Eklem Hastalıkları ve Cerrahisi
Joint Diseases and Related Surgery

Case Report / *Olgu Sunumu*

Eklem Hastalık Cerrahisi
2013;24(3):173-177
doi: 10.5606/ehc.2013.37

Intrapelvic protrusion of the ceramic head resulting from forte ceramic liner fracture without a significant trauma: a case report

Forte seramik linerin belirgin travma olmaksızın kırılması sonucu seramik başın intrapelvik protrüzyonu: Olgu sunumu

Halil İbrahim Bekler, M.D., Yiğit Erdağ, M.D., Murat Özşahin, M.D.

Department of Orthopedics and Traumatology, Dr. Lütfi Kırdar Kartal Training and Research Hospital, İstanbul, Turkey

In this article, we present a 48-year-old female case who had an unsuccessful previous forte ceramic-on-ceramic total hip arthroplasty for early coxarthrosis secondary to acetabular dysplasia. She had fracture and protrusion of the ceramic liner through the titanium acetabular shell without any apparent trauma, possibly resulting from the mistake during the implantation of the ceramic liner into the metal shell in the initial operation. The patient had no other risk factors (component malposition, trauma, malalignment) for ceramic liner fracture. She underwent revision surgery with allograft, reinforcement ring, all-polyethylene cup and reinforced stainless-steel femoral head.

Key words: Arthroplasty; ceramic; hip; replacement.

Bu yazıda asetabüler displaziye sekonder erken koksartroz nedeniyle başarısız bir forte seramik-seramik total kalça artroplastisi yapılan 48 yaşında kadın olgu sunuldu. Hastanın görünürde herhangi bir travma öyküsü olmaksızın, muhtemelen birinci ameliyatta seramik linerin metal kap içine yerleştirilmesindeki hatadan kaynaklanan, seramik liner kırılmış ve titanyum asetabüler kap içeri doğru protrüze olmuştu. Seramik liner kırığı için hastanın başka bir risk faktörü (komponent malpozisyonu, travma, dizilim bozukluğu) yoktu. Hastaya allogreft, güçlendirilmiş halka, tam polietilen kap ve güçlendirilmiş paslanmaz çelik femoral baş ile revizyon ameliyatı yapıldı.

Anahtar sözcükler: Artroplasti; seramik; kalça; replasman.

Ceramic components have been used in total hip arthroplasty (THA) because of excellent surface hardness, lubrication and increased resistance to wear. However, fracture of components may occur in relation to larger grain size, impurities, poor manufacturing, poor design or surgical errors.[1] Many authors have reported fracture of the ceramic head or both the ceramic head and the ceramic insert, but few have found a fracture of the ceramic insert alone.[2-5] We report a case of intrapelvic protrusion of the fractured ceramic liner through the titanium acetabular shell without any apparent trauma.

CASE REPORT

A 48-year-old woman underwent an uncemented total hip arthroplasty of the left hip through an anterolateral approach. The implant used was on forte ceramic on ceramic bearing system. The acetabular component was a 52 size titanium shell with a forte ceramic liner; the femoral component was a titanium straight stem designed for diaphyseal fixation with a 28 mm modular ceramic head and medium neck.

One month postoperatively, the patient felt a “click” in the operated hip, without any pain or disturbance in walking, but neglected to inform the surgeon. After 12 months, she admitted this event to a general practitioner and a radiograph was taken. No failure at either the acetabular or femoral component was diagnosed. At 14 months postoperatively, she felt pain with limitation of range of motion after a sudden cracking sound and was admitted to our clinic.

On clinical examination, a functional limb shortening of 3 cm and a Trendelenburg gait on

• *Received: December 26, 2012 Accepted: September 16, 2013*
• Correspondence: Halil İbrahim Bekler, M.D. Dr. Lütfi Kırdar Kartal Eğitim ve Araştırma Hastanesi Ortopedi ve Travmatoloji Kliniği, 34890 Cevizli, Kartal, İstanbul, Turkey. Tel: +90 542 - 414 89 69 Fax: +90 216 - 352 00 83 e-mail: hbekler@yahoo.com

Figure 1. Preoperative radiographic view of the hip.

the operated side were revealed. On radiographic examination of the hip, an uncemented THA with a well-fixed femoral stem and failure of the acetabular component with protrusion into the pelvis were seen (Figure 1). The acetabular shell was completely disturbed by the femoral head and neck being displaced into the shell, with a fracture of the acetabular wall. The pelvic ring had lost its continuity, and broken ceramic components of the acetabular ceramic liner were in the pelvic ring. Informed consent was obtained from the patient prior to revision surgery using the previous anterolateral incision.

Intraoperatively, migration of the proximal femoral head into the acetabulum was observed. After gentle dislocation of the hip, the ceramic femoral head was removed to facilitate exposure of the acetabular component. The ceramic femoral head surface was intact but was severely abraded and revealed a band of metallic deposition. The acetabular liner was completely broken with one large and multiple small pieces dispersed into the soft tissues. The entire wound was covered with black-colored tissue-- extensive metallosis (Figure 2). The titanium acetabular shell was completely abraded at the central part with a big hole (Figure 3). The acetabular titanium shell was loose but all three screws were firmly fixed to the bone; their heads had completely lost their shape. The shell was carefully detached from each screw by gentle rotary movements and removed from the bony acetabulum. Broken parts of the acetabular liner were found in the pelvis and fragments of the broken ceramics, covered with black metallic deposition, were removed. During the debridement, great attention was given to preserve healthy tissues away from the sharp edges of the liner. The large cavitary defect in the acetabulum was reconstructed with demineralized bone matrix/ bone morphogenic protein putty, allograft and a reinforcement ring. An all-polyethylene cup was inserted into the reinforcement ring and secured with cement. The femoral stem was not changed as

Figure 2. The entire wound was covered with black-colored tissue, extensive metallosis.

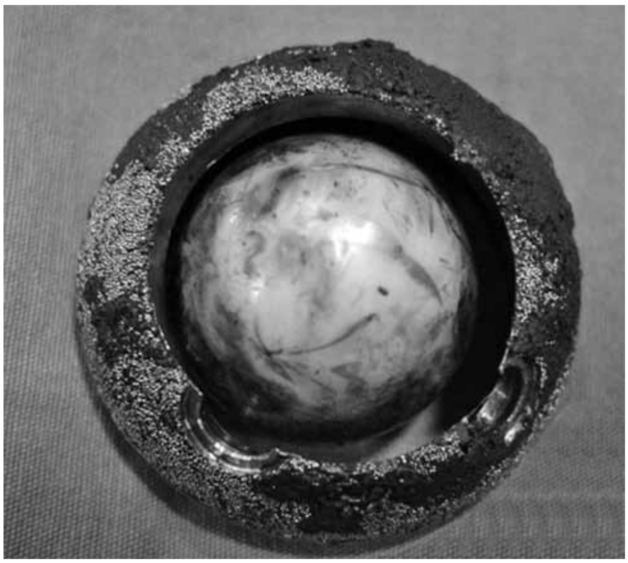

Figure 3. Titanium acetabular shell was completely abraded at the central part with a big hole.

it seemed well-fixed. A new, reinforced stainless-steel femoral head was used to replace the damaged femoral head. The patient had an uneventful recovery and had no pain at the hip at the most recent follow-up examination at 15 months. The patient was able to return to full activity without any discomfort in the hip. The acetabular grafts healed well and the acetabular and femoral components were well-fixed (Figure 4a, b).

DISCUSSION

The risk of fracture is a main disadvantage of ceramic prostheses. Fracture rates for contemporary ceramics range from 0% to 0.004%.[6] Although ceramic-on-ceramic articulation has been assumed to cause the least amount of wear, fractures may occur in the femoral heads, especially with the earlier designs. Nizard et al.[7] found that the ceramic heads in patients less than 50 years of age (and therefore presumably more active) had a better rate of survival than those in older patients. In addition, it is likely that extrinsic factors, such as strenuous activity, play a minor role in the occurrence of ceramic fractures, because they will remain below the fatigue limit of the product. Fracture of the ceramic head is as likely to occur in cemented as in non-cemented THAs. While some authors state that the failures usually appear during the first months after the operation, others have observed that these are more frequent after the first year.[8] Risk factors may be patient-specific: age, obesity, activities, and a history of trauma or surgery-specific; high cup inclination, rough insertion of the ceramic liner, impaction of the femoral head against the liner rim during reduction, and a history of dislocation.[9] Finally, manufacturer-specific factors affecting the risk of a ceramic fracture include the quality of the ceramic and the design of the insert.[2,10,11] Trauma, directly or indirectly, high levels of activity, and obesity may influence the risk of breakage by increasing the load across the joint surfaces.[5] Other factors creating fracture risk are the loads anticipated with the application of the component, surgical technique and application of the component by the surgeon, bone condition of the patient, and material and design properties of the component.[1] The vulnerability property of ceramic prostheses seems to be impinging between components, e.g.,

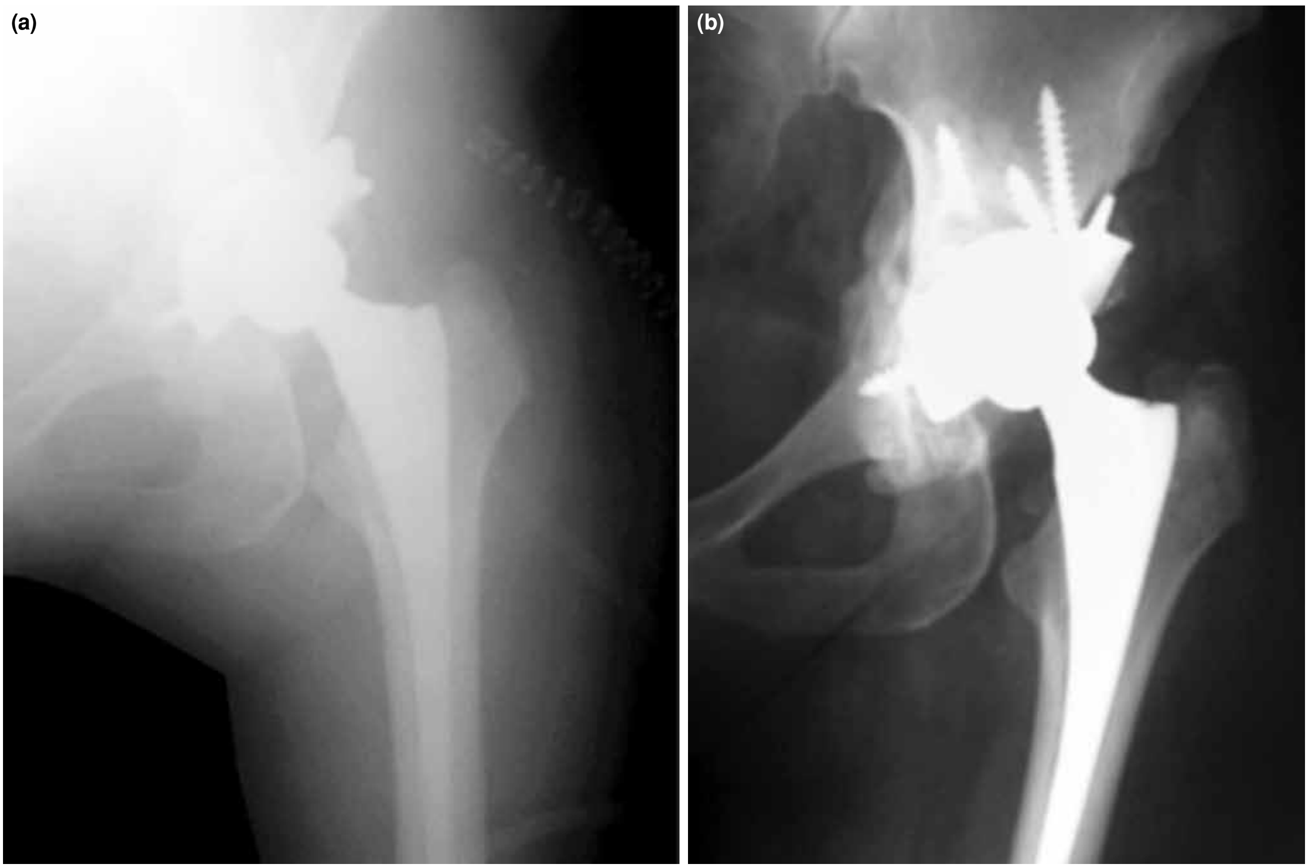

Figure 4. (a) Revision of early postoperative radiograph. **(b)** The first year postoperative radiograph.

the stem neck and the inferior portion of the acetabular rim in external rotation and the superior rim of the ceramic liner by the femoral head. Cracks may propagate, suggesting the cause of the fracture might be the stress concentration.[3] To minimize the risk of impingement and to achieve better forces distribution, acetabular component should be placed at 45 degree.[7] We think that a layer of polyethylene may be used for elimination of liner impingement with screw heads and for stress absorption, particularly at the time of head implantation. Thick liners were designed to control the risk of fracture. The ceramic liner without a polyethylene layer is thicker than that of a sandwich cup. However, very careful technique is required when inserting the ceramic liner into the metal shell to avoid chip fractures.[11] The presence of a polyethylene layer in a sandwich cup can ease the insertion of the ceramic liner into the metal shell.[3,12] However, we think much more attention should be given to the convex liner surface (i.e., the metal backing-acetabular liner interface) as another possible cause of impingement. Recent studies evaluate the relationship between wear of the convex surface and the importance of screw holes and other potential conduits in the process of acetabular osteolysis, with little association being reported.[13-17] Prominent heads of improperly placed screws may be another cause of impingement; stress concentration at the screw heads and the full-thickness ceramic liner could cause early catastrophic liner fractures. The internal stresses within the ceramic liner and the metal backing increase with nonconformity of the surfaces. Ceramics have excellent compression and limited bending strength. Small irregularities can grow until a sudden fracture without adequate trauma occurs.[10] The stress concentration at the rim of the ceramic liner has been reported as the possible cause of the ceramic liner fracture. Vertical placement of the cup and avoiding impingement are recommended. Hasegawa et al.[3] suggest that the rim of the alumina ceramic liner must be made thicker, but others direct attention to the reduction of the rigidity of the ceramic-on-ceramic coupling and prevention of impingement by the layer of polyethylene between the ceramic liner and metal neck of the femoral stem. In our case, breakage of the liner was possibly due to mistakes during the implantation of the ceramic liner into the metal shell at the initial operation, rather than late trauma or patient obesity. Thick ceramic liners need more attention during insertion and we need more industrial investigations to produce better and easier-to-use hardware.

Declaration of conflicting interests

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding

The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Heros RJ, Willmann G: Ceramics in total tip arthroplasty: history, mechanical properties, clinical results, and current manufacturing state of the art. Semin Arthroplasty 1998;9:114-22.
2. Suzuki K, Matsubara M, Morita S, Muneta T, Shinomiya K. Fracture of a ceramic acetabular insert after ceramic-on-ceramic THA--a case report. Acta Orthop Scand 2003;74:101-3.
3. Hasegawa M, Sudo A, Hirata H, Uchida A. Ceramic acetabular liner fracture in total hip arthroplasty with a ceramic sandwich cup. J Arthroplasty 2003;18:658-61.
4. Michaud RJ, Rashad SY. Spontaneous fracture of the ceramic ball in a ceramic-polyethylene total hip arthroplasty. J Arthroplasty 1995;10:863-7.
5. Fritsch EW, Gleitz M. Ceramic femoral head fractures in total hip arthroplasty. Clin Orthop Relat Res 1996;328:129-36.
6. Chotai PN, Su EP. Fracture of a titanium sleeve-encased third-generation ceramic liner in a modern THA. Orthopedics 2011;34:e682-4.
7. Nizard RS, Sedel L, Christel P, Meunier A, Soudry M, Witvoet J. Ten-year survivorship of cemented ceramic-ceramic total hip prosthesis. Clin Orthop Relat Res 1992;282:53-63.
8. Arenas A, Tejero A, Garbayo A, Arias C, Barbadillo J, Lecumberri J. Ceramic femoral head fractures in total hip replacement. Int Orthop 1999;23:351-2.
9. Elkins JM, Pedersen DR, Callaghan JJ, Brown TD. Do obesity and/or stripe wear increase ceramic liner fracture risk? An XFEM analysis. Clin Orthop Relat Res 2013;471:527-36.
10. Hannouche D, Hamadouche M, Nizard R, Bizot P, Meunier A, Sedel L. Ceramics in total hip replacement. Clin Orthop Relat Res 2005;430:62-71.
11. Butt U, Knowles D. A fractured and immovable ceramic liner in a screw-fixed acetabular shell during total hip arthroplasty: a case report. J Orthop Surg (Hong Kong) 2012;20:395-7.
12. Lombardi AV Jr, Berend KR, Seng BE, Clarke IC, Adams JB. Delta ceramic-on-alumina ceramic articulation in primary THA: prospective, randomized FDA-IDE study and retrieval analysis. Clin Orthop Relat Res 2010;468:367-74.
13. Wasielewski RC, Jacobs JJ, Arthurs B, Rubash HE. The acetabular insert-metal backing interface: an additional source of polyethylene wear debris. J Arthroplasty 2005;20:914-22.
14. Flóris I, Bodzay T, Vendégh Z, Gloviczki B, Balázs P. Short-term results of total hip replacement due to acetabular fractures. Eklem Hastalik Cerrahisi 2013;24:64-71.

15. Sarıkaya B, Ataoğlu B, Görmeli G, Öztürk BY, Turanlı S. Eight-year follow-up of uncemented hydroxyapatite coated hip prosthesis for hip osteoarthritis secondary to developmental hip dysplasia. [Article in Turkish] Eklem Hastalik Cerrahisi 2013;24:91-5.
16. Lee SC, Jung KA, Nam CH, Kim TH, Ahn NK, Hwang SH. Acetabular screw head-induced ceramic acetabular liner fracture in cementless ceramic-on-ceramic total hip arthroplasty. Orthopedics 2010;33.
17. Lopes R, Philippeau JM, Passuti N, Gouin F. High rate of ceramic sandwich liner fracture. Clin Orthop Relat Res 2012;470:1705-10.