The Wear Problem in Total Joints

Wear related failure of total joint replacements remains a serious problem. The release of wear particles from implant components causes a biological reaction that can end in bone breakdown (osteolysis) and implant loosening. The problem is very complex because the implant wear can be affected by patient risk factors, surgical technique, implant design and materials.

Recent advances have improved understanding concerning how total joints wear and the consequences of wear debris. This has led to new means of addressing the problem of wear-related breakdown.

The size of the problem remains difficult to measure. Patient activity can vary widely and may be the single-most important risk factor affecting wear. When failure of a joint replacement does occur, problems with bone loss faced at revision surgery are extremely serious and very difficult to deal with.

I have been involved in many revision surgeries over the years which have been caused by this type of joint failure and I wish to tell you that this is one of the most demanding surgeries that we face. The problems related to bone loss are a very serious challenge to the surgeon.

The introduction of more wear-resistant materials will not eliminate the problem, because of the large number of total joint replacements that have already been performed in the last two or three decades.

You should probably skip this because it is very technical! Biologically the reaction to wear debris results from activation of phagocytosis by macrophages accompanied by local production of cytokyne enzymes that in turn cause a paracrine activation of peri-prosthetic osteoclasts.

In plain English, this means that the bone breaks down around the prosthesis in response to the wear debris, causing loosening of the prosthesis and many changes in the surrounding tissues.

The host response to wear particles is quite different from one patient to the next. Identification of the factors responsible for these differential effects is of great clinical importance. We now have technology available for identifying genetic factors that determine the pattern of host response.

Biomedical Engineering

The Biomedical engineers have been extremely busy in their laboratories giving us new materials to use for total joint replacement. Ultra high molecular weight polyethylene has been introduced which has the ability to wear at much lower rates than regular polyethylene. New cross-linked polyethylenes have been developed in which gamma radiation is used to form an increased number of cross-links between the polyethylene molecular chains. Degradative free radicals that form during the cross-linking are removed through thermal treatment of the material.

The resulting materials have significantly better wear resistance than conventional polyethylene, especially in hip joint acetabular components.

Metal-on-metal bearing surfaces were reintroduced when the FDA approved a cobalt alloy-on-cobalt alloy total hip replacement.

We also have been given ceramics such as Alumina and Zirconia which promise much lower wear rates in hips.

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