**Introduction:** In total joint arthroplasty, particulate wear debris is thought to be a principal cause of aseptic loosening and premature failure. These particulates include a release of cytokines, such as interleukin-1β (IL-1β), interleukin-6 (IL-6), interferon (INF), tumor necrosis factor (TNF), and prostaglandins (PGs) (1,2). IL-1β has been shown to stimulate both osteoclastic cell formation as well as increased osteoclastic activity which can lead to the destruction of the bone matrix surrounding the device (3). Since an activated osteoclast can be identified by the release of a specific enzyme, tetrarate-resistant acid phosphatase (TRAP) (4,5), it is possible to better monitor this bone resorption process.

The purpose of this study was to determine if IL-1β and TRAP levels found in synovial fluid aspirates from total knee arthroplasty (TKA) can be used as indicators of increased inflammatory and osteolytic reactions within a replaced joint. We have compared the IL-1β and TRAP levels in osteoarthritics (DJD) scheduled for TKA to those in TKA scheduled for revision (REV). Revision cases involving failed Porous Coated Anatomic (PCA) (Howmedica, Inc., Rutherford, NJ) and Genesis2 (Smith & Nephew Richards, Inc., Memphis, TN) prostheses produced varying amounts of cobalt-chrome alloy (CoCr), UHWW polyethylene, and PMMA debris particles. Revision cases involving failed Miller-Galante (Orthofix, Inc., Sandy, UT), and TRA prostheses produced varying amounts of titanium alloy (Ti), UHWW polyethylene, and PMMA debris particles.

**Methods:** In the operating room, an 18 gauge needle was inserted into seven DJD and twenty REV (11 Ti and 9 CoCr) knee joints prior to the incision of the synovial capsule. The synovial fluid was aspirated from each knee joint and was immediately transferred into lavender-topped Vacutainer® tubes (Ryan Medical, Brentwood, TN) containing EDTA.Aliquots of 1 ml were then transferred to dolphin microcentrifuge tubes (Sorenson, West Salt Lake City, UT), and were stored at 30° Celsius. The IL-1β and TRAP assays were performed using the Quantikine High Sensitivity ELISA kit (R&D Systems, Minneapolis, MN) and a Phosphatase Endpoint Colorimetric assay kit (Sigma Diagnostics, St. Louis, MO), respectively. For both assay procedures, a microcentrifuge tube of synovial fluid from each knee was brought to room temperature and centrifuged at 14250g for seven minutes. The optical densities for the IL-1β and TRAP assays were obtained using a spectrophotometer (Model LP4000, Sanofi Diagnostic Pasteur, Chaska, MN) set at 492nm and 405nm, respectively.

For the IL-1β assay, aliquots from each synovial specimen were added to two test wells. A blank as well as seven standards were created, in duplicate, under the benchtop plasma protocol (0.125, 0.25, 0, 1, 2, 4, 8pg/ml). Special procedures included automatic mixing during pipetting of diluents due to the viscous nature of some of the synovial fluid specimens. Additionally, inorganic phosphates or excessive drying of the wells by vacuum aspiration. All washings procedures again included automatic mixing during pipetting of diluents due to the viscous nature of some of the synovial fluid specimens. 0.125, 0.25, 0.5, 1, 2, 4, 8pg/ml. Special procedures included automatic mixing during pipetting of diluents due to the viscous nature of some of the synovial fluid specimens. Additionally, standard protocols were used to verify that the TRAP assay kit was performed optimally.

All knees were free of infection as determined by routine aerobic/anaerobic gram stain and bacteriology culture techniques. Demographic data including age, gender, and synovial fluid color were collected. A medical chart review was conducted to exclude patients suffering from other underlying conditions such as rheumatoid arthritis and diabetes mellitus. For the REV knee group, the duration of time the components had been implanted was noted. Each of the failed prosthetic components were retrieved and visually inspected for the failed prosthetic components were retrieved and visually inspected for the failure of the component or the amount of wear that had occurred for either the REV knees. Additionally, no significant correlation was found between the IL-1β and TRAP concentrations.

**Discussion:** Following phagocytosis of the wear debris the synovocytes release IL-1β. This cytokine has the ability to stimulate both osteoclastic cell formation as well as osteoclastic bone resorption (3). Activated osteoclasts are specialized cells capable of dissolving large areas of bone matrix. TRAP is an enzyme produced primarily by activated osteoclasts and is essential in the bone resorptive process (4,5). Therefore, both the IL-1β and TRAP concentrations are used to better understand the level of inflammation and bone osteolysis that is occurring within the TKP capsule.

**Conclusion:** This study has shown that there were significantly greater concentrations of both IL-1β and TRAP in REV knees than in the DJD knees. These results show that while both knee groups are in an inflammatory state, there was a greater inflammatory and osteolytic reaction occurring in the REV knees which was most likely attributable to the high concentration of particulate wear debris produced from the prosthesis. Additionally, regardless of their inflammatory nature, both Ti and CoCr alloy knees produced TRAP levels of comparable proportions (49.59 U/L and 52.98 U/L, respectively) reflecting an equivalent bone resorptive environment.

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**References:**


2. TRAP results were converted to International Units (U/L) by multiplying by a factor of 16.7. Special procedures again included automatic mixing during pipetting of diluents due to the viscous nature of some of the synovial fluid specimens. Additionally, normal and elevated enzyme controls were used to verify that the TRAP assay kit was performed optimally.

All knees were free of infection as determined by routine aerobic/anaerobic gram stain and bacteriology culture techniques. Demographic data including age, gender, and synovial fluid color were collected. A medical chart review was conducted to exclude patients suffering from other underlying conditions such as rheumatoid arthritis and diabetes mellitus. For the REV knee group, the duration of time the components had been implanted was noted. Each of the failed prosthetic components were retrieved and visually inspected for wear. Student’s t-tests, regression, and ANOVA, followed by Tukey analyses, were used to analyze the data from the knee groups. Significance was accepted at p<0.05.

**Results:** The average aspirated fluid volumes were 11.4ml ± 5.6ml from the DJD knees and 16.9ml ± 5.2nl from the REV knees (p<0.05). The Ti and CoCr knees produced similar levels of IL-1β (25.75 U/L and 29.64 U/L, respectively) did not statistically differ from each other. The average IL-1β concentration was 0.25pg/ml ± 0.03pg/ml for the DJD knees and 6.25pg/ml ± 4.34pg/ml for the REV knees (p<0.0001). Additionally, the average IL-1β concentration was 9.92pg/ml ± 2.66pg/ml for the Ti knees and 2.57pg/ml ± 1.57pg/ml for the CoCr knees (p<0.0001). The average TRAP concentration was 14.07 U/L ± 3.90 U/L for the DJD knees and 51.12 U/L ± 25.75 U/L for the REV knees (p<0.0001). The TRAP concentrations found in the Ti and CoCr REV knees (49.59 ± 23.48 U/L and 52.98 ± 29.64 U/L, respectively) did not statistically differ.

Regeneration analyses failed to show any significant relationships for either IL-1β or TRAP concentrations with age, gender, or fluid color. No significant relations were found for either IL-1β or TRAP concentrations with the duration of time since implantation of the component or the amount of wear that had occurred for either the REV component type. Also, no significant correlation was found between the IL-1β and TRAP concentrations.