



## A polyethylene liner dissociation case report in depuy pinnacle cup. An impingement problem?

Alvaro Martinez-Ayora, Guillermo Sosa-Gonzalez, Carlos Luis Vidal-Fernandez

### ABSTRACT

The modular components facilitate joint replacement surgery but are associated with potential complications not present in the previous components. We present a case of polyethylene dissociation due to rupture of the anti-rotational blocks in a total hip prosthesis two years after surgery. We think about the possible causes and risk factors. Despite its low incidence, the dissociation between polyethylene and the acetabular cup is a catastrophic complication. The femoroacetabular impingement seems to play a key role.

**Key words:** Total hip arthroplasty, liner dissociation, femoroacetabular impingement

### Introduction

Arthroplasty hip surgery has substantially developed over the last decades. This is due to an increase in the quality of available implants. The new highly cross-linked polyethylene (HCPE) have reduced wear rates, and modular components offer great flexibility and versatility to help to achieve needed stability and fix anatomical alterations or technical errors during surgery. However, these upgrades are not exempt from complications. HCPE loses mechanical properties, and modularity properties create new failures and friction points.

There are some reports of early failures. In 2002, Werle et al. [1] reported seven polyethylene liner dissociation in Harris-Galante acetabular components (Zimmer, Warsaw, Indiana). In 2005 Mesko et al. [2]

reported an acute liner disassociation of Pinnacle-Marathon acetabular component (DePuy, Warsaw, Indiana). In 2010, Powers et al. [3] reported 5 Duraloc (DePuy) locking ring failures.

Several causes were considered to explain the components collapse, such as incorrect positioning and assembling problems, manufacturing faults or femoroacetabular impingement.

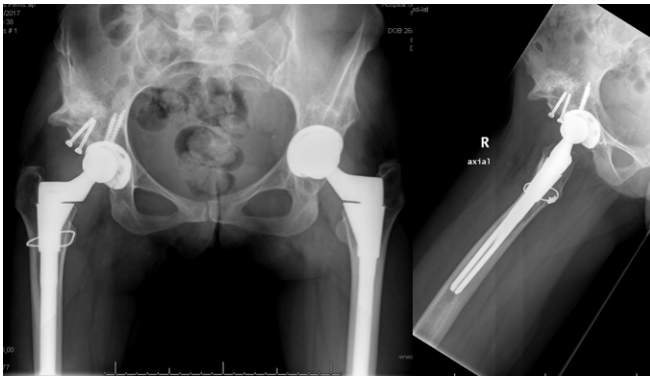
Prior informed consent, we present the case of a Pinnacle-Marathon polyethylene liner dissociation failure in the 24th month after the surgery.

### Case Report

A 35-year old female patient underwent a bilateral total hip arthroplasty (THA) for secondary osteoarthritis due to bilateral congenital hip dysplasia. The left hip was replaced in 2010, achieving an excellent func-



**Figure 1.** X-ray after offset and head replacement.



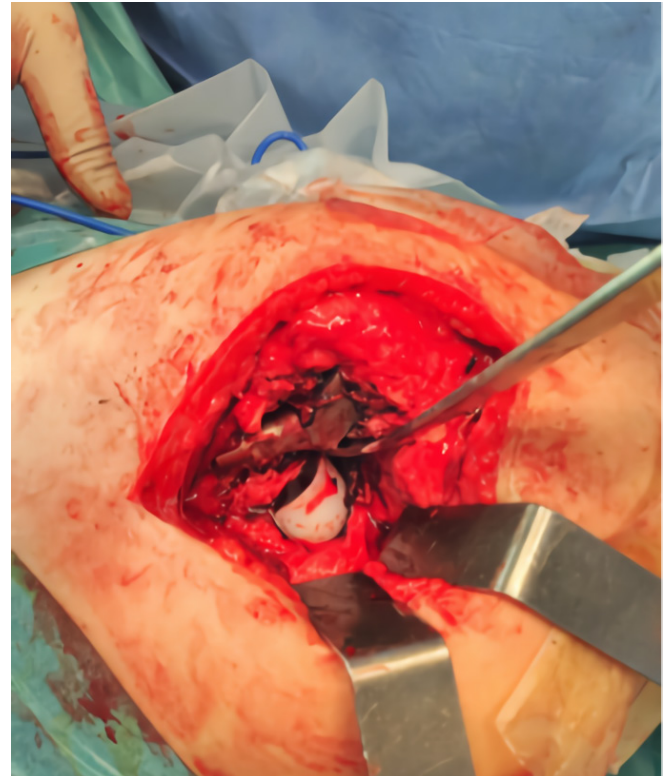
**Figure 2.** Eccentrically positioned head compatible with a polyethylene dissociation.

tional outcome. The right hip was operated on October 2015 using postero-lateral approach, implanting a 28mm ceramic head, S-ROM stem (DePuy, Warsaw, Indiana) and a 44mm Pinnacle cup (DePuy) fixed with two superior screws. A 28 mm +4 Marathon HCPE with a 10° postero-inferior lip was used. An acute dislocation appeared on the fourth postoperative day. The CT-scan revealed a 38° acetabular tilt, 36° acetabular anteversion, 60° anterior and 118° posterior acetabular sector angle.

The patient has operated again, changing S-ROM offset by +8 lateral and a 28mm+3 head. The acetabular cup, or the polyethylene (PE) were not modified. Weight-bearing was allowed since the beginning just taking notice of a leg-length difference of 1 cm due to pelvic tilt (Figure 1).

Twenty-four months after surgery, the patient reports a cracking sound and sudden pain in the groin area with no walking impairment. The X-Ray shows an eccentrically positioned head compatible with a PE dissociation due to a broken PE (Figure 2).

Revision surgery was undergone in December 2017. The surgery discovers a moderate metallosis due to cup-ceramic headwear off. The liner appears dissociated, and four of the six peripheral anti-rotation locks



**Figure 3.** Intraoperative findings. Broken polyethylene.



**Figure 4.** The polyethylene lip appears deformed by femoral neck impingement.



**Figure 5.** X-ray after last surgery.

were broken. The lip was deformed due to neck impingement (Figure 3 and 4). The stem and cup position and fixation is deemed acceptable, and no screw is protruding into the cup. The acetabular blocking system was intact.

A neutral ceramic liner and a 28mm +6 ceramic

head were implanted; no impingement was found after reduction. The patient was discharged after seven days (Figure 5). Normal weight-bearing was allowed after four months. Currently, one year after last surgery, the patient has no pain, has a functional range of motion, and maintains a pelvic tilt of 1 cm.

### Discussion

Modular prostheses have greatly assisted joint replacement surgery. They allow the correction of anatomical deformities and deficiencies in soft tissue. Also, the surgeon can easily correct the implant version in case of a dislocation, provide replacement of components, and perform revision surgeries. In the 90s, the first generation of modular cup components had poor outcomes due to the mobility between PE and the cup metal-back (backside polyethylene wear). New generations upgraded congruence and contact between PE and metal, including peripheral locking tabs to reduce its mobility.

The Pinnacle implant is a porous hemispheric titanium cup with 12 peripheral locking slots. Half of them will be used by the PE, which is locked by a Morse taper. The cup allows metal, ceramic, and polyethylene liners, which are the most frequently-used [4]. The Marathon is a mildly cross-linked PE. This intermediate dose provides the needed cross-link to diminish wear rate without compromising its mechanical properties.

Favorable outcomes for Pinnacle have been published. A study published in 2014 demonstrate ten years survival rates for any cause up to 99.2% in 150 THA [5], without any disassociation complication. Engh [4] published a 15 years survival rate of 100% for aseptic loosening in 596 Pinnacle cups

Disassociation between polyethylene and acetabular cup is a rare but catastrophic complication. The real incidence is difficult to establish since most publications are limited to a series of cases [2,3,6]. In 2013, the National Registry of England and Wales reported an insert dissociation rate of 0.02% in 35386 total Corail-Pinnacle hip replacements between 2003 and 2010, although it does not refer to how many of the cases refer to polyethylene inserts [7]. A study reports the incidence of disassociation of 0.17% in 4751 Pinnacle cups with polyethylene insert [8].

Proposed causes of dissociation are the poor as-

sembly between the polyethylene and the acetabular cup by the interposition of soft parts, bone remnants or protrusion of acetabular screws in the acetabular cup, femoroacetabular impingement, repetitive impact activities, traumatismos or manufacturing defects.

In our case, two characteristics make us suspect that failure was caused by impingement between polyethylene and femoral neck. On the one hand, the deformity of the lip, although this fact could also occur after the dissociation of the polyethylene (in the revision surgery the lip had migrated to the lower quadrant of the cup, where it also collided with the femoral neck). On the other hand, the break of the polyethylene locking systems occurred on the opposite side to the lip, the area subjected to greater tension in case of impingement. Several studies have identified the posterior aspect of the cup as the main femoroacetabular impingement point [9]. No other possible causes were found. The patient did not present an excess of physical activity, did not perform impact sports activity or suffered any trauma, the acetabular screws did not protrude, and a poor assembly when inserting the polyethylene is unlikely since the disassociation occurred after 24 months.

We found several risk factors for impingement in our patient. The posterior approach weakens the posterior capsule, predisposing to dislocation. The increase in anteversion theoretically reduces the possibility of subsequent dislocation [10], but a pronounced anteversion of the cup favors the posterior femoroacetabular impingement. Besides, the elevation that supposes the polyethylene lip plus and the 4mm offset could increase the torsional load. Use small heads, so common in dysplasia cases, also conditions an unfavorable head/neck relationship.

Dysplastic hip with anatomical abnormalities may explain the possibility of impingement despite the good position of the components. Intraoperatively, the presence of impingement is evaluated with the pelvis in the lateral decubitus position. This position may not correspond with the pelvic position during the patient's ambulation.

Impingement is a dynamic process, and therefore difficult to identify with plain x-rays. Acetabular impingement has been identified due to the recovery of

the implants in a large percentage of cases in which the components were oriented in the safe area. Shon et al. [9] identified impingement in 59% of 162 revision surgeries. 92% of the prostheses replaced by recurrent dislocation presented signs of collision, but also 41% of those replaced for other causes, concluding that the impingement was frequent even in hips without a history of dislocation.

The consequences of the femoroacetabular impingement are an increased risk of dislocation, instability due to polyethylene deformation, increased wear, generation of particles, and aseptic loosening. The appearance of cracks in highly cross-linked polyethylenes, which has been classically related to alterations in mechanical properties as a result of oxidation, have also been related to femoroacetabular impingement [11].

Although the variables favoring femoroacetabular impingement (implant design, the orientation of the components, characteristics, and activity of the patients) and the relationship between the impingement and the risk of dislocation have been widely studied, it is necessary to study which variables condition the break of polyethylene instead of recurrent episodes of dislocation. It seems appropriate to verify the absence of femoroacetabular impingement intraoperatively throughout the joint range and to perform an exhaustive follow-up of total hip prostheses in dysplastic hips.

#### Conflict of interest statement

The authors have no conflicts of interest to declare.

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