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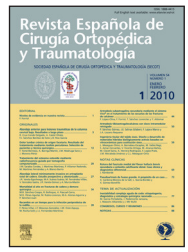

CLINICAL NOTE

Catastrophic failure of the acetabular component in total hip arthroplasty

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KEYWORDS
Hip arthroplasty;
Polyethylene wear;
Acetabular component

Abstract
Objective: The final stages of the natural history of polyethylene wear in total hip arthroplasty by itself or dislodgement of the liner, may lead to catastrophic failure of the acetabular component. The objective is to analyse this preventable situation.
Material and methods: The medical histories of four patients with serious destruction of the acetabular component have been retrospectively analysed. The patients were all young, the polyethylene was less than 6 mm and all of them experienced a delay in the polyethylene revision.
Discussion: Close radiographic monitoring of polyethylene wear is recommended, particularly when there are risk factors.
Conclusions: The potentially serious effects of delaying a revision operation until symptoms appear should be explained to patients, who frequently do not suffer any pain and are reluctant to undergo further operations.

PALABRAS CLAVE
Artroplastia de cadera;
Desgaste de polietileno;
Componente acetabular

Desgaste catastrófico del componente acetabular en prótesis total de cadera

Resumen
Objetivo: En su estadio final, el desgaste natural del polietileno en una prótesis total de cadera, tanto por sí mismo como por disociación con el componente metálico, puede conducir al fracaso catastrófico del cotilo y destrucción de la cavidad acetabular. El objetivo es analizar esta situación siempre evitable.
Material y métodos: Se analiza de forma retrospectiva la historia clínica de 4 pacientes con prótesis de cadera y graves destrucciones del componente acetabular. Tenían en común que eran pacientes jóvenes, el espesor del polietileno inferior a 6 mm y que en todos se había demorado la intervención de recambio de éste.

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Discusión: Se recomienda una estrecha monitorización radiológica del desgaste del polietileno especialmente si existe algún factor de riesgo.
Conclusiones: Los graves inconvenientes de demorar la revisión quirúrgica deben explicarse a los pacientes, que frecuentemente ante la ausencia de dolor están reticentes a aceptarla.

Introduction

Polyethylene wear particles are cited as a primary cause of aseptic loosening of the acetabular component in total hip arthroplasty. Research on hip arthroplasty has been focused on the friction surface because mitigating the production of these particles is crucial to achieving satisfactory, long-term results.[1] Left to their natural progression, both the wear process itself and dissociation of the polyethylene from the metallic cup[2] could result in contact between the prosthetic head and the cup, giving rise to a catastrophic situation with swift destruction of the metallic surface as well as the underlying bone. Four cases where this situation occurred are presented; in 2 of them there was also dissociation of the polyethylene. The objective is to analyse how risk factors in the patient combine with risk factors in the primary prosthesis so that replacement surgeries, which are always rather complicated, may be avoided.

Clinical cases (table 1)

Patients were informed that the data on their respective cases would be submitted for publication, and they gave their consent.

The primary prosthesis was a Poropalcar® (IQL, Valencia, Spain). It is a cementless, titanium-aluminum-4 vanadium implant with poropros metaphyseal coating and calcar support collar. The composition of the acetabulum is the same as that of the rod, with poropros coating over its entire surface and 3 lugs for its immediate fixation. Ultra-high-molecular-weight ArCom® polyethylene sterilised by gamma-in-vacuum.

Case 1. 37-year-old rheumatic patient who had been asymptomatic for 104 months but, prior to the second surgery, had a Harris Hip Score of 18–that is, severe pain with significant limitation; walking with 2 canes, around the house only; completely unable to climb stairs, put on shoes, sit down, or use public transportation. Patient had a leg length discrepancy and limited joint mobility. X-ray showed superior dislocation of the prosthetic femoral head due to wearing of the metallic acetabulum and its subsequent mechanical failure; this was confirmed after the components were removed (fig. 1). During the surgery, a bony defect of more than 50% of the pelvic ring was appreciated, with severe involvement between 0900 and 1700 on the clock face. It was impossible to do the replacement, and a Girdlestone resection arthroplasty was done instead.

Case 2. 44-year-old patient with rheumatoid arthritis. The patient was walking with a cane, reported no pain, and had refused consent for hip revision surgery on several occasions. Pre-operative Harris Hip Score: 70 points. However, 106 months after the intervention, the patient agreed to rescue intervention on the surgeon's advice, in view of an x-ray showing superior dislocation of the prosthetic head and formation of a neo-acetabulum. The prosthetic head and acetabular component were removed and replaced with a DePuy Duraloc® primary acetabulum and 28-mm head, with the rod's 12/14 cone maintained and the defect filled in beforehand with an allograft.

Case 3. 54-year-old patient with pre-operative Harris Hip Score of 71 points. Patient had moderate pain, took acetylsalicylic acid occasionally, and was walking without canes. On x-ray, an eccentricity of the femoral head in the acetabulum could be appreciated. In the revision surgery performed at 85 months, the polyethylene insert was found to be dislocated and was removed along with the prosthetic head and the metallic acetabulum; these were replaced with a Biomet BatCup® metallic cup with screws, with structured allograft secured with screws, and a 28-mm prosthetic head. Unlike the foregoing cases, polyethylene wear was not found; rather, there was a hole in the acetabulum that did not appear in the insert.

Case 4. 55-year-old patient with pre-operative Harris of 62 points. Patient was in mild pain attributable to osteoarthritic genu varum. Joint noises. Despite the obvious

Table 1 Description of the series

	Age	Pathology	Acetabulum/head	Polyethylene thickness - primary	Acetabular cup angle	Time prior to revision
Case 1	37	Rheumatoid arthritis	46 mm/32 mm	3.65 mm	52º	104 months
Case 2	44	Rheumatoid arthritis	44 mm/32 mm	3.62 mm	63º	106 months
Case 3	61	Primary coxarthrosis	46 mm/28 mm	5.43 mm	33º	85 months
Case 4	55	Primary coxarthrosis	48 mm/32 mm	3.68 mm	47º	125 months

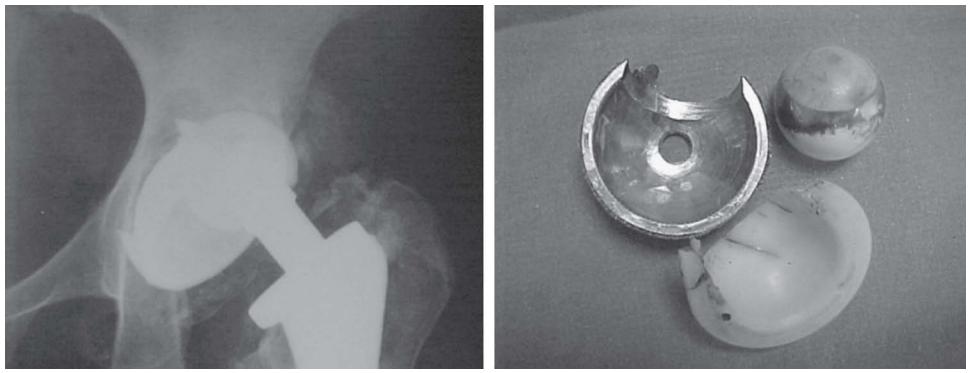

Figure 1 Case 1: pre-operative X-ray and implants removed.

eccentricity of the prosthetic head, no further intervention had been proposed to the patient for years. When rescue was done at 125 months, the insert was found to be dislocated, with a hole in the metallic acetabulum and in the acetabular bone cavity. It was replaced with a DePuy Duraloc® primary acetabulum and a 28-mm head.

The patients had small acetabular components, which meant that, coupled with the fact that 3 of them had a 32-mm prosthetic head, the polyethylene was not very thick. Youth was a factor the patients had in common: they ranged in age from 37 to 55 years. The acetabular angle varied from 33º to 63º.

Discussion

Metallic acetabular components improve the mechanical behaviour of the prosthesis, protecting the underlying bone by distributing the load more evenly; on the other hand, however, they require that a thinner polyethylene be used in connection with cemented acetabulums.[1] Polyethylene wear increases as its thickness decreases because its deformation capacity diminishes and, in turn, the contact area diminishes, thereby increasing mechanical pressure.[3] For Schmalzried,[4] the minimal thickness should be 6 mm.

Using a 32-mm prosthetic femoral head reduces the number of dislocations and increases the range of motion[5] but is associated with greater volumetric polyethylene wear compared to the wear seen with smaller diameter heads.[6]

If a 32-mm head is also used with a small-diameter acetabulum, requiring polyethylene that is not very thick, the contact pressure on the friction surface is increased. In Case 2 and Case 4, a thicker polyethylene was achieved only by changing the head from 32 mm to 28 mm.

Destruction of the metallic cup can also occur when initial wear leads to separation between metal and polyethylene, as in Case 3 and Case 4. This is not the only mechanism, for a metal-polyethylene separation can also occur as an acute event. On x-ray, it manifests as an eccentric position of the prosthetic head, breakage of the metallic wire, if there is one, and a curved radiolucent image at the level of the prosthetic neck corresponding to the dislocated polyethylene.[2]

When the head comes in contact with the acetabular metal, by either of the 2 mechanisms, the contact pressure from these 2 extremely rigid surfaces rubbing together is enormous, and this sets the stage for catastrophic failure.

Special attention to positioning of the acetabular component will not only promote stability but also help to minimize the risk of failure. The optimal orientation is thought to be 40±10 degrees of lateral tilt and 15± 10 degrees of anteversion.[7] Thus, Case 1 and Case 2 may be considered slightly verticalised.

For von Schewelov,[8] the red flag in periodic follow-up of a total prosthesis is an annual polyethylene wear of more than 0.2 mm. Although there are wear measurement methods that, supported by computer programs[9] or simple x-rays,[4] have a certain precision, we do not yet know how to distinguish wear from the polyethylene bedding-in phenomenon or plastic deformation resulting from weight-bearing. This phenomenon does not produce particles, and it stabilizes over the first 3 post-operative years.[10] Therefore, if it extends beyond those 3 years, it will be considered wear.

Pain does not appear to correlate with x-ray evidence of loosening, so this loosening can be asymptomatic for a long period of time and the diagnosis delayed until an unmistakable migration appears on x-ray.

In conclusion, when various risk factors coincide, precautions must be maximised. Patients of short stature should make us think of small prosthetic components and, therefore, the option of polyethylene that is less than 6 mm thick. If, in addition, the acetabular component is at the limits of the optimum range and the patients are young, annual examinations must be recommended. The surgeon should be trained to appreciate changes in the polyethylene on x-ray and should make an effort to convince the patient that it would be advisable to undergo hip revision surgery when polyethylene wear is of such magnitude that metal-ceramic contact is likely, even though, as is often the case, the patient is not in pain. The overall aim is to eliminate the true root of the problem, which is delay in replacing the polyethylene.

Protection of human and animal subjects

The authors declare that no experiments were performed on humans or animals for this investigation.

Confidentiality of data

The authors will declare that they have followed the protocols of their work centre on the publication of patient data and that all the patients included in the study have received sufficient information and have given their informed consent in writing to participate in that study.

Right to privacy and informed consent

The authors must have obtained the informed consent of the patients and / or subjects mentioned in the article. The author for correspondence must be in possession of this document.

Evidence level

Evidence level V.

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