

Comparison of osseous integration rate at bone-implant interface according to systemic administration of parathyroid hormone

JIUN KIM¹, Hyeon Jang Jeong², Joo Han Oh²

¹Kangwon National University College of Medicine, ²Seoul National University Bundang Hospital

INTRODUCTION:

While symptomatic loosening after shoulder arthroplasty is relatively rare, asymptomatic radiolucent lesions around joint prostheses have been frequently reported. This occurrence becomes more prevalent with prolonged follow-up. Efforts to prevent such complications have been relatively limited, therefore, our study aims to evaluate the impact of systemic recombinant human parathyroid hormone (rhPTH) administration on implant-bone bonding around joint prostheses in the rabbit model.

METHODS: A total of 24 rabbits were randomly selected with a control group and an rhPTH group (12 rabbits each). The rhPTH group received a daily dose of 10ug of teriparatide per kilogram of rabbit weight for four weeks. Implants were inserted in all groups, and a hematological evaluation was conducted prior to insertion using an enzyme-linked immunosorbent assay (ELISA) kit to measure bone markers: tartrate-resistant acid phosphatase (TRAP), alkaline phosphatase (ALP), and osteocalcin (OC). Four weeks after insertion, all groups underwent a second hematological evaluation before being euthanized. Subsequently, six rabbits from each group were subjected to a biomechanical study including load-to-failure measurement. Additionally, a radiologic study was performed using micro computed tomography to measure bone mineral density (BMD) and bone volume (BV).

RESULTS: There were no statistically significant difference in the results of ELISA test for TRAP, ALP before implant insertion within each group (all $p > 0.05$), except for OC ($p < 0.001$). At four weeks after implantation, the TRAP levels were 34.1 ± 10.1 IU/L in the control group and 32.2 ± 9.9 IU/L in the rhPTH group ($p = 0.67$). The ALP levels were 66.0 ± 14.4 IU/L in the control group and 83.6 ± 23.2 IU/L in the rhPTH group ($p < 0.05$). OC gap levels were measured at -6.7 ± 2.8 ng/ml in the control group and 0.8 ± 3.8 ng/ml in the rhPTH group ($p < 0.001$). Which meant that the similar levels of TRAP in both groups indicated comparable rates of bone resorption, while the increased levels of ALP and OC in the rhPTH group suggested enhanced bone formation activity. The mean load-to-failure of the rhPTH group (649.5 ± 105.7 N) was significantly higher than the control group (544.1 ± 68.6 N, $p < 0.01$). However, The mean BMD (rhPTH : 1.0 ± 0.1 mm³, control : 1.0 ± 0.2 g/cm³) and BV (rhPTH : 351.0 ± 49.5 mm³, control : 348.3 ± 89.4 mm³) was no statistically significant differences (all $p > 0.05$).

DISCUSSION AND CONCLUSION:

In this rabbit model, rhPTH led to increased bonding at the prosthesis-bone interface in shoulder joint arthroplasty. Based on the current study, we infer that rhPTH may facilitate bone ingrowth around artificial joint replacements, which could contribute to improved long-term outcomes following shoulder arthroplasty.