The Biedermann Lab: Current Research Trajectory and Future Directions

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Since its opening in 2015, the Biedermann Lab has sought to characterize the macroscopic biomechanical interactions between connective tissues, bone, and orthopaedic implants. We have con-ducted a variety of biomechanical experiments that span across a variety of injuries and subspecialties. These efforts have resulted in abstracts and full-length publications that include but were not limited to: tendon and ligament biomechanics[1–4], trauma implant performance[5–10], osteoporotic fracture and fixation[11,12], and other orthopaedic applications[13–15].

Our group focuses on implant compliance, which, among other pathologies, has direct clinical implications with respect to osteoporotic fracture reconstruction. Several publications from the Biedermann Lab demonstrate the importance of implant compliance. For example, one of our first studies revealed that fatigue life is codependent upon stable locking of the screws, and the im-plant's ability to bend elastically[8]. We have also shown that location of the implant may have direct implications with respect to fixation strength and fatigue life[11].

Our research focus has resulted in several sponsored projects with industrial partners. In a recent study with Zimmer Biomet, we found that cement augmentation can significantly change initial compliance of a reconstruction, but these changes made no significant improvement in fatigue life. In a separate study, funded by Integra Life Sciences, we examined the compliance of reverse total shoulder implants. We found no changes between compliant and stiff groups before initial implant loosening; however, stiffer implants significantly delayed the onset of catastrophic failures. Results from these two studies are uniquely different, which underscores the importance of examining research questions in this niche on an application-specific basis. Aside from the aforementioned studies, the Lab has also been supported by the following sources: AOFAS, AOTNA, The Bach Fund, DePuy Synthes, The McCabe Fund, NIAMS, OREF, and Stryker Orthopaedics.

Results from our work are beginning to directly impact clinical practice. For example, our "don't miss high" finding in proximal humerus locking plate location has begun to change clinical practice. This study provides critical evidence that buttressing (not perforating) poor quality bone stock with surgical screws provides improvements in fixation strength and fatigue life. This finding has recently been confirmed in a clinical study[21], while findings from another study have directly led to an actively funded clinical trial at Penn.

It is clear that the forward momentum of the lab is strong, our national recognition is on the rise, and the future holds great promise to change the current paradigms associated with osteoporotic fracture fixation. None of this would be possible without the Biedermann family's generous contribution. We look forward to making this this already successful collaboration even more successful in the coming years.

Instron machine set-up at the Biedermann Lab for Orthopaedic Research

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