Editorial

Biotribology

The short history of biotribology includes several valuable innovations and, regrettably, some disasterous failures. The low-friction total hip arthroplasty by Charnley serves as an example of how one can learn from errors and improve. However, as total joint implant failures are often a catastrophe for the patient, new implant materials or designs should be introduced into wide clinical use only after rigorous biotribological testing, including several tools which are available today. In about 1960, Charnley could only dream about sophisticated hip simulators, artificial aging of polyethylene, radiostereometry and currently available mathematical simulations. Also, the Nordic arthroplasty registers have been successful in detecting bad implants relatively quickly. During recent years, biotribology has become one of the main topics of the major international orthopedic research meetings.

Ultra-high-molecular weight polyethylene (PE) is still a cornerstone of most joint replacements, but it is subject to oxidation, changes in tensile properties with time and variable wear. Several attempts at improvement have failed. The oxidative degradation of traditional PEs is the result of the residual free radicals that lead to oxidation which causes chain scission. The net effect of such processes is a reduction in the strength and toughness of the PE. Manufacturers of the new PEs have tried to develop optimum methods to increase molecular cross-linking of the material. In simulator studies, the new highly crosslinked PEs have performed excellently and have reduced the wear rates significantly. Also, the clinical wear seems to be less than with conventional PEs. There are great hopes that the hip surgeon community can start using larger femoral heads to avoid impingement and dislocation in THR. This, however, leads to the use of thinner PE acetabular shells. There is some preliminary evidence that the new highly cross-linked PEs may lose some of the initially optimal ductility during aging. Theoretically, this could lead to an increased risk of fracture of e.g. thin PE liners in metal-backed acetabular components. In general, it appears that the new highly cross-linked PEs are a great advancement in THR technology. However, clinical researchers point out that too little is still known about the long-term behavior of the previous and current PEs. In any event, technological research focusing on this useful and exciting material is currently advancing at high speed, and hopefully the direction of this process is being carefully chosen. The true clinical results will be seen first after a few years—in analyses using data of the Nordic arthroplasty registers.

During the past decade, metal-on-metal (m-o-m) THR prostheses have become increasingly popular. However, very few controlled studies regarding m-o-m THR arthroplasties exist and many of the publications commonly referred to are 2 or 3 decades old. Also, most of the studies included only small groups of patients, which does not allow any conclusions regarding possible teratogenic effects. Should use of these THRs be restricted in female patients of fertile age? To avoid the risk of impingement, which is very detrimental in the case of all hard-on-hard THRs, larger head prostheses have been introduced by the industry. The first clinical and tribological laboratory results have been encouraging. Currently, resurfacing THRs have again become very popular, especially for younger and active patients. Here again, very limited long-term outcome data from controlled studies exist in the current literature. Clearly, a good collaboration between clinical researchers, tribologists and the industry is very important for true advancement in THR technology.

Seppo Santavirta

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