Improving the durability of total joint replacement

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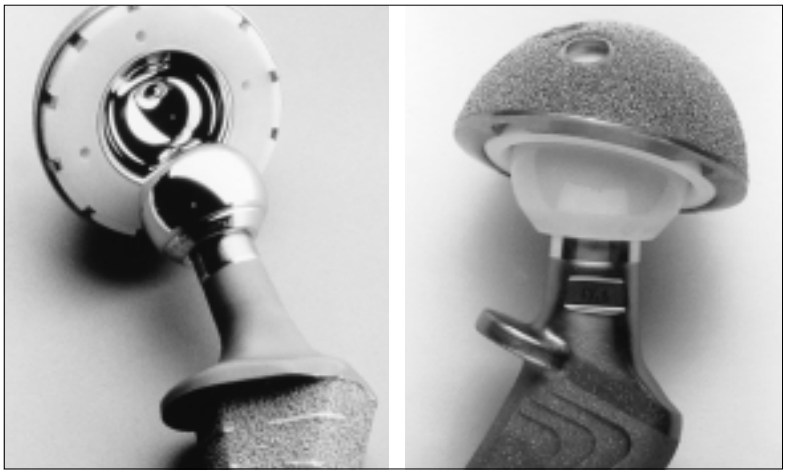
Technology: Alternative bearing surfaces for total joint replacement

Use: Wear, a major problem with joint prostheses, limits the durability of joint replacement surgery; however, new technology and materials have greatly increased its longevity.[1]

History: The first widely used joint replacement bearing involved metal-on-metal articulation. This combination was abandoned in favour of polyethylene–metal articulation because of the frictional torque associated with metal on metal. Although polyethylene and metal provide a low coefficient of friction and good biocompatability long-term studies have demonstrated that the durability of these surfaces is also limited by wear. Thus, metal–metal pairings are once again at the forefront of joint replacement technology. Improved engineering and manufacturing has resulted in more durable metal–metal prostheses with lower coefficients of friction.[2]



Metal–metal prosthesis (left) and ceramic–ceramic prosthesis (right).

As a bearing surface ceramic also shows great potential; its hardness, which tolerates rigorous polishing, makes it quite scratch resistant. In addition, the fact that it is wetable allows for less friction.[3]

Promise: These bearing surfaces show great promise in prolonging the durability of joint replacement.[4] In addition to lasting longer, it is hoped that the volume of wear debris, which is injurious to the bone around the prosthesis, will be minimal.

Problems: Metal–metal articulations still produce some wear debris that may be harmful to the surrounding cells because of the metallic nature and small size of the particles. Ceramic–ceramic articulations produce minimal wear debris, but debris that is created is highly abrasive and may cause long-term problems. Ceramic is also very brittle and can fracture if it is subjected to unusually high loads[5] or if unacceptable stress is applied to it by virtue of poor tolerance between ceramic and metal components.

Prospects: The prospects for improved bearing surfaces are good. Metal–metal and ceramic–ceramic are the surface combinations that are advanced enough for commercial production and general use. Their efficiency when compared with the conventional metal–polyethylene bearing surface has not yet been determined, however; large clinical trials are underway in Canada.

Other biocompatable, nonrigid bearing surfaces such as improved high-density polyethylene are currently being developed and will, hopefully, be available for clinical trials in the near future.

Competing interests: Dr. Waddell has received research funding and travel assistance from orthopedic manufacturing companies.

References

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