Cell Attachment to Orthopaedic Implants Is Affected by Local Fracture Conditions

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Purpose: Orthopaedic implant-related infections occur in open fractures at a 20% infection rate. Recent work has established that endogenous cell attachment to implants is critical for protection from bacterial adhesion and biofilm formation. We use external fixator (ex-fix) pins as a model of human host cell attachment to implants to investigate the effect of fracture type on implant-adhered cell phenotype toward the goal of improved implant- associated infection prevention and care. We hypothesize that differences in the implanted pin microenvironment will affect cell type prevalence in the implant-adherent cells.

Methods: This study was approved by the Institutional Review Board (IRB00091189). Upon removal, ex-fix pins were treated with an enzymatic solution to isolate the adherent cells, followed by density gradient separation of erythrocytes from mononuclear cells. The resulting implant-adherent cell population was stained for flow cytometric analysis. Four main cell populations were identified as fibroblasts, fibrocytes, innate lymphoid, and leukocytes (including the subtypes of monocytes, macrophages, and other leukocytes). Statistical analysis was performed in GraphPad Prism, version 10.3.0.

Results: In the initial cohort of this ongoing study, 31 patients have been enrolled. A total of 41 samples were analyzed, including 21 pins from fractured bones and 20 pins from adjacent, uninjured bones used for injury stabilization. There were no significant differences in cell type prevalence based on patient age or sex or whether the implant location of the ex-fix pin was a fractured bone or an uninjured bone. Within the pins that were implanted in a fractured bone, there were significant differences in the main cell types based on whether the fracture was open or closed (2-way ANOVA, $p<0.00005$) but no differences in leukocyte subtypes.

Conclusion: The present study observed that distinct cell populations adhered to orthopaedic implants based on open or closed fracture type. Further patient accrual and planned in vitro and animal model studies will provide mechanistic insight into the potential difference in cell type recruitment, adhesion, or proliferation under different injury conditions, and this may provide discrete treatment targets for improved host cell integration with implants via implant surface coatings or modifications.