

## Advanced Ceramic Components for Hip and Knee Arthroplasty

### **Introduction:**

The use of ceramic oxide materials for hip arthroplasty was pioneered in France during the 1970's by Prof Pierre Boutin who used aluminum oxide femoral heads to provide a solution to high wear rates with metal on polyethylene bearing couples. The combination of low wear rates combined with aluminum oxide's excellent biocompatibility provided a successful approach to reducing clinical issues associated with polyethylene wear.

Since these pioneering days many technical innovations of the materials and processes used for hip component manufacture have taken place such as hot isostatic pressing of materials and the introduction of ceramic matrix composites. All of which have led to ceramic materials that provide the same low wear rate and proven biocompatibility but with greatly increased strength and toughness properties.

It is these benefits that C5medicalwerks provides to our customers using state of the art materials, manufacturing and a world class quality system. This technology enables C5 to provide its customers with next generation products that can greatly reduce the risk of fracture and allow more advanced designs that lead to better quality of life for patients.

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## Materials

The terminology “ceramic” when applied to femoral heads and acetabular inserts covers numerous materials with differing chemistries that provide each with distinct properties and distinction between them needs to be made. The following is a brief overview of the main oxide ceramics used in orthopaedics and offered by C5medicalwerks.

- **Alumina**

Aluminum oxide (or alumina) has the longest running successful clinical history for use in hip arthroplasty beginning in France and shortly after in Germany, its use is now widespread throughout the world.

- **Yttria partially stabilized zirconia (Y-PSZ)**

This is a material offering superior mechanical properties to alumina through a transformation toughening mechanism. Its use in orthopaedics as a bearing surface material has been practically eliminated due to poor long term clinical issues and a large product recall.

- **Ceramic matrix composite (CMC)**

The latest generation of orthopaedic ceramic materials are ceramic matrix composites that aim to provide the proven properties of alumina with the added mechanical benefits of zirconia but with greater in-vivo stability. These engineered composites incorporate transformation toughening as well as platelet reinforcement to enhance fracture resistance.



### **Femoral Heads and Acetabular Inserts**

C5medicalwerks offers the following features for modular system heads manufactured to customer specific designs:

- 28mm to 60 mm ball head diameters
- Taper type and neck length options to suit customer need

C5medicalwerks offers the following features for inserts manufactured to customer specific designs:

- The ability to offer ceramic on ceramic articulation
- A range of sizes to suit individual customers metal shells



### **Future directions for ceramics in orthopaedics**

- Hip Femoral Resurfacing

Recent attention in orthopaedics has been focused on the negative issues associated with the metal ions generated from metal on metal articulations, in particular metal on metal resurfacing procedures.

The use of ceramic bearings in resurfacing arthroplasty is one possible solution to eliminate the issue of metal ions being released from wear debris. The ability of C5medicalwerks to produce large diameter bearings using high strength ceramic matrix composite materials offers the potential to explore a ceramic solution.



- **Knee Femoral Components**

The benefits of ceramic materials in hip replacements can also be realized in knee replacements and ceramic knees have been in clinical use since the early 1970's. The benefits of low wear combined with no metal ion wear debris make them an alternative to metallic prosthesis for metal sensitive patients.

C5medicalwerks combination of advanced ceramic materials and state-of-the-art manufacturing provides our customers with next generation technology today.

Please contact one of our experts for more information:

**About the Author**

Steve Hughes, BSc, PhD is the Orthopaedic Product Manager at C5medicalwerks. He has a degree in Materials Chemistry and following his PhD on porous ceramics processing has focused on ceramics in medical applications. He has been involved in new materials development and orthopaedic implant technology development for over 10 years. He can be reached at C5medicalwerks on 303-919-8314 or

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