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Massive Eccentric Wear of the Acetabular Cup after Polyethylene Liner Abrasion in Hip Arthroplasty may lead to a high Risk of Injury during Revision Surgery

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Learning Point of the Article:

Progressive eccentric wear due to liner abrasion in hip arthroplasty may occur rapidly and in cases with excessive wear characteristics, appropriate knowledge of implants and planning of revision surgery is crucial.

Abstract

Introduction: Polyethylene wear is known to be a major cause of long-term failure after primary hip arthroplasty which results in the activation of an innate immune response with subsequent osteolysis and component loosening. However, polyethylene wear in hip arthroplasty may be asymptomatic for a long time and following massive, eccentric abrasion of the cup with subluxation of the femoral head after fully polyethylene wear has not yet been described. Hereby, we present a case of rapid progressive eccentric wear of the acetabular cup after complete polyethylene liner abrasion in a ceramic-on-polyethylene bearing.

Case Report: A 80-year-old-lady presented on our emergency department with a subluxated hip arthroplasty on the right side implanted 30 years ago. The X-ray showed a Zweymüller stem combined with a Gartenmann cup and a ceramic head with excessive eccentric wear of the acetabular cup with razor blade sharp edges after fully polyethylene liner abrasion.

Conclusion: Progressive eccentric wear of the acetabular cup after fully polyethylene liner abrasion in ceramic-on-polyethylene bearings in hip arthroplasty may be asymptomatic for a long time but may progress rapidly. To prevent patients from extensive revision surgery and the revision surgeon from serious injury due to intraoperatively findings such as razor blade sharp edges, routine long-term follow-up radiographic evaluation is crucial.

Keywords: Revision surgery, hip arthroplasty, abrasive wear, cup wear, injury.

Introduction

Polyethylene wear is known to be a major cause of long-term failure after primary hip arthroplasty [1, 2, 3] which results in the activation of an innate immune response with subsequent osteolysis and component loosening [4]. Especially non highly cross-linked polyethylene, for example, in older implants showed a minor implant survival compared to the use of highly cross-linked polyethylene [5]. On the other hand, a recently published systematic review and meta-analysis about the survivorship and wear rates of ceramic and metal heads articulating with polyethylene liners in total hip arthroplasty showed no difference in revision rates nor linear and volumetric wear between ceramic-on-polyethylene and metal-on-polyethylene bearings [6]. From a mechanical point of view, polyethylene wear also results in altered geometry and stress forces of the remaining articulating implants supporting progression of abrasion. However, asymptomatic patients with severe abrasive wear of the polyethylene liner and the cup in ceramic-on-polyethylene bearings may present late and often implicate demanding revision surgery due to osteolysis of the supporting segmental acetabular bone and the anterior and posterior column [7].

Hereby, we present a case of massive eccentric wear of a ceramic-on-polyethylene bearing with consecutive abrasion of

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Author's Photo Gallery

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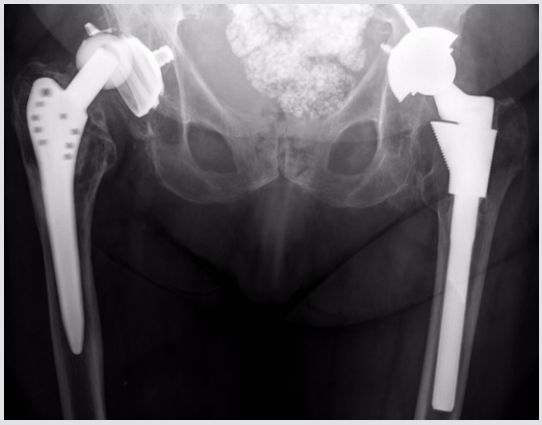

Figure 1: Primary X-ray (anteroposterior-view) assuming right-sided dislocated hip-prosthesis.

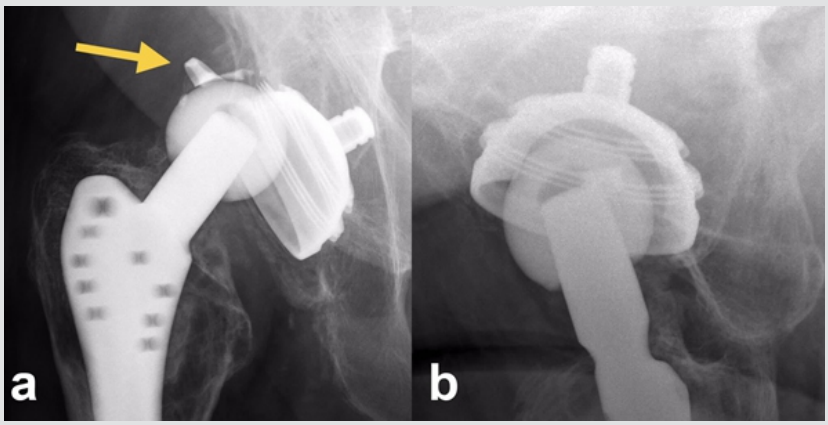

Figure 2: Magnification of Figure 1 showing partially broken lateral cup (arrow) but revealing only subluxated hip-prosthesis: (a) Anteroposterior-view, (b) axial view.

the cup with subluxation of the ceramic head 30 years after hip arthroplasty. To the best of our knowledge, no such a case has yet been reported.

Case Report

An 80-year-old lady underwent right-sided hip arthroplasty 30 years ago. She presented on our emergency department with a radiographically confirmed right-sided hip subluxation and massive wear of the polyethylene liner and cup (Fig. 1, 2). Assuming that the head is seized in the lateral cup, we decided to directly go for surgery instead of first trying a reposition of the prosthesis. Planning of the revision surgery revealed a Zweymüller® first generation stem with a 14/16 mm taper combined with a Gartenmann cup and ceramic head (Zimmer GmbH, Winterthur, Switzerland).

The patient underwent revision surgery through a lateral approach. The thickened and scarred capsule already presented with black metallosis-stained tissue and was consecutively removed anteriorly to expose the prosthesis. The ceramic head was completely displaced from the polyethylene liner and jammed in the lateral roof of the acetabular cup. After fully dislocation of the hip, the ceramic head was removed. At this point, it was discovered that the ceramic head of the femoral component had worn completely through the cranial polyethylene liner and rim of the acetabular component (Fig. 3). During further debridement of the capsule, the orthopedic surgeon cut his index finger at the razor blade sharp edges (Fig. 4) of the worn acetabular cup. After removing the cup without any major loss of the acetabular bone stock, a DS Evolution cup (Mathys AG, Bettlach, Switzerland) was cemented into the acetabulum. The Zweymüller® stem remained stable, so it was left unchanged. The hip was reduced with a 28 mm Metasul® CoCrMo head with a 14/16 taper within the 28/48 mm highly crossed-linked polyethylene inlay. Afterward, the joint showed excellent stability (Fig. 5).

Discussion

About 0.9–5.71% of the patients after primary total hip arthroplasty need revision surgery [8, 9, 10] within the first 3 years and revision rates of about 6% after 5 years and 12% after 10 years are to be expected [11]. A complication-based analysis using worldwide arthroplasty registers concluded aseptic loosening to be the most common reason (55.2%) for the need of revision surgery after primary total hip arthroplasty [12]. Aseptic loosening is meant to occur by a pathway of particulate debris formation, activating macrophages releasing cytokines which results in osteolysis [13, 14] and subsequent component

Figure 3: Implants after removal showing massive wear and razor-sharp edges.

Figure 4: Detailed view of removed cup with razor-sharp edges.

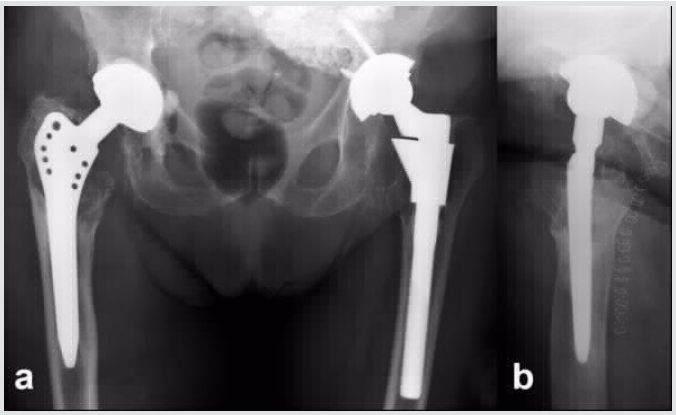

Figure 5: Postoperative X-ray: (a) Anteroposterior-view, (b) axial view.

loosening. Besides wear particles from ceramic-on-polyethylene and metal-on-polyethylene bearings as sources for particulate debris formation, other sources such as bone, cement, metallic corrosion products, or hydroxyapatite particles have been described [15]. However, the fully abrasion of the polyethylene liner in hip arthroplasty may result in subsequent wear of the cup of the artificial hip joint. Alexander-Malahias et al. [16] reported a case of a rapid (<1 year time), complete central wear-through of a ceramic femoral head through a polyethylene liner and titanium acetabular cup without joint instability. A quite similar case has been reported from Ding Zhao et al. [17]. Our case of an eccentric abrasion of the cup after fully polyethylene wear in a ceramic-on-polyethylene bearing differs from a central wear-through by its additional impact on hip joint stability. These three cases can be asymptomatically for a long time but progress rapidly what highlights the importance of routine long-term follow-up radiographic evaluation. Referring to this, Ries and Link [7] proposed routine radiographic monitoring for polyethylene wear and osteolysis at 5 years after total hip arthroplasty, with a radiograph made every 2–3 years thereafter. Patients with a higher risk of developing osteolysis, for example, younger and more active patients, should be monitored more closely. In the unfavorable event of symptomatic and excessive wear characteristics after hip arthroplasty with or without osteolysis, the revision surgeon needs adequate knowledge of the past and actual implants available on the market, appropriate interpretation of the medical imaging modalities, and suitable planning to avoid unexpected intraoperative issues. In addition, in cases with excessive eccentric wear of the cup after complete polyethylene abrasion, the revision surgeon should be warned of razor blade sharp edges to prevent momentous injury.

Conclusion

Progressive wear of the acetabular cup after polyethylene liner abrasion in ceramic-on-polyethylene bearings can occur rapidly a may be asymptomatic for a long time. To prevent patients from extensive revision surgery, and the revision surgeon from serious injury due to intraoperatively findings such as razor blade sharp edges, routine long-term follow-up radiographic

Clinical Message

Massive, eccentric abrasion of the acetabular cup following fully wear of the polyethylene liner in ceramic-on-polyethylene bearings after primary hip arthroplasty can progress rapidly and may occur independently of concomitant implant loosening or any further symptoms. Therefore, routine long-term follow-up radiographic evaluation is crucial to prevent extensive revision surgery and momentous injury to the revision surgeon due to razor blade sharp edges of worn implants.

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