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### **Establishment Of Standard Values For Multielement Analysis Of Metal Ions In Knee Joint Synovial Fluid**

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#### **Abstract:**

**Introduction:** Standard diagnostics in metal wear of implanted knee and hip endoprosthesis include blood analysis. Standard values already exist in EDTA whole blood and serum. The local concentration of metal ions in the synovial fluid has not yet been considered as a valuable diagnostic tool and standard values do not exist yet. In a study by Houdek et al. the cobalt and chromium concentration in the synovial fluid was found to be the best predictor for an ALTR (adverse local tissue reaction) in the context of hip revision arthroplasty. The aim of this study was to perform metal ion analysis of synovial fluid from patients without existing metal implants indicated for primary knee arthroplasty to establish standard values in order to evaluate the local metal ion concentration.

**Methods:** During the period of 04/2022 to 01/2023 multielement metal ion analysis of the synovial fluid and blood of 50 patients with primary knee arthritis who underwent implantation of a bicondylar knee arthroplasty was performed. The arthrocentesis was performed in the beginning of the operation before arthrotomy. EDTA blood (min 3ml) was taken before the beginning of anesthesia and i.v. infusion. The levels of cobalt, aluminum, chromium, manganese, molybdenum, niobium, nickel, tantalum, titanium, vanadium and zirconium were evaluated for both blood and synovial fluid. Patients with any other metal implant in the body such as other endoprosthetic implants, cardiac pacemakers, osteosynthetic material or dental implants were excluded from the study. We performed descriptive statistical analysis. The 95th, quantile, median, mean value and standard deviation were determined. Furthermore, the lowest detection limit was calculated for each type of metal.

**Results:** Our systematic analysis showed characteristic patterns for the synovial fluid, which differed significantly from the systemic profiles in the blood. Based on this, we have defined appropriate reference values representing the range of unexposed patients.

**Discussion:** To our knowledge this is the first analysis of physiological metal ion analysis of the synovial fluid. An increase of knee revision arthroplasty cases has been described in literature including the more frequent use of rotating and total hinged knee arthroplasty models in order to restore sufficient function and stabilisation in the collateral ligament deficient knee. This leads to an increase of metallosis (Gramlich Y, 2022) which should not only be diagnosed by blood samples but also by an analysis of the local synovial fluid concentration of metal ions. Metal ions serve as different parts in the metabolism and play an important role in complex biochemical pathways. Accumulation is different in

every type of metal ion and not fully understood.

**Significance/Clinical Relevance:** Establishment of standard values in the local surrounding of knee endoprotheses, introduction and addition to diagnostic tools for indication of knee arthroplasty revisions and follow up diagnostics

Author Disclosure Information:

**S. Donner:** 2; J&J DePuy, Smith&Nephew. **L. Heinemann:** None. **M. Ort:** None. **K. Huesker:** None. **C. Perka:** 2; DePuy J&J, Zimmer. **S. Geissler:** None.

**Additional Questions (Complete):**

\* **Abstract Description:** Translational

\* **Abstract Collaboration:** 2

**Abstract Collaboration Details:** : IMD Institute, Julius Wolff Institutue

\* **Abstract Nature of Research Animal Study:** No

\* **Abstract Nature of Research Human Subjects:** Yes

\* **Abstract Nature of Research Cell Culture:** No

\* **Abstract Nature of Research Computer Model:** No

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\* **Abstract references:** : N/A

\* **Abstract acknowledgements:** : N/A

**Category for Review (Complete):** Biomaterials - Orthopaedic Implant Materials ; Hip and Knee Arthroplasty - Implant Materials, Fixation and Wear ; Knee - Diagnostics

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