



Case Series

Catastrophic wear in uncemented acetabular cups after Total Hip Arthroplasty. A case series

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ABSTRACT

INTRODUCTION: Catastrophic wear is a rare outcome following Total Hip Arthroplasty (THA), documented to happen in less than 0.5% of THA. We present 5 cases of revision THA performed successfully on 5 patients presenting Catastrophic wear, following Total Hip Arthroplasty (THA). Specifically, Catastrophic wear cases were selected, emphasizing differential diagnosis, and a revision THA was performed in all of them and resulted in a good long-term outcome.

The purpose of this case series is to contribute to the literature in evaluating both the causes of implant failure as well as the outcomes after their revisions.

METHODS: We evaluated 5 patients that presented Catastrophic rupture of acetabular implants in a 3-week period in our prosthesis center.

RESULTS: The 5 patients were females, the mean age was 56 years (44–65), the mean post-surgery time was 20 years (17–23), 4/5 of the coupling wear was ceramic–polyethylene and only one case was metal–polyethylene; 4/5 had bilateral total hip replacement. In the 5 cases a revision THA was performed, all with a successful outcome.

CONCLUSION: Catastrophic failure is an unusual entity; however, when a patient with a prosthesis presents with sudden pain, an immediate image study is indicated, with careful attention to the differential diagnosis, so as to accurately advise receiving a revision THA. The main causes of implant failure are implant duration, volumetric wear and subsequent rupture. Patients with Catastrophic wear and implant rupture, treated with a revision THA, usually have a good long-term outcome.

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1. Introduction

The aim of this case series report is to document a series of revision THA's, performed successfully on 5 cases of Catastrophic wear, following Total Hip Arthroplasty (THA). The aim is to present each case, the revision THA performed in each one, and the positive long-term outcome obtained respectively.

Catastrophic wear refers to the superficial damage of materials that have been worked with and manipulated to make a product such as an implant. It can result on loss of the material, an affectation of its dimensions, usually a decrease, and a loss of its resistance. This is mostly due to plastic deformation, cracks and corrosion [1].

Catastrophic wear is an uncommon outcome after performing a THA, appearing in less than 0.5% in the metal cup, and in up to 10.9%

in the polyethylene acetabular liner [2,3]. The polyethylene wear rate is 0.03–0.34 mm/year, depending on the tribological coupling [4].

In many cases it is secondary to volumetric wear of the polyethylene, followed by a secondary implant rupture. The wear rate of the polyethylene is documented to be 0.03–0.34 mm/year, but it depends on the tribological coupling, the position of the components, and the Body Mass Index among other factors [4]. There are many other factors associated with component failure, such as quantity of prosthesis, metabolic disease, infections and usage of the prosthesis. The outlier is that, in all 5 cases in the present report, none of the factors above were the main reason of failure. In all cases, an adequate component position was recorded before the failure, and the main cause was secondary to regular usage, with suddenly increased pain and radiographic images with component rupture [5].

The differential diagnosis when evaluating Catastrophic wear, should take into account the alternative possibility of pseudo tumors, heterotopic ossification, septic and aseptic instabilities, and dislocations.

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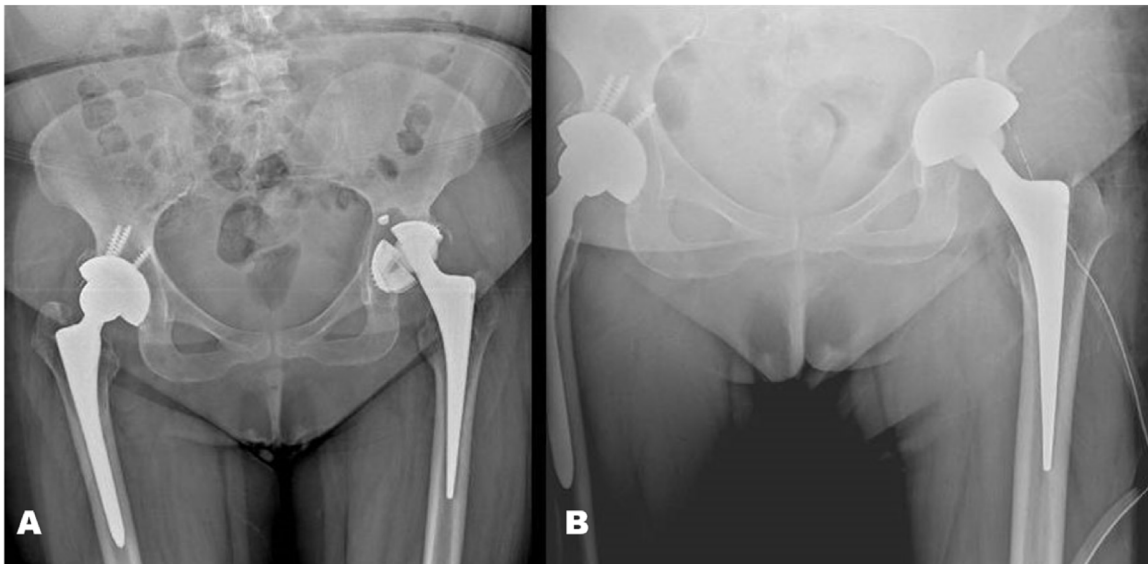


Fig. 1. AP Pelvis x-ray. A: Before the surgery, B: After the surgery (Patient 1).

Our case series reports the evaluation of 5 patients with Catastrophic wear and implant rupture and follows the revision THA performed in each case, all of which had a good long-term outcome.

We intend to contribute to the literature on implant failure and its treatment on several accounts. First, in directing the physician's attention to the importance of achieving a better assessment in cases of implant failure, taking into account Catastrophic wear as one of the possible causes, thus assuring a correct diagnosis. Second, by evaluating metal acetabular cups, while most of the published literature evaluates ceramic cups. And third, by showing that performing a THA revision on Catastrophic wear cases, when done timely, and based on an accurate diagnosis, results in a good long-term outcome.

2. Methods

This case series was made retrospectively, in a single center and the cases were consecutive in a 3-week period. We selected patients that presented Catastrophic rupture of acetabular implants at our center in this chosen 3-week period. This resulted in the selection of 5 patients who presented Catastrophic wear in this period of time. All of them had undergone a THA in the past (17–23 years before) and had presented recently with Catastrophic wear of the prosthesis components.

In all cases a revision THA was performed after the diagnosis by an orthopedic surgeon.

Although it is a rare condition, our prosthesis center performs around 1800 procedures every year and about 80% of them are THA revisions, so we were able to do our research on the basis of those that presented this condition in the chosen 3-week period.

These patients were evaluated and a revision THA was performed on them with subsequent evaluation of outcome.

The elaboration of this case report has been reported in line with the PROCESS guidelines, making sure it is compliant with all of the criteria of the PROCESS Checklists [6].

3. Case presentation

3.1. Patient 1

60-year-old female, with coxarthrosis, who underwent left THA 23 years ago, with an uncemented expansion acetabular compo-

nent, a tribology coupling ceramic-on-polyethylene and a right THA, 21 years ago. The patient had an uneventful recovery with full range of motion until 2 years ago when she started with left inguinal pain. Other past medical history is not relevant for the case presented. Shown in Fig. 1A is an AP Pelvis x-ray with bilateral THA, a left acetabular component with rupture and articular incongruence, and osteolysis around the acetabular cup. A revision THA was recommended.

3.2. Patient 2

65-year-old female, who underwent bilateral THA 19 years ago, with an uncemented multi-hole acetabular cup, with tribology coupling metal-on-polyethylene. The patient had an uneventful recovery, with full range of motion, until 5 days ago, when she suffered a fall and was taken by the Emergency Medical Services to her primary family doctor. Other past medical history is not relevant for the case presented. After x-rays, thinking that it was dislocated, he attempted 2 unsuccessful closed reductions; the patient was then sent to our hospital for treatment. Although the patient presented dislocation, she was evaluated to fit in the case selection criteria since the mechanism of the trauma was not enough to warrant causing the Catastrophic wear found. Shown in Fig. 2A is the AP Pelvis x-ray, with bilateral THA components, left head with articular incongruence, superior and lateralized. A revision THA was recommended.

(Implant fragments are shown in Fig. 2 B)

3.3. Patient 3

44-year-old female with a diagnosis of Systemic Lupus Erythematosus and Rheumatoid Arthritis, who underwent bilateral THA 17 years ago, with an uncemented expansion acetabular component, and an uneventful recovery, until 1 year ago, when she began with right hip pain. Other past medical history is not relevant for the case presented. An AP Pelvis x-ray was performed (Fig. 2D) showing bilateral THA components: the left one was well positioned and the right one had an acetabular cup rupture. Surgical treatment was recommended but was initially refused by the patient; finally, she accepted it 2 months later because of increased pain. (Implant fragments are shown in Fig. 2 E)

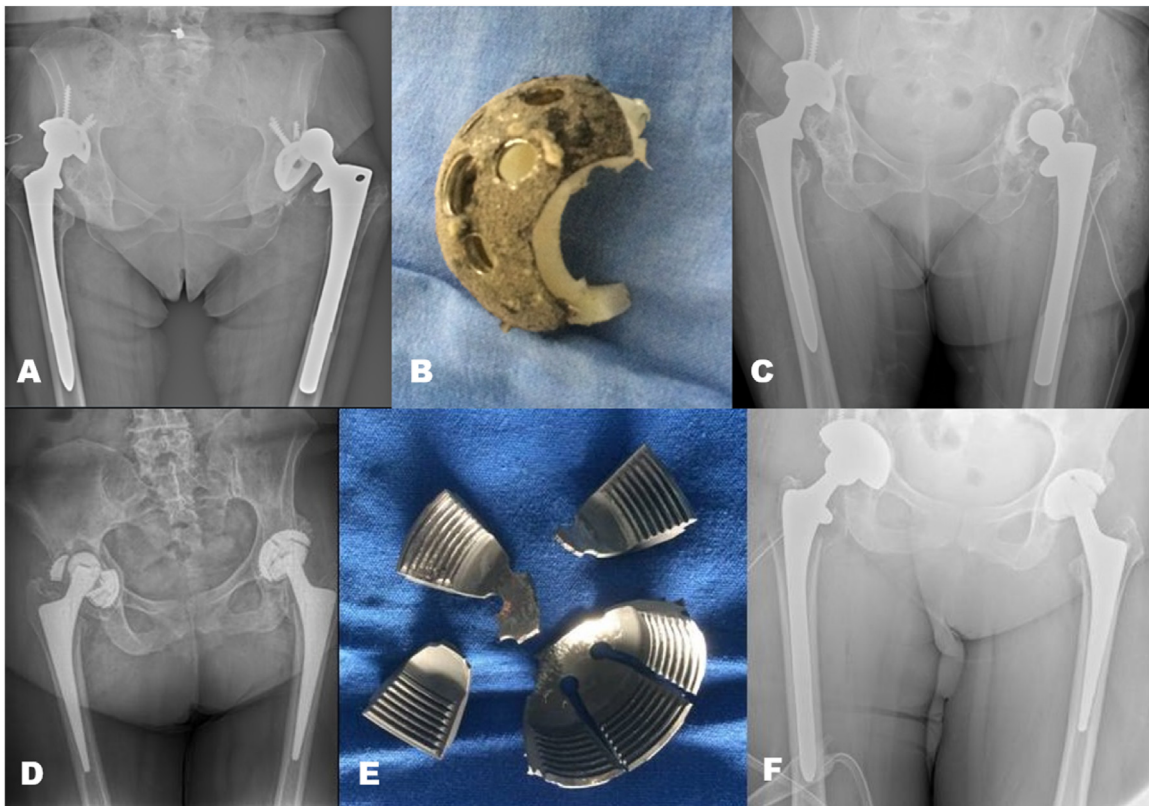


Fig. 2. A: AP Pelvis x-ray before the surgery (Patient 2), B: Rupture of the acetabular implants (Patient 2), C: AP Pelvis x-ray after the surgery (Patient 2), D: AP Pelvis x-ray before the surgery (Patient 3), E: Rupture of the acetabular implants (Patient 3), F: AP Pelvis x-ray after the surgery (Patient 3).

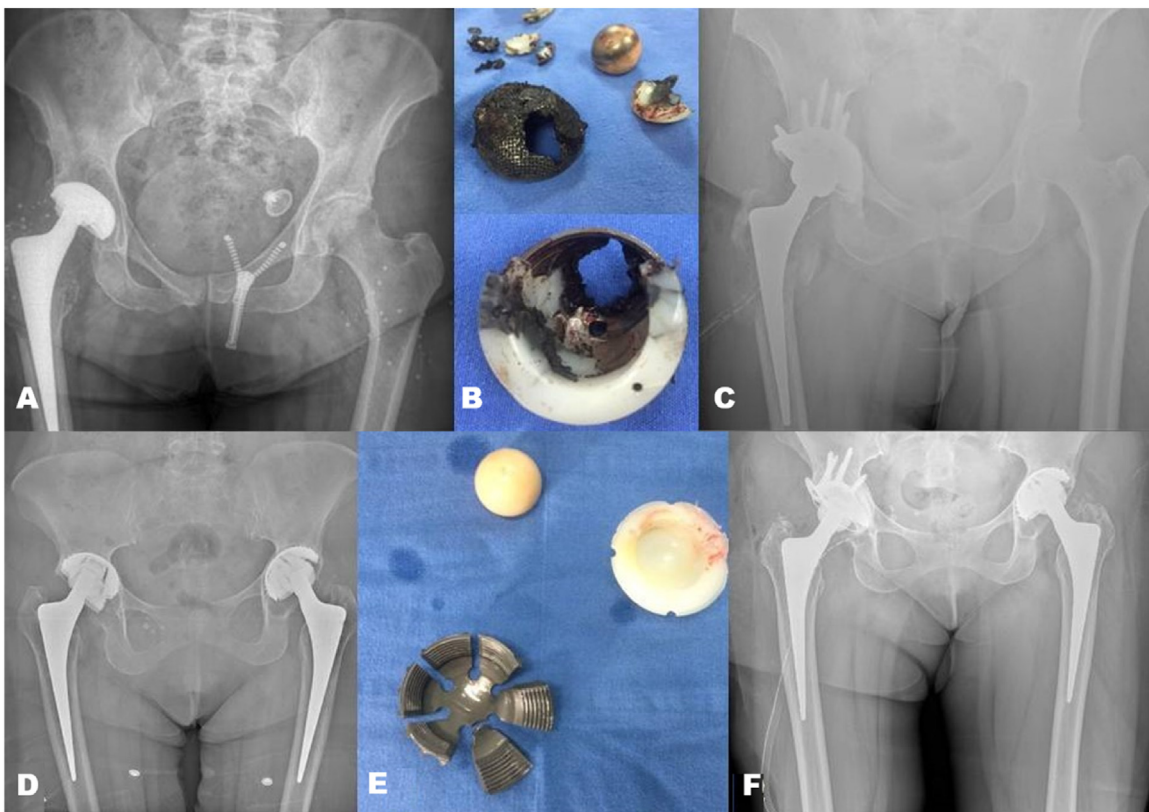


Fig. 3. A: AP Pelvis x-ray before the surgery (Patient 4), B: Rupture of the acetabular implants (Patient 4), C: AP Pelvis x-ray after the surgery (Patient 4), D: AP Pelvis x-ray before the surgery (Patient 5), E: Rupture of the acetabular implants (Patient 5), F: AP Pelvis x-ray after the surgery (Patient 5).

3.4. Patient 4

54-year-old female who underwent right THA 18 years ago, with good and unremarkable evolution, began with right hip pain 2 years ago. Other past medical history is not relevant for the case presented. Physical evaluation revealed painful range of motion. Fig. 3A shows an AP Pelvis x-ray with right THA components well positioned, but the head apparently protrudes through the acetabular cup. A revision THA was recommended. (Implant fragments are shown in Fig. 3B)

3.5. Patient 5

59-year-old female, who underwent bilateral THA; the right side was 23 years ago, and the left side was 21 years ago, followed by an excellent painless full range of motion. Other past medical history is not relevant for the case presented. The patient began with right inguinal pain 6 months ago. Fig. 3D shows an AP pelvis x-ray with bilateral THA components, left hip well-positioned, right hip with acetabular cup rupture and acetabular osteolysis. A revision THA was recommended. (Implant fragments are shown in Fig. 3 E)

4. Treatment

4.1. Patient 1

Revision THA was performed with an acetabular cup change with uncemented acetabular metal back (B Braun plasma cup # 54) and a 28 large head Fig. 1B.

4.2. Patient 2

Revision THA was performed with an acetabular cup change with cemented acetabular all-polyethylene cup (S & N Reflection cup) Fig. 2C.

4.3. Patient 3

Revision THA was performed with an acetabular cup change with uncemented acetabular metal back (B Braun plasma cup # 60), long femoral uncemented stem and Oxinium head +4 Fig. 2F.

4.4. Patient 4

Revision THA was performed with an acetabular cup change with uncemented acetabular metal back (B Braun plasma cup # 60), long femoral uncemented stem, and Oxinium head +4 Fig. 3C.

4.5. Patient 5

Revision THA was performed with an acetabular reinforcement ring placement with cemented muller acetabular liner, and Oxinium head Fig. 3F.

5. Outcome and follow-up

All 5 patients completed our clinical protocols of 2–3 days post-operative hospital stay and followed them up with progressive weight-bearing and physical therapy.

All of them had a full prosthetic range of motion at the 2 weeks follow up, full recovery after 2 months, with follow up x-ray showing adequate position of the components; the 1 year follow up was uneventful.

6. Discussion

Only a few cases have been reported in the literature of Catastrophic wear with acetabular rupture, where the wear rate depends on many factors: osteolysis, secondary Catastrophic failure and femoral head ruptures [7].

Despite the benefits of the cross-linked ultrahigh molecular weight polyethylene acetabular liners, they may present cracks in some portions of the implant [8].

The characteristics of the ceramic–polyethylene THA implant makes its rupture uncommon. A study published in 2010 presented a case of expansion cup rupture in an implant of this type; as in other studies, they concluded that the correct placement of the implant is determinative for the duration of the implant [9]. In 2017 a publication of stem fractures reported different causes of implant failure and the stages before the failure occurred, mentioning at the start of the failure the multiple microfractures of the implant [5]. Similar cases to our case 4, where the ceramic head protruded through the acetabular cup, were found twice in the literature [10,11].

In another case report, it is reported that no failures in polyethylene were thicker than 5 mm [2]. And in a classic article, it was shown that, in vitro, there is no difference between the polyethylene wear in different types of polyethylene thickness, head sizes, and head materials [12].

There are few cases reported in the literature of acetabular cup rupture, and most refer to ceramic cups, metallic cups being less frequent, as in our cases. The interesting thing is that these five cases occurred in this concentration center in a period of three weeks. In this sample, implant rupture was related to implant duration, volumetric wear and subsequent rupture.

One of the strengths of this study is that it evaluates metal acetabular cups while most of the published literature evaluates ceramic cups.

7. Conclusion

Catastrophic wear is uncommon and will depend on many factors. The longevity of the implant is directly related to the adequate position of the implants. Although it is an uncommon entity, after 15 years of a prosthesis the incidence increases, and appropriate follow up as well as early treatment will have the benefit of a better outcome.

When following a long term THA, it should be noted that images of incongruence between components may be secondary to Catastrophic wear. It is important to consider that in some cases we found acetabular cup rupture without polyethylene wear.

For the best duration and evaluation of the implants, we recommend verifying proper placement, general post-operative patient care including weight control, annual radiographic follow-up, and assessing differential diagnoses, such as dislocations, septic and aseptic instabilities, heterotopic ossification, and pseudotumor. In cases where Catastrophic wear does occur, a revision THA usually results in a good long-term outcome.

Further research should be done on the relationship between the prosthesis materials and the Catastrophic wear incidence; a retrospective study would be useful to assess this.

Declaration of Competing Interest

All authors declare they have no conflicts of interest.

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Ethical approval

The study is exempt from ethical approval.

Consent

Written informed consent was obtained from all of the patients for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contribution

This manuscript has been read and approved by all the authors. SJR, REG, LGA, DPS and IBA contributed in the acquisition of the clinic patient data for the case presented, as well as the research of the related literature and the preparation of the manuscripts DPS and IBA made the design of the study images and finally SJR, REG and LGA made the critical revision of the manuscript.

Registration of research studies

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Salomon Jasqui Remba: Validation, Formal analysis, Supervision, Project administration. **Ricardo Esquivel Gomez:** Validation,

Formal analysis, Supervision. **Luis Gutiérrez Ambriz:** Conceptualization, Methodology, Investigation. **Daniel Portman Santos:** Conceptualization, Methodology, Investigation, Resources, Writing - original draft, Visualization. **Isaac Baley Amiga:** Conceptualization, Methodology, Investigation, Resources, Writing - original draft.

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