Hip arthroplasty for failed internal fixation of intertrochanteric fractures

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Abstract

Introduction: The aim of this retrospective study was to evaluate the medical-radiologic behaviour, the complications and the technical difficulties of hip replacements after DHS failed osteosyntheses in intertrochanteric hip fractures.

Materials and Methods: We analyzed 38 hip replacements in 38 patients (31 females and 7 males averaging 75.59 years of age [67-90 range]), with an average 45.5-month follow-up (16-128 range). We conducted 30 total replacements, 7 procedures using bipolar prostheses and one unconventional endoprosthesis. In 29 cases, the length of the femoral stem was standard whereas in 9 cases we used long stems. From the medical point of view we assessed the presence of pain and objectively we used the Harris' hip score. In the X-rays we analyzed the quality of the cement application (Barrack), prosthetic demarcation, prosthetic loosening, greater trochanter non-union and its complications.

Results: The postoperative average Harris' score was 79 (70-88 range). Out of the 35 cemented stems, 30 were Barrack's Class A; four, Class B, and one, Class C. We did not conduct any revision. Four cemented acetabular cups showed demarcation in zone I; one, in zones II and III; and another one, in the three zones. There were 5 cases of non-union in the greater trochanter and 3 acute infections which did well with surgical toilet and antibiotics. Three patients suffered dislocation, one of them requiring revision.

Conclusions: Failed DHS rescue by hip replacement represents a procedure with appropriate functional results, giving the patients gait proficiency back. It is a technically challenging procedure associated with high complication rates.

Key words: Intertrochanteric fracture; DHS; failed osteosynthesis; hip replacement

Level of evidence: IV

Artroplastia de cadera luego de una osteosíntesis fallida en fracturas laterales de cadera

Resumen

Introducción: El objetivo de este estudio retrospectivo fue evaluar el comportamiento clínico-radiológico, las complicaciones y las dificultades técnicas de los reemplazos de cadera luego de una osteosíntesis fallida con tornillo placa dinámico (DHS) en fracturas laterales de cadera.

Materiales y Métodos: Se analizaron 38 reemplazos de cadera en 38 pacientes (31 mujeres y 7 hombres, edad promedio 75.59 años [rango 67-90]), con un seguimiento de 45.5 meses (rango 16-128). Se realizaron 30 reemplazos totales, 7 con prótesis bipolares y uno con una endoprótesis no convencional. En 29 casos, la longitud del tallo femoral fue estándar y 9 eran largos. Clínicamente se evaluó la presencia de dolor y objetivamente se utilizó el puntaje de cadera de Harris. En las radiografías, se analizaron la calidad del cementado (Barrack), las demarcaciones protésicas, la presencia de aflojamiento, seudoartrosis del trocánter mayor y sus complicaciones.

Conflict of interests: The authors have reported none.

Resultados: El puntaje de Harris promedio posoperatorio fue de 79 (rango 70-88). De los 35 tallos cementados, 30 fueron clase A; cuatro, B y uno, C de Barrack. No hubo revisiones. Cuatro cotilos cementados presentaron demarcación en zona I; uno, en zona II y III; y otro, en las tres zonas. Hubo 5 seudoartrosis del trocánter mayor, 3 infecciones agudas que evolucionaron favorablemente con limpieza quirúrgica y antibióticos. Tres pacientes sufrieron luxaciones, uno requirió revisión.
Conclusiones: El rescate de un DHS fallido mediante un reemplazo de cadera representa un procedimiento con resultados funcionales aceptables, devuelve a los pacientes la capacidad de marcha. Es un procedimiento técnicamente demandante y se asocia a una alta tasa de complicaciones.

Palabras clave: Fractura intertrocantérica; DHS; osteosíntesis fallida; reemplazo de cadera.
Nivel de Evidencia: IV

Introduction

Intertrochanteric fractures represent one of the most frequent lesions in the proximal femur. Approximately nine out of 10 fractures occur in >65-year old patients, and three out of four occur in women.[1,2]

Most of these fractures can be successfully treated with cephalomedullary nails or with dynamic hip screws (DHS); however, a reported percentage between 3 and 12%[3-5] and up to 56% of the cases[6] may not do favourably, due to the lesion pattern, comminution, insufficient fixation, mistakes in the selection or insertion of the implant or due to poor bone quality.[7-9]

Depending on the characteristics of the patient, after failed osteosynthesis the treatment options for this sequela are revision to new osteosynthesis for those young patients with good bone quality who show a viable femoral head to fix the new osteosynthesis with or without augmentation, osteoarthritic or non-acetabular damage and the fracture pattern[10-12] or, in elder patients with decreased bone stock, THR (total hip replacement) is to be used as a rescue precedure.[10-15]

Kligman et al.[14] reported high incidence of intraoperative and postoperative complications, which include periprosthetic fracture, infection and mechanical loosening in 16 patients treated with THR after failed osteosynthesis. Zhang et al.[15] conclude that these rescue procedures result technically demanding and are associated with high complication rates too.

At the time of the preoperative planning of a THR, diverse issues should be taken into account, apart from the presence of the osteosynthesis material, such as the deformity of the proximal femur—in general varum deformity, the loss of bone stock and bone quality, the type of prosthetic fixation to be used, the length of the femoral stem, the patient's physical demands and the presence of osteoarthritis or acetabular damage.[16]

The aim of this retrospective study was to evaluate the medical-radiologic results, the complications and the technical details in hip replacement as rescue procedure in intertrochanteric hip fractures treated with failed DHS techniques.

Materials and Methods

Between August 1997 and December 2012, at our Centre, we carried out 101 THRs in patients with failed osteosynthesis.

The inclusion criteria were: 1) patients subject to hip replacement after failed osteosynthesis, 2) DHS failed osteosynthesis, 3) original intertrochanteric hip fracture, and 4) a minimal follow-up of 16 months.

At the end of the study, we had to exclude three patients from the analysis: two of them had not had minimal follow-up and one patient had undergone arthroplasty due to osteoarthritis stemming from osteosynthesis.

The series included 38 hip replacements in 38 patients; 31 were females and seven, men, averaging 75.79 years of age (ranging from 69 to 90) with a 45.5-month follow-up (ranging from 16 to 128). The average time between primary fixation and arthroplasty was 9.69 months (ranging from 1 to 38).

Twelve of the original fractures were treated at our Centre, whereas the other 26 were referred to our institution from somewhere else. According to the Evans' classification,[17] 25 were unstable interthrocanteric hip fractures while 13 were stable fractures.

THR was prescribed due to the following causes or a combination of them: infection, failed surgical technique, non-union, loss of fixation, avascular necrosis of the femoral head, and protrusion of the cephalic screw.

Every surgery was carried out by the same surgical team, in a laminar flow operating theatre under hypotensive epidural anaesthesia. In the first three patients of the series we used the Charnley approach, whereas in the other ones we used the direct anterior-lateral approach, always in supine position. In all cases we identified the origin of the osteosynthesis material and asked the orthopaedic implant company for the necessary tools for osteosynthesis removal.

Septic failures were treated in two times by a cement spacer with antibiotics. In those cases in which there was aseptic failure, the osteosynthesis was removed during the same surgical procedure as hip replacement was conducted. This was after joint dislocation in the cases of bone

healing or those of good anchorage of the cephalic screw, whereas in the remaining cases, we first removed the plate and then the head and the cephalic screw.

We carried out 30 (79%) total hip arthroplasties: 19 (63.3%) cemented prostheses, eight (26.6%) hybrid prostheses and three (10%) non-cemented prostheses. Seven out of the remaining eight (18.4%) were cemented bipolar prostheses and there was one unconventional endoprosthesis. In nine cases (23.7%), we used long femoral stems and, in one, a tripolar acetabular cup. We made the decision of using bipolar prostheses based on the patients' physical demands, age and gait proficiency before the surgery. The use of conventional or long stems was based on the bone quality that X-rays showed at the time of preoperative planning. The only case in which we used an unconventional endoprosthesis in the proximal femoral third was that of a patient treated due to infection that had to undergo resection of the whole proximal femur and received a mega-spacer.

Femoral cement was administered retrogradely using a distal plug for pressurization. Plate holes on the outer side were occluded by hand in all cases, whereas the posterior inner holes only were occluded when they were affordable, also by hand at the time of cement application.

When there was >2.5 cm-rise in the greater trochanter we carried out wiring and we lowered the greater trochanter to fix it and give tension to the gluteal muscles.

From the medical point of view, we evaluated every patient by the data recorded in medical histories—the presence of pain, gait proficiency and the need of assistance to walk. To objectify results we used the Harris' hip score.[18]

We assessed prostheses fixation with X-rays. We classified the quality of the femoral cement application using the Barrack's criteria.[19] The presence of radiolucent lines was classified according to Gruen[20] in the femur and to DeLee and Charnley[21] in the acetabular cup. Loosening in the cemented acetabular cups was classified according to the DeLee and and Charnley's criteria,[21] and also Hodgkinson's.[22] We considered the presence of radiolucent lines in the three zones or migration as loosening of the acetabular component. For loosening of the cemented stems we used the Harris' criteria.[23] Non-cemented components were assessed using the Engh's criteria.[24] Heterotopic ossification was classified according to Brooker's.[25]

Results

Medical results

Six patients reported mild or moderate pain and required pain-killers. Thirty of them asked for assistance to walk (cane or walker), and eight patients did not require assistance. Twenty patients were able to walk outdoors and 18, indoors. The average postoperative Harris' score was 79 (ranging from 70 to 88). At the end of follow-up, five patients had passed away due to different causes unrelated to the procedure.

Radiologic results

According to the Barrack's criteria,[19] 30 out of the 35 cemented stems were Class A; four, Class B, and one of them was Class C (Figure 1). In six cases we verified cement extrusion through the inner holes of the femoral plate. Femoral demarcation according to the Gruen's zones was seen in zones 3 and 4 in one case and in zones 2, 3, 4, 6 and 7 in another one, what has to do with cement application Class C. The latter case was classified according to the Harris' criteria as possibly "loose" with no correlation with medical findings up to the patient's last follow-up.

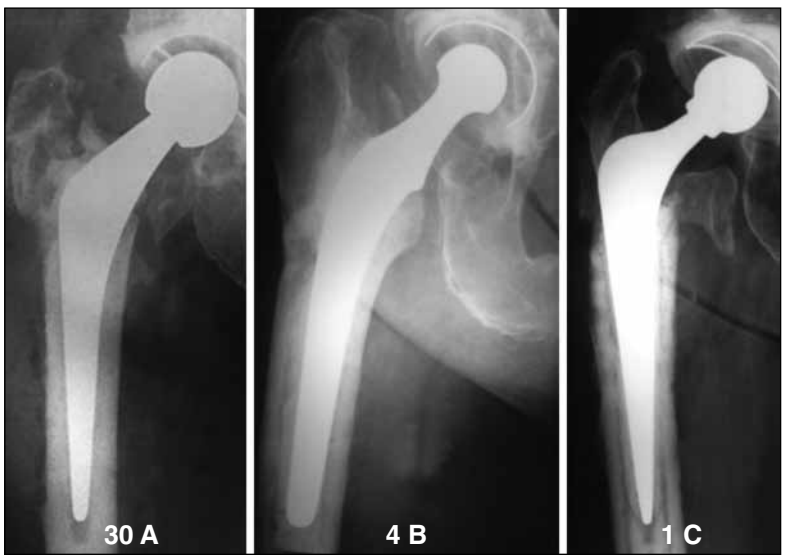

Figure 1. Postoperative check-ups—X-rays showing quality of cement application according to the Barrack's classification: Classes A, B and C. There was no case of Class D.

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As regards the behaviour of the cemented acetabular cups, two of them were considered to be poorly cemented due to the presence of a >5mm-cement mantle, with one of them projected towards the lateral side. In six cases we verified demarcation in the DeLee-Charnley's zone 1, in one of them demarcation was also seen in zone 2 and in another one, in the three zones. Although it was considered as radiologic loosening, so far this demarcation has not had medical impact.

With respect to non-cemented components, all of them have showed good bone fixation up to now.

Complications

Five (13.5%) patients showed non-union in the greater trochanter with rupture of the trochanteric wiring in two of them. In two of these cases we also verified the rise of the greater trochanter with subsequent Trendelemburg sign. One of them was the case of an 80-year old female who suffered infection after the surgery. She needed two spacers with timely surgical toilets and i.v. antibiotic treatment. At the time of the prosthetic implant, she had a major bone defect in the proximal femur which involved the whole greater trochanter and affected the continuity of the abductor system—she underwent unconventional endoprosthesis. The other patient was a 75-year old female operated on due to non-union in an unstable intertrochanteric fracture with rupture of the cephalic screw, who underwent cemented THR with no further surgical action on the greater trochanter and, in the subsequent follow-ups, she showed greater trochanter rise.

Three (7.89%) patients showed prosthetic dislocation: two of them suffered just one episode which required closed reduction and did well, whereas the other one underwent four episodes and, therefore, he was subject to prosthetic revision. It was the case of a 70 year-old male whose lower limb resulted 18 mm shorter after prosthetic implantation. We revised the acetabular component and inserted a constrained acetabular cup, while in the femoral component we carried out prosthetic head interchange using a larger one; the patient did well up to his last follow-up, 37 months after the surgery (Figure 2).

There were three acute infections (7.89%) which required surgical toilet and suitable i.v. antibiotic treatment, and did well. One patient (2.63%) underwent type I heterotopic ossification.

The whole of the aforementioned complications stands for a 23.68 percent-complications rate, a 2.63 percent-revision rate and, taking revision for any reason as end point, a prosthetic duration of 97.36%.

Discussion

During the conversion of a failed DHS into a hip replacement, there are specific technical difficulties which will have to be taken into account at the time of carrying out the procedure.[6,12,15] Apart from the osteosynthesis, the surgeon will find distortion in the proximal femur anatomy, especially when bone reduction has not been anatomic, in cases of great medial comminution or where there has been osteotomy—For example, Dimon's. The greater trochanter may be found to have undergone non-union or, in a more complex scenario, fragmentation, what increases the risk of dislocation and affects future gait proficiency. [4,6,7,16,26,27]

There will be a decrease in bone stock due to previous osteoporosis, which will add to that caused by disuse stemming from a failed treatment. Moreover, there will be weakness spots caused by the removal of the screws from the plate and by the lateral cortex thinning generated by

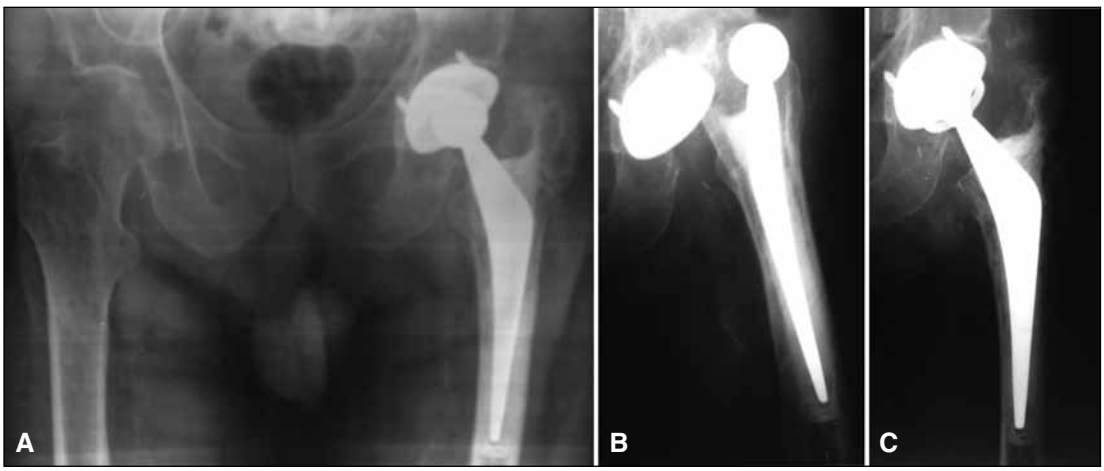

Figure 2. Patient subject to revision due to recurrent prosthetic dislocation. We inserted a larger prosthetic head and a constrained acetabular cup. **A.** There is unbalance in limbs length. **B.** Prosthetic dislocation. **C.** Check-up two years after revision.

support, which will also increase the risk of intraoperative fracture at the time of dislocating the joint. Haidukewych et al.[26] recommend removing the osteosynthesis after dislocation so as to avoid or decrease the risk of such complication. We believe that this is possible in healed fractures or in those where the cephalic screw still shows proximal anchorage, allowing the surgeon to move the proximal femur in block. Otherwise, removing the osteosynthesis by separating the proximal fragment from the distal one, and then taking out the femoral neck and head without dislocating the joint may result less risky. This technical detail is similar to that suggested by Zhang et al.[15] to decrease the incidence of greater trochanter fracture.

Understanding the deformity of the proximal femur will be key to its management for the subsequent insertion of the femoral stem so as to avoid a possible intraoperative fracture due to false passage. The surgeon will have to take into account that the opening to the medullar canal can be obliterated by remodelling, sclerosis not only related to the fracture but also to the presence of the cephalic screw.[27] It may also be projected medially or laterally by the varum or valgum deformity. Individualizing the femoral canal with a blunt tool fluoroscopically guided can simplify this step.

Although every case should be individually assessed, due to these patients' characteristic bone stock and age cemented fixation results to be the most frequently used method. In such cases, diaphyseal holes will hamper proper pressurization and, therefore, cement application quality because of extrusion, with what the stem survival will result affected. So as to avoid such events, there are several techniques reported, such as direct or digital occlusion, bone graft filling of the femoral head or the use of cortical screws which will later be removed.[15,27-29]

In our series, according to the Barrack's classification,[19] 30 out of the 35 cemented stems (85.7%) resulted to be Class A; four (11.4%), Class B, and only one (2.85%) was Class C. We did not disclose the inner holes of the femoral aspect and, therefore, three times (7.9%) cement extruded through these holes (Figure 3). We believe that maybe this percentage is low because the femur being worked on progressively with different calcar reamers results in spongy tissue somehow occluding these holes and hindering extrusion. Comparatively with the Zhang et al. series'[15] cement application in our series was appropriate—these authors reported Class C cement application in 81% of their cases. Likewise ours, these series did not show mechanical loosening to be reported at the end of follow-up. We agree with these authors in that, maybe, the low functional demand that characterizes this group of patients has protective effects in cases of suboptimal techniques of cement application.

With respect to the non-cemented stems that we used, in our series we spared them for those cases with considerable bone defects in the proximal femur, using distal fixation stems with good results in all cases. Laffosse et al.[29] and Abouelela[30] reported excellent results with this type of stems in their respective series. It is worth taking into account that the use of non-cemented implants of metaphyseal fixation might not be advisable, because such fixation system is conditioned by the type of fracture and the poor bone quality of the proximal femur, along with fracture risk due to bone weakness at the time of removing osteosynthesis.

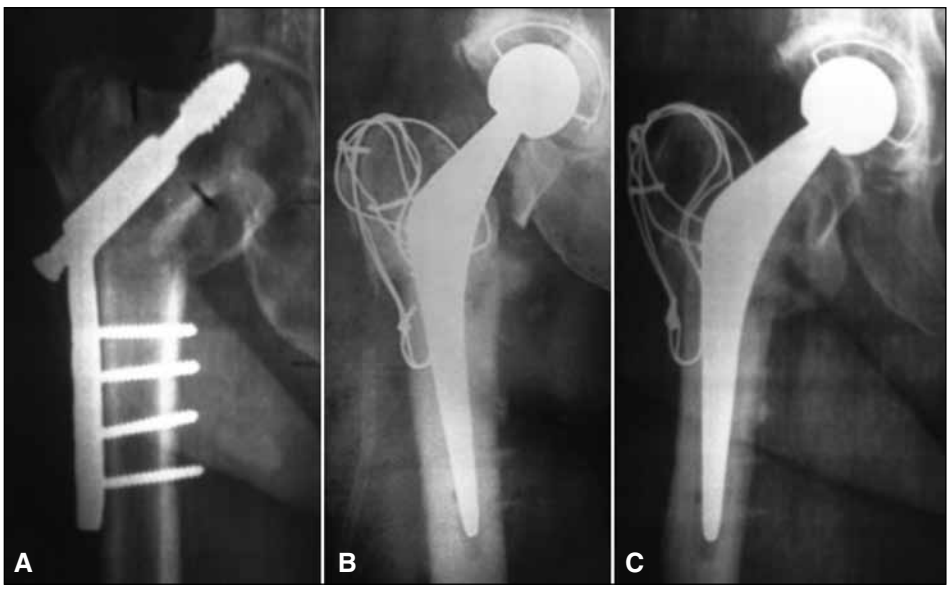

Figura 3. A. Osteosynthesis mechanical failure with varum deformity in proximal femur and cephalic screw protrusion. **B.** Cemented total hip replacement with trochanteric wiring. There is extrusion of cement through the inner cortical holes. **C.** 34-month check-up.

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Another issue worth mentioning with respect to femoral implants is their length. In these rescue procedures, the general trend is to use femoral stems that are longer than the conventional ones so as to overcome the distal holes of the removed ostesyntheses, missing such weakness zones out. Different studies have showed that defects affecting less than 20-30% of the femoral diameter do not reduce significantly their torsion resistance and, in general, the holes of the removed screws do not exceed such dimensions.[31,32] However, it is also worth mentioning that, none of such studies reports the implant of prosthetic femoral components, with what maybe stems ends nearby such weakness zones affect such resistance to a larger extent.

In our series, we used 28 conventional stems with no fracture in the distal end, results that are similar to those reported by Zhang et. al[15] and Hammad et al.[33] We used cemented long stems when we verified a Dorr C femoral canal type[34] or in those cases in which we opted for distal-fixation non-cemented stems. Analysing different series and taking the aforementioned issues into account, we conclude that the most frequent complications in this type of surgery are dislocation, periprosthetic fracture, greater trochanter non-union and infection (Table).

In our series, 13.15% of the cases showed greater trochanter non-union, a percentage that is similar to that reported by Hammad et al.[33] (12.5%) and Zhang et a.[15] (32%). These second group associates this complication's high rates with the combination of osteoporosis, weakness stemming from the opening for the DHS devices on the lateral cortex and the stress suffered by the bone during the removal of the osteosynthesis material. As an alternative to reduce this complication they suggest the removal of the plate in the first place, with dislocation of the joint and ultimate removal of the cephalic screw right from the femoral head. In our series, when we verified trochanteric detachment, we carried our trochanteric wiring (6 cases); however, trochanteric structures got broken on two occasions anyway. It is worth highlighting that, although the greater trochanter suffers non-union, it does not sistematically rise with subsequent weakness of the abductor system. Sometimes, continuity in gluteal muscles is enough for the patient not developing postoperative Trendelemburg sign.

Although this is neither a unique nor an absolute conditioning factor, it may be associated with prosthetic dislocation. In our series, such complication showed in 8% of the cases, one of them requiring revision due to recurrence. Although comparatively with primary hip replacements this rate feels high, it resulted to be lower than Zhang et al's 12.5%[15] but higher than Laffosse et al.'s 6.9%[29] and Hammad et al.'s 3.1%[33]. Similarly to us, Laffose et al.[29] also had to undertake one patient's revision (3.45%) due to recurrent dislocation. In these cases we suggest the use of greater-diameter prosthetic heads or constrained acetabular cups to reduce this complication rates.

Independently of the fact that there were no periprothetic fractures in our patients, it is worth mentioning that the reported rates of such complication range between 0 and 7 %, according to different authors.[12,15,29,32]

Last but not least, three patients in our series required surgical toilet due to acute infection, what results to be a high rate as compared with the D'Arrigo's 1%[16] or the Hsieh et al.'s 3.7%.[35] Analysing these cases on a particular basis, we verify that the three of them had suffered a previous infection and had been treated with spacers. Two of them suffered recurrence with the same germ, even though all humoral infectious parameters (WBCs, ESR

Table. Treatment, type of arthroplasty, stems length and complications according to different series

Author	Number of patients/ Follow-up (months)	THR/ Bipolar prosthesis	Standard/ long stem	Complications (%)	Intraoperative fracture	Postoperative dislocation	Greater trochanter non-union	Others
Zhang[15] (2004)	19/40	16/3	16/0	47	5	3	-	Heterotopic ossification
Laffosse[29] (2007)	29/20	7/22	0/29	13.8	-	2	2	
Hammad[33] (2008)	32/57	32/0	28/5	18.7	1	1	4	
D'Arrigo[16] (2010)	21/6	19/2	5/16	9.5	1	-	-	Acute infection
Abouelela[30] (2012)	16/60	16/0	0/16	12.5	-	-	2	Trendelemburg sign
Esta serie	38/40	31/7	29/9	23.7	0	3	5	Acute infection, Heterotopic ossification

THR= total hip replacement; standard/long stem = femoral stem of standard length/longer-than-standard length.

and RCP) were normal before reimplantation and they had completed suitable i.v. antibiotic treatment, as prescribed by the Department of Infectious Diseases. In the remaining case, the microorganism got in the intraoperative sample was different from the previous one.

The weaknesses of this study are the characteristic ones in retrospective studies— although all the patients suffered a DHS complication, their diagnoses were different (non-union, avascular necrosis of the femoral head, infection), we used different prosthetic models and completed a relatively short follow-up. The study strengths are focused on the facts that surgeries were carried out by the same surgical team, at the same Centre, preoperative and postoperative assessments were identical, and the number of cases is appropriate as compared to that in other series.

Conclusions

Conversion of failed DHS into hip replacement is a technically challenging procedure. It is associated with high complication rates, such as infection, dislocation and greater trochanter non-union. Although prosthetic survival does not seem to become affected, at least short- and mid-term prosthetic survival, maybe due to this group of patients' low functional demands, we should be careful at the time of inserting a cemented stem due to the difficulties associated with cement pressurization. However, consistently with literature, in spite of these difficulties and the aforementioned complications, this one seems to be valid rescue procedure due to improvement in pain and the possibility to give these patients gait proficiency back.

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