A fractured and immovable ceramic liner in a screw-fixed acetabular shell during total hip arthroplasty: a case report

Usman Butt, David Knowles
Department of Orthopaedic Surgery, Royal Lancaster Infirmary, Lancaster, UK

ABSTRACT

We report a complication during total hip arthroplasty using an uncemented press-fit acetabular shell and ceramic liner for a woman with osteoarthritis. Fracture of the ceramic liner occurred during its insertion owing to non-concentric reduction. The main body of the ceramic liner became wedged in the acetabular shell and was resistant to removal. The shell itself was immovable owing to the prior insertion of 2 polyaxial screws, to which access was covered. Successful removal involved drilling a hole in the ceramic liner as a stress riser, and then cracking the liner with a Steinman pin.

Key words: arthroplasty, replacement, hip; ceramics; prosthesis failure

INTRODUCTION

Uncemented, press-fit acetabular shells mated with modular liners enable flexibility in selection of bearing surface for total hip arthroplasty. The Corail Pinnacle cup (DePuy, Warsaw [IN], USA) can be used with polyethylene, metal, or ceramic bearing surfaces. Ceramics have favourable lubrication characteristics and very low wear rates, with particles that are less bioactive than polyethylene or metal. Nonetheless, there are concerns over squeaking and fractures. The BIOLOX Delta (CeramTec, Plochingen, Germany) is a ceramic acetabular component comprising aluminium oxide (82%), zirconium oxide (17%), chromium oxide (0.5%), and strontium crystals (0.5%). It has improved wear characteristics and fracture toughness, but there have been reports of fractures at the time of its insertion. We report a case of a circumferential fracture at the rim of the BIOLOX Delta ceramic cup during insertion and difficulty with its removal.

CASE REPORT

In May 2011, a 51-year-old woman with osteoarthritis underwent an uncemented left total hip arthroplasty using a ceramic-on-ceramic bearing. The acetabulum
was reamed to 55 mm for a 56-mm Pinnacle acetabular shell to be inserted with a press-fit, in keeping with the pre-operative templates. Two additional screws were inserted into the acetabulum for added stability. During insertion of the Delta ceramic liner, the rim fractured and delaminated (Fig.). The main body of the liner remained firmly wedged in the acetabular shell. Extraction using the standard device was not successful given the damaged liner. Attempts at dislodging the liner by tapping at the edge and by fracturing the liner with direct central blows were also unsuccessful. Following further attempts to remove the liner, the whole acetabular construct was seen to rock, limiting further attempts at disgrading the liner. Although the shell could be rocked a few millimetres, this movement was insufficient for removal of the construct given the polyaxially placed screws. Given the potential for damaging the acetabulum, the procedure was discontinued.

Radiographs and computed tomography of the pelvis confirmed that the screws had not broken and that there were no acetabular fractures. A method was devised involving drilling a hole in the ceramic liner as a stress riser using a diamond-tipped drill-bit attached to a water-cooled dental drill. The patient was taken back to the operating theatre after obtaining her consent for the procedure. Throughout the drilling process, a water-cooling mechanism was combined with continuous suction to minimise the dissemination of any debris. A hole was created through the liner after 7 drill-tips were used. A Steinman pin was introduced at the rim of the hole, and the liner was cracked with a single modest impact and was removed with ease (Fig.).

The acetabular screws and the shell were then removed. Further inspection confirmed no fractures in the previously prepared acetabular bed. The Corin Trinity shell (Corin, Cirencester, UK) has a thicker porous coating than the Pinnacle shell. Thus, its 56-mm size was used with a solid press-fit, with no further reaming necessary. A ceramic liner was inserted with care and the total hip replacement went on to completion uneventfully. Postoperative radiographs showed a satisfactory appearance. At one-year follow-up, the patient remained well as expected for a primary total hip arthroplasty.

DISCUSSION

There have been reports of delayed fractures\(^4\)–\(^8\) and insertional fractures\(^3,^6,^9\) of ceramic liners in total hip replacement. The fracture risk is reduced with the use of the Delta ceramic liner, but insertional-related fractures and chipping remain a problem. In a multicentre trial comparing ceramic and polyethylene liners, 3 intra-operative ceramic liner-related events were reported.\(^3\) In one event, the liner fractured during insertion and was removed easily. In the second, the liner was improperly seated and was fractured during removal. In the third, the liner and shell could be removed together. There were also 2 cases of ceramic chipping or fragmentation on postoperative radiographs.\(^3\) In one case, eccentric seating of the liner was noted at the time of revision.

Imperfect seating of the ceramic liner within the acetabular shell is considered a major cause of insertional fractures and delayed chipping and fragmentation of the ceramic liner.\(^3,^{10,11}\) One study reported up to 16% of titanium-backed ceramic liners were improperly seated;\(^12\) difficulty in liner seating is not restricted to linings with metal backings.\(^3,^{10,11}\) Eccentric seating may cause peak stresses in the liner leading to intra- or post-operative fractures secondary to repeated impingements.\(^3,^{11}\)

Titanium shells have been shown to have an average of 0.16 mm of deformation during placement, particularly in hard bone.\(^13\) Any deformation in the shell may bias the ceramic liner toward non-concentric seating. The most likely cause for non-concentric reduction is the presence of soft-tissue or bony debris in the shell; even a very small amount of debris present may result in tilting in the resting position of the liner. Clearance of any debris is therefore of high importance. After placement of the liner, its concentricity should be checked circumferentially prior to final impaction, as minor degrees of tilt may not be appreciated if viewing directly from above. Therefore, an unobstructed exposure of the entire acetabulum to enable direct circumferential visualisation is important for insertion of both the acetabular shell and liner, particularly when...
minimally invasive approaches\textsuperscript{14–16} and un cemented acetabular components\textsuperscript{17} are used.

In most instances, mal-reduced liners can be removed from the shell by tapping the edge or by direct central blows to fracture the liner. Alternatively, the whole acetabular construct can be exchanged. In our patient, the liner could not be dislodged from the shell or fractured by direct impact. The screw fixation and solid press-fit of the acetabulum prevented removal of the liner without damaging the acetabular bone. Attention should be paid in placement of ceramic liners, particularly into well press-fitted metal shells in younger patients with harder bone who are undergoing un cemented total hip arthroplasty using ceramic bearings. The shell should be cleared of any soft-tissue or bony debris, and the correct seating of the liner should be confirmed through a full circumferential view of the acetabulum prior to final impaction. In the event that a non-concentric reduction occurs and the liner is not removable by conventional means, a hole can be drilled in the ceramic liner as a stress riser, and the liner can be cracked with a Steinman pin and then removed readily.

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