

Comparison of Biological Response to UHMWPE and CFR-PEEK Particles in Epidural Space*K. Kabir¹, J. Schwiesau², C. Burger¹, R. Pflugmacher¹, T. Grupp², D.C. Wirtz¹*¹Universitätsklinikum Bonn, Department for Orthopaedics and Trauma Surgery, Bonn, Germany,²Aesculap AG Research & Development, Tuttlingen, Germany

Introduction: Total disc arthroplasty (TDA) is designed to preserve motion and to decrease the risk of accelerated degenerative disease at adjacent levels. The clinical significance of wear debris is reported after TDA. One of the goals in designing new implants is to use materials with low wear rate-behaviour, which produces wear debris with low biological activities. Our goal was to compare the biological response of Ultra High Molecular Weight Polyethylene (UHMWPE) and carbon fibre reinforced PEEK(CFR-PEEK) wear debris in epidural space.

Materials and methods: Thirty six female rabbits were randomly allocated to 3 groups: CFR-PEEK, UHMWPE-particles and sham. The particles were implanted into the epidural space of the cervical region by percutaneous technique (fluoroscopic guidance). Neurobehavioral observations were conducted at pretreatment, on day 1-14 postinjection, then weekly. The rabbits were sacrificed at 3 and 6 months. Histologic sections from the regional lymph nodes, organs, from remote and implantation sites, were analyzed for any abnormalities and inflammation.

Results: Expect of three animals of CFR-PEEK group, non of the animals showed any neurological or musculo-skeletal abnormality. The neurological deficits presented immediately after injection and did not progress. Blood results from predeath samples were consistent with preoperative blood work values. There was no evidence of systemic toxicity. Histopathological examination revealed, that crystalline wear debris was seen in the vertebral canal of examined test injection sites surrounded by inflammatory cells. Regardless of the implantation time, both CFR-PEEK and UHMWPE particles remained at the implantation site. The inflammation was limited to the epidural space around the particles. The image shows the histopathological response to wear debris in epidural space after 6 months: a. UHMWPE-group and b. CFR-PEEK group. (* cervical spinal cord, X epidural space with different wear debris and + bony lamina). The time(3 or 6 months) after implantation did not effect the extent of histological response.

Conclusion: The established percutaneous implantation of wear debris in the cervical epidural space could be used as a standardised in vivo model to simulate the biological consequences of debris after TDA. CFR-PEEK and UHMWPE show similar histopathological changes in the cervical epidural space. The inflammation was limited to the epidural space around the particles. In past studies, CFR-PEEK demonstrated an excellent wear behaviour with a wear rate reduction in comparison to UHMWPE in in vitro studies. Therefore CFR-PEEK based articulations may be a good alternative to UHMWPE on metal and have a high potential for next generation disc replacements.