

## 4.5 Revision Surgery utilizing Ceramic Bearings

J. P. Garino

### Introduction

Revision surgery is a highly variable experience depending on the reason for the failure of the currently implanted hip replacement and the bone stock. The current technology in hip replacement revision surgery on the femoral side has evolved into a complex array of highly modular, extensively coated or very long devices that seek to establish durable fixation in whatever remaining bone has been left behind. These devices often take into account or have the versatility to adapt to varied and abnormal anatomy often encountered in revision surgery. On the acetabular side, bone loss has created a development of a wide variety of solutions ranging from the jumbo cups to "double bubble" and cage designs. Ceramic-ceramic bearings are quite new to the primary hip market in the USA, and therefore there is little experience with their use in revisions [1]. This paper will address some practical aspects of revision of or with ceramic bearings.

### Revision With Ceramic Bearings

The vast majority of revision surgery usually involves the revision of either the acetabular or femoral component, but usually not both. Frequently one or the other has become loose and painful and replacement of the offending component is necessary to allow the patient to return to a reasonable level of comfort and function. When both components are not changed, then rare will be the circumstance that a ceramic-ceramic bearing can be introduced. If both the acetabular and femoral components are being changed out, then an opportunity for ceramic bearings to be used may well exist. Currently there are three things to keep in mind. First, obviously, one must choose to perform the revision using components from a manufacturer that has approval for ceramic bearings as most companies do not yet have such an approval. Secondly, acetabular bone loss must be at a moderate level and one should be planning to solve the problem with a moderate to large cup as ceramic bearings do not as yet exist in the "Jumbo" sizes. Thirdly, ceramic ball heads require the use of a limited number of taper sizes that might not exist on all revision stems in a manufacturer's armamentarium. Clearly, if these three premises are met, then ceramics can be entertained as a bearing solution for the revision at hand. Ceramics may be a good choice in younger and more active to reduce the risk of another wear related failure in the near future. In addition, ceramic bearings thrive on the use of larger ball heads which should positively impact the risk of dislocation.

Other things to keep in mind when considering ceramic bearings in revision include the limited range of neck lengths (as skirted balls are not allowed) and the single acetabular liner option (as offset or face changing liners are not available). These issues may limit the ability of ceramic bearing to be used effectively in revisions. Nonetheless, in younger and more active patients, serious

consideration should be made for employing ceramic bearings in revision THR with a back-up plan available should the needs of the patient not be met by current component availability.

## Revising Ceramic Bearings

There are two "may" category subtypes in this circumstance. The first is revising for a fractured ceramic component and the second is revision for any other reason.

In the case of ceramic ball head fractures, ideally, the use of another ceramic-ceramic THR would be best. This is due to the hardness of the material and its resistance to abrasive wear. In spite of most adequate attempts to removal all of the small broken ceramic particles, complete clearance is difficult. With the retention of ceramic debris, there is an increase risk of developing significant third body wear, and the use of a new ceramic articulation reduces that risk to its lowest level.

There are two ways of accomplishing this, however only one is currently available in the United States. That would be the exchange of the acetabular or the femoral component that had sustained the ceramic failure. When a ceramic component fails it may have done so because there was some damage on the taper through which the ceramic part transferred load. In addition this taper gets exposed to ceramic debris after the failure and usually sustains further damage. For both of these reasons it is not advisable to reuse that taper for another ceramic component. Use of a ceramic component in this situation carries an increased risk of a repeat failure.

Revision of a well fixed total hip replacement often not an easy undertaking. In this circumstance, an acceptable alternative solution would be the placement of a metal ball on the femoral component and insertion of a poly liner into the acetabular component. In the case of the acetabular component, some manufactures may now be introducing a multibearing cup which would allow for easy interchangeability in these difficult situations. In cups that are specifically manufactured for a ceramic bearing, a decision needs to be made by the surgeon if the cup should be excised with an attempt to re-establish a ceramic-ceramic articulation, or if a simple poly line should be cemented into that cup. Both are viable and acceptable solutions.

On the femoral side, alumina composite materials with increased mechanical properties and a significantly increased fracture toughness may offer a reliable solution in situations where a new ceramic ball head is desirable. This material, with a metal sheath which can slip over the current femoral taper is now being used in Europe with encouraging results (Fig.1) [2].



**Figure 1:**  
CeramTec's Revision Ball head System, BIOLOX® option.

Finally, if an acetabular revision is being carried out and the femoral component has a ceramic ball head and the surgeon wishes to remove the ball head either to enhance exposure or to change the diameter or length of the current ball, what can be done?

The manufacturers of ceramic ball heads list very clearly in their label that the tapers of modular parts are never to be re-used. This is done because the quality of the taper and the mechanism of the ball removal is not in their control and can sustain some degradation or damage, particularly if the ball is removed roughly. All manufacturers have a ball head removal tool. This tool, although with differences in design for manufacturer to manufacturer, essentially places a tensile load across the taper, breaking it and separating the parts. This careful and non-destructive manner of removing the ball allows for the potential for re-use of ceramics once again. However, care must again be taken to protect the taper during the revision, often a difficult challenge. A 22 mm ball head trial can often be used for this purpose. It is therefore recommended to perform the revision with the original ball head in place if possible, and replace it at the end of the case. This eliminates the need to protect the taper for that long period of time during the cup revision. With great care, this type of replacement can be considered and, although an "off-label use" of the ceramic components, the surgeon can make a judgement that this an appropriate approach given the difficulty in removing well fixed components and the inferiority of other bearings in young and/or active patients.

Laurent Sedel, has had this approach and in his experience of over 55 cases, no fractures of components exchanged at revision has occurred [3].

## Conclusion

Ceramic revisions can be difficult due to the critical nature and therefore imposed limitations in the transfer load mechanisms designed in the stem taper to ball head and shell taper to insert. This coupled with the material limitations from both a mechanical property standpoint as well as an availability standpoint can create a challenge for the operating surgeon. With great thought, care and utilization of the guidelines outlined in this paper, the revision Total hip Replacement being performed can often be optimized for new or continued use of ceramic bearings.

## References

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