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CORR Insights

CORR Insights®: Do Alumina Matrix Composite Bearings Decrease Hip Noises and Bearing Fractures at a Minimum of 5 Years After THA?

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Where Are We Now?

The implantation of alumina ceramic bearings in total hip replacement began around 45 years ago. Ceramic bearings are advantageous because they have a low volume of wear debris, high biocompatibility of the particles that are generated, and increased wettability of the surface compared to other friction couples. Previous studies [4, 6, 8] have demonstrated the long-term limited observation of osteolysis and a low frequency of revisions even in active and young patients, some of whom practice sports. One study [7] reported on the stability of pure alumina ceramic over time. This study also examined the dense fibrous tissue that might diminish the long-term risk of hip dislocation, an interesting biological reaction to pure alumina ceramics. However, concerns about fractures have justified the search for other materials. The introduction of an alumina matrix composite material, Delta ceramics (CeramTec, Plochingen, Germany), could potentially reduce the risk of dislocation by allowing for a larger head and thinner liner [5]. This material, which includes embedded zirconia particles, is believed to provide an improved fracture resistance during the initial phase [1, 2]. The zirconia particles in the alumina matrix composite bearing can stop a crack from spreading by changing its phase from tetragonal to monoclinic. Does this phase modification have any impact on long-term ceramic resistance? The current study does not answer this question, but rather focuses on short-term results.

The current study by Baek and colleagues examined the frequency of bearing-related complications regarding alumina matrix composite ceramic bearings in cementless THA. The authors also determined the Harris Hip Scores and calculated the survivorship free from reoperation and revision at a minimum of 5 years after cementless THA performed with alumina matrix composite ceramic bearings.

The authors described one case of liner dissociation that could be related to the large cone angle (18.5°) of the construct. Regarding noise generation, they found two cases of click, which may be related to some form of limited

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instability. Clicking is different than squeaking. Squeaking is likely related to dry contact, or socket design (trident cup). The majority of complications found in the current study were related to material design or surgical skill. The number of femoral cracks or femoral fractures were possibly due to strong impaction of a large stem, and not friction couple.

Where Do We Need To Go?

A total hip that can allow even younger patients to resume higher-demand activities while avoiding adverse effects (like squeaking, fractures, and revisions) is a tall order, but should be the ultimate goal. Although improvements in alumina matrix composites have been made, we are still learning about this new bearing material. The intermediate and long-term effects remain unclear.

There is no demonstration of the superiority in the long-term of this alumina matrix composite compared with a regular modern pure alumina ceramic [6, 8]. In fact, it appears that evidence is emerging in support of biological advantages of pure alumina ceramic that were postulated years ago [3]. In particular, more recent studies have suggested a decreased risk of infection with ceramic bearings as well as a reduced risk of late dislocation, perhaps related to differences in fibrous-tissue formation [7].

The biomaterials field is complex because all mechanical, biological, and surgical details must be considered when determining failure or success. There is no free lunch; every change, every pesky detail, may have consequences. At the moment, we have more questions than answers. What are the benefits of alumina matrix composite ceramic bearings compared to those of a good pure alumina ceramic? To avoid dislocation, do we really need extra-large femoral heads and thin liners? Are 32 mm diameter bearings not safe enough when one balances the risks of dislocation or fracture? Is noise generation a real clinical problem or an anecdotal event that does not compromise the result? What role should other materials, such as metal-on-polyethylene play?

How Do We Get There?

In order to answer the questions above, researchers will need to use more patient-related outcome measures, long-term studies, and registries that can differentiate between materials. More research, specifically, prospective randomized studies comparing friction couples of the same design, is warranted. Although this kind of research may take many years, it is important to find the answers.

The tendency seems to be to go from something that worked well to something that we do not know much about. Do we do this for scientific reasons or because of marketing? A surgeon must be aware of the materials he or she is using and must resist every market pressure, considering the evidence before applying new materials in practice.

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