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"Are Markers of High Bone Turnover, Representing Poor Bone Quality, Associated with Pain After Total Knee Arthroplasty?"

Introduction: Osteoporosis is a condition that is drastically underdiagnosed in patients who undergo total knee arthroplasty (TKA) for osteoarthritis. Our group previously found only 20% of a cohort of 204 Louisiana patients undergoing TKA, who also met USPSTF criteria for bone mineral density screening, had been screened for osteoporosis. Because BMD screening was under-utilized in our patient cohort, this study seeks to determine if bone quality prior to surgery affects post-surgical pain. Patient bone quality was assessed by measuring serum levels of five markers indicative of active bone turnover--Dickkopf-related protein 1 (DKK-1), Sclerostin (SOST), Osteocalcin (OCN), Osteoprotegerin (OPG), and C-terminal telopeptide of type 1 collagen (CTX-1). We hypothesized poorer outcomes (high pain post-surgery) would be associated with markers of high bone turnover--low DKK-1, SOST; high OCN, OPG, CTX-1. Additionally, we tested if co-variates age, gender, and race affect levels of bone turnover markers in our patient cohort.

Methods: Serum samples were collected from 40 patients (32 women; 8 men) at the time of TKA. Enzyme-linked Immunosorbent Assays (ELISA) were run to quantify each of the five bone turnover markers, and the results were analyzed via Pearson correlation (R) analysis for association with patient reported pain scores at 3 months post TKA. The Knee Osteoarthritis Outcome Score (KOOS) scale was used to measure patient post-surgical pain and outcomes. Correlation analysis of the ELISA results was also run with patient age, race, and sex.

Results: We found serum concentrations for DKK-1, SOST, and OCN were not a good indicator of patient outcomes and pain after TKA ($p > 0.05$). Significant associations were noticed, however, for OPG and CTX-1. OPG significantly ($p < 0.05$) positively correlated with patient-reported KOOS pain, indicating lower serum levels of OPG were associated with greater pain after TKA. Serum CTX-1 significantly ($p < 0.05$) negatively correlated with patient-reported KOOS pain as well as symptoms, indicating higher serum levels of CTX-1 were associated with greater pain and poorer symptoms after TKA. Also, a unique relationship was observed between serum levels of OPG and patient sex and race. Compared to other cohort patients, white men were statistically more likely to have higher levels of OPG, while black women were statistically more likely to have lower levels of OPG ($p < 0.05$).

Conclusion: Currently, many interventions exist to improve bone health prior to TKA surgery, as well as methods to correct for poor bone health during TKA surgery. Thus, knowing patient bone quality prior to surgery could greatly improve TKA outcomes. In this study, we attempted to identify ex vivo markers of bone quality that predict high pain after TKA surgery, thereby providing new tools for testing patient bone health prior to TKA surgery.