BIOMATERIALS IN ENDOPROSTETICS

Drago Dolinar

Orthopedic Clinic of University Medical Center Ljubljana, Zaloška cesta 7, 1000 Ljubljana, Slovenia

The endoprosthetics of hip- and knee-joint replacements is currently the most common and successful method in advanced surgery to treat degenerative joint disease, for relieving pain and for correcting deformities.
Cobalt-chromium-molybdenum alloys, titanium alloys, trabecular tantalum, biolox ceramics, UHMWPE polyethylene and PMMA bone cement are the most common biomaterials used in endoprostetics.
The published results of long-term investigations demonstrate the excellent clinical results from at least 15 years after TJR surgeries. Using new, improved surgical operation methods as well as new, improved implants of advanced biomaterials, the greater success with clinical results is expected.
While these surgeries have positive outcomes, approximately 10% of the implants fail prematurely. Aseptic loosening and periprosthetic joint infection are the main causes of failure for joint arthroplasty.
The Orthopedic Clinic Ljubljana performs between 80 and 100 revision surgeries of knee and hip endoprostheses per year. The most common causes for revision surgeries are aseptic loosening and implant infection. For all treated patients the clinical course of treatment including X-ray documentation is precisely followed. The retrieved endoprostheses are sent for bacteriological analysis, while the endoprosteses are preserved for further investigations.

The biotribology analyses of retrieved hip and knee endoprostheses were performed in cooperation with IMT Ljubljana using advanced analytical and integrated electron spectroscopy techniques. Two new and two retrieved endoprostheses were studied. The surface chemistry and microstructures of both the new and used titanium alloys and CoCrMo alloys used for hip and knee endoprostheses were determined using SEM (morphology), EBSD (phase analysis), and AES and XPS (surface chemistry). SEM SE and BE images showed their microstructures, while EBSD provided the phases of the materials. During the production of hip and knee endoprostehses, these materials are subject to severe thermomechanical treatments and physicochemical processes that are decisive for CoCrMo alloys. The AES and XPS results showed that thin oxide films on (a) Ti6Al4V are a mixture of primarily TiO_2 with a small amount of Al_2O_3, while the V is depleted, (b) Ti6Al7Nb is a mixture of primarily TiO_2 with a small amount of Al_2O_3 and Nb_2O_5, and (c) CoCrMo alloy is a mixture of primarily Cr_2O_3 with small amounts of Co and Mo oxides. Biolox ceramic delta and forte were investigated by HR-TEM and UHMWPE polymer by differential scanning calorimetry (DSC) and differential thermal analysis (DTA).