated, in addition to tranexamic acid at the time of anesthetic induction and at wound closure.

With the patient under spinal anesthesia in strict left lateral decubitus, the prosthesis was accessed through a posterolateral approach to the hip and the implant is found to be dislocated. The proximal module of the femoral component was removed to increase the working field. The consolidation of the greater trochanter was confirmed intraoperatively, given that, radiologically, it showed pseudarthrosis. The polyethylene was removed from the acetabular component, verifying the correct orientation and stability of the previously implanted uncemented cup (Figure 5) and the screws were removed from the cup, to use the holes as retentions for cementation. Due to the smooth finish of the internal surface of the retained metal cover, we roughened it with a tungsten carbide bit, which increases the resistance to cemented fixation by up to 20%.[13] To prevent metal debris from remaining in the joint, the area was covered with gauzes and subsequently profusely washed.

Figure 5. Fixed uncemented cup. P proximal, D distal, PO posterior, A anterior.

A 44 mm trial cup is placed (Figure 6). It is verified that its dimensions will allow leaving 2-3 mm for the cement layer, which was previously confirmed in the pre-surgical planning (Figure 7). Cement with antibiotic (gentamicin + vancomycin) was used to reduce the probability of infection.

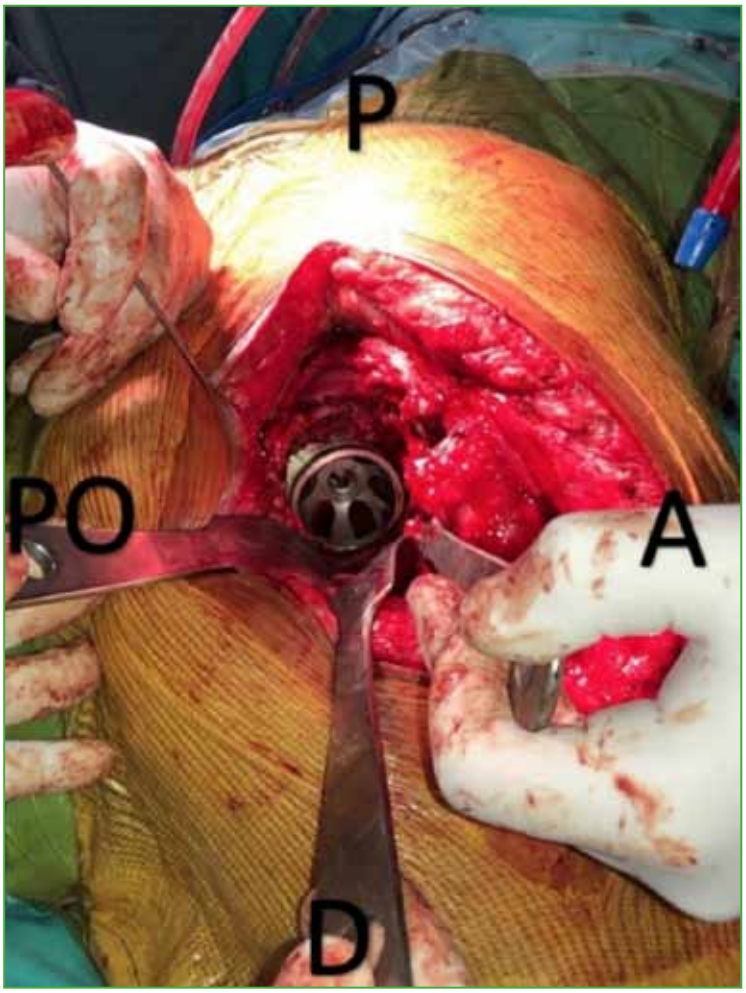

Figure 6. Trial 44mm DM cup.
P proximal, D distal, PO posterior, A anterior.

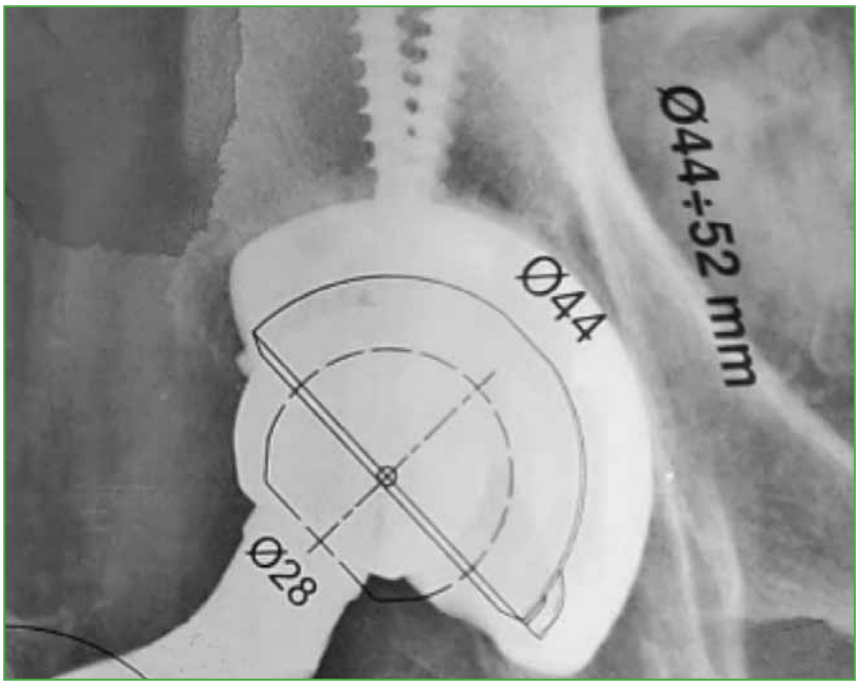

Figure 7. Radiological planning of the cup.

Its advantage is the possibility of cementing with an orientation independent from the pre-existing fixed cup. The dual mobility cemented cup was placed at the desired angle of anteversion and inclination using manual and centralized pressure, with care to prevent the component from touching the bottom of the metal cup, until the cement set.

Then, due to the acetabular extrusion generated with the new cemented component, the proximal femoral module was replaced by one of an immediately inferior length; therefore, the length of the limb was adjusted with the reduction in the size of the proximal femoral modular component and the offset was increased to optimize soft tissue tension.

Before the procedure, the stability of the components was verified by evaluating their fixation using Engh's[14] criteria and it was corroborated intraoperatively. Stability was tested with the trial components by performing flexion, extension, abduction, and rotation maneuvers.

The reduction was performed with the definitive components, the complete stability of the implant was verified. A joint drainage was left for 48 hours and the closure was carried out by planes up to the skin.

Postoperative analgesia began with ropivacaine infiltration of the wound during wound closure and continued with intravenous ketorolac in combination with oral acetaminophen. This multimodal pain management facilitates physical and rehabilitation therapy, which is essential to maintain joint range of motion, thus speeding hospital discharge and reducing the risk of deep vein thrombosis, along with the administration of enoxaparin for 30 days.

In the case described, some details that facilitated its resolution are highlighted: 1- having an osseointegrated cup of adequate size (54 mm), enough to allow the cementation of a dual mobility cup in its smallest diameter (44 mm, which could be found in the country); we were able to corroborate this during pre-surgical planning using the classic method, with real-size printed radiographs and templates of the components to be implanted; 2- preserving the uncemented cup is an advantage, because it maintains the patient's acetabular bone stock; 3- the versatility offered by a modular stem, with which the length of the proximal module could be changed (from one of 60 mm to one of 50 mm) (Figure 8); and 4- having the option of extending the offset to achieve the reduction of the prosthesis and the best tension of the abductor apparatus, without compromising the length of the limb, thus favoring prosthetic stability. Modular femoral revision components allow the surgeon to perform more precise intraoperative adjustments in anteversion and sizing, resulting in lower dislocation rates and improved stability.[15]

Figure 8. Length variability of the proximal component of the femur.

Series	Cervicodiaphyseal angle	Length
120362540	125°	40 mm
120362550	125°	50 mm
120362560	125°	60 mm
120362570	125°	70 mm
120362540	135°	40 mm
120362550	135°	50 mm
120362560	135°	60 mm
120362570	135°	70 mm

Regarding the results, the resolution of the prosthetic instability was achieved, without new episodes of dislocation to date. The patient restarted her rehabilitation with ambulation 48 hours after surgery using two Canadian crutches for 3 weeks, then she walked with a single crutch for another 3 weeks, until she achieved independent ambulation. The revision of the implant was carried out in order to corroborate the preservation of the bone stock and the correct balance of the soft tissues and the length of the affected limb (Figure 9). A 24-month follow-up was carried out and the evolution was evaluated using the modified Harris Hip score : the estimated score was 4/80 (poor result) in the preoperative period, and this changed to 61/80, 73/80 and 76 /80 at 3, 6 and 9 months after surgery, respectively, which is considered an excellent result. Regarding the level of ambulation, the functional outcome showed large changes between the pre- and postoperative evaluations. The patient walks without the need for orthopedic devices and without pain, there is no discrepancy in her limbs and she has not presented new episodes of dislocation.

Figure 9. Immediate post-surgical outcome.

In the post-surgical radiological analysis of the plate, an increase in the horizontal offset was evidenced, which went from 39 mm to 42 mm due to the use of the extended offset . This was determined by the method by Bellova et al.,[16] in which a line is drawn joining the independent centers of rotation of the uncemented cup and the DM cup. Having an independent orientation, the DM cup has a 41.3° inclination, different from the uncemented cup (42.7°), which optimizes the inclination and anteversion. Limb discrepancy was improved to a difference of only 1 mm (Figure 10). In the radiographic evaluation 24 months after the procedure, the complete consolidation of the proximal femur was evidenced and no changes were found in the inclination, anteversion and offset values, nor signs of loosening in the interface between the uncemented cup and the DM cup. Similarly, no signs of loosening were observed in any of the components (Figure 11).

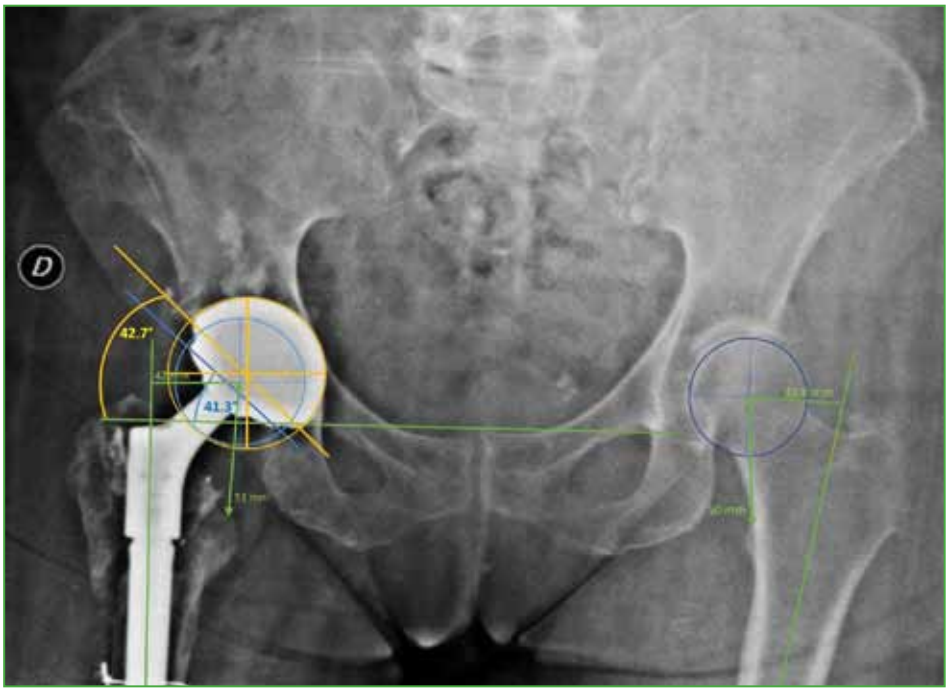

Figure 10. Postoperative radiographic evaluation.

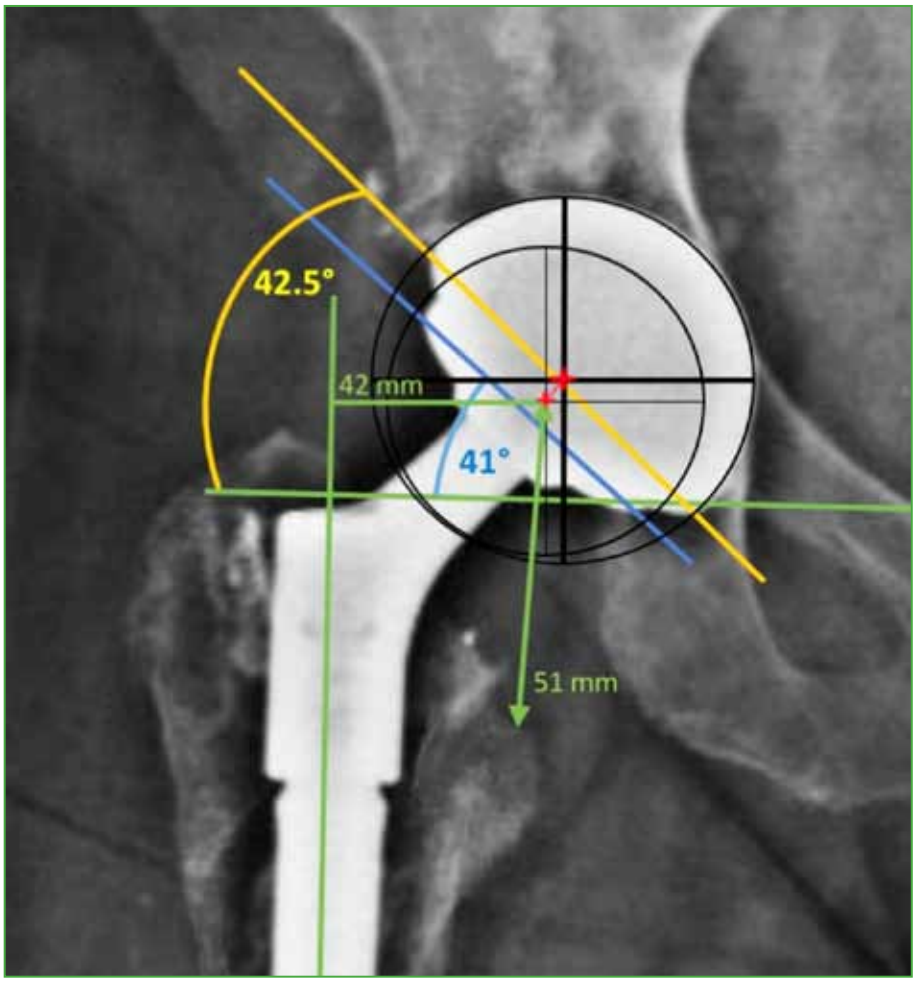

Figure 11. Radiographic evaluation 24 months after surgery.

DISCUSSION

This case report indicates that the technique of cementing a DM cup inside a fixed uncemented cup, or "cup-in-cup" technique, could be an option in cases of recurrent dislocation or high-risk patients, at least in the short term.

This technique has been proposed as an alternative to conventional revision to shorten surgical time. This is because removal of an uncemented metal component can create substantial technical challenges for the surgeon, related to disruption of a secure bone-implant interface and potential bone loss. The preservation of the uncemented cup aims to reduce blood loss, bone damage and general perioperative morbidity, which is essential in patients with high surgical risk.

Wegrzyn et al.[17] first proposed the cementation of a dual mobility cup in a well-fixed metal component with biomechanical validation of this construction. There is growing evidence in the literature of excellent results with DM systems in preventing dislocations and reinterventions after a revision THR, especially after a previously unstable THR.[18]

One of the most critical factors in achieving adequate stability after a primary or revision THR is the position of the components, especially the acetabular cup. Wera et al.[19] found that one of the most frequent etiologies was malposition of the cup and suggested revision of the acetabulum to achieve an adequate position. Rogers et al.[20] reported that stability was successfully achieved in 73% of the patients who underwent revision due to malposition of the acetabular component. In contrast, in patients with unknown causes of dislocation, the success rate was only 33%.

In a series of 355 revision THRs, Hartzler et al.[21] found a dislocation rate of 3% in patients treated with DM implants, compared to 10% in patients treated with a 40-mm femoral head. Furthermore, reoperation for any cause was less frequent in the DM cohort (6%) than in the 40mm femoral head cohort (15%).

Brüggemann et al.[22] reported a lower dislocation rate when using DM cups compared to polyethylene liners cemented in porous tantalum. Dislocation-free survival at 4 years was 99% (only 1 patient had dislocation) in the DM group, while in the polyethylene group, success was only 88%.

Another cause of dislocation is the deficiency of the abductor apparatus. When this mechanism is absent or severely deficient, DM cups may not be effective and the use of a constrained insert is generally recommended.[19]

In hip arthroplasty, revision surgeries have a large increase in morbidity and mortality and a lower success rate than primary surgeries. Recurrent dislocations are a frequent cause of prosthetic revision; in these cases, achieving the least damage, the greatest preservation of bone stock and the fastest recovery of the patient are the measures of success. Knowing the cause of the previous instability greatly facilitates surgical planning; If this information is not available, it is necessary to have a wide range of resolutions at the time of surgery.

On the other hand, it is important to consider that THR after failed internal fixation of the proximal femur is associated with a high risk of implant dislocation.[23] Failure of an extracapsular proximal femoral fracture fixation carries a higher risk of complications than that of an intracapsular fracture, with worse outcomes for salvage THR surgery, especially in terms of implant stability.[24] It is estimated that primary THRs performed as salvage against failed osteosynthesis with a cephalomedullary nail have up to twice as many postoperative dislocations compared to primary THRs (8.1% vs. 4.5%).[25]

The use of DM cups seems to be a good alternative when there is prosthetic instability. In the case presented, the proximal module of the femoral implant was modified; the offset achieved went from 39 mm to 42 mm and the change in the module made it possible to compensate for length. Furthermore, the angle of inclination achieved with the DM cup was 41.3° compared to 42.7° with the uncemented cup. This variation of 1.4° should not be considered influential in reducing the rate of dislocation. Therefore, it could be inferred that, due to its own characteristics, already referred to by other authors, the DM cup is a valid alternative for the management of prosthetic instability.

CONCLUSION

Although the follow-up of the case described is still short, the cementation of a DM cup in a previously well-fixed cup seems to be a viable option to treat and prevent instability after revision THR. In addition, the preservation of the uncemented cup is an advantage for maintaining bone stock and shortening surgical time in high-risk patients.

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