Effects of Glenoid Ultrastructural Bone Architecture on Suture Anchor Stability

**Abstract Introduction:**
Suture anchors are widely used in arthroscopic repair of the glenoid labrum. A wide variety of anchor shapes, materials and sizes are available, however no consensus as to the optimal anchor type exists, nor whether certain anchor types are more appropriate for different bone ultrastructure. Furthermore, the quality of the bone around the glenoid rim and anchor fixation strength are known to vary with location, but no previous work has expressly evaluated the relation between these. This study tested two different anchor types in locations around the glenoid and compared stability to the local ultrastructure.

**Methods:**
Sixteen human cadaveric glenoids (average age 80±5) were dissected and imaged with micro-computed tomography (MicroCT scanner, GE Healthcare, Milwaukee, WI). These scans were analyzed with MicroView software (GE Healthcare, Milwaukee, WI) to determine trabecular bone mineral density (BMD, mg/cc), bone fractional volume (BFV, %), trabecular thickness (TbTh, mm), trabecular spacing (TbSp, mm) and trabecular number (TbN, #). All parameters were evaluated in three separate 2x2x2mm cubes: one immediately below each of the 12, 9 and 4.30 clock face positions on the gelenoid. These regions represent the superior gelenoid, the posterior gelenoid and the anti-tero-inferior gelenoid immediately below the cortical layer. (Figure 2). Cortical thickness (mm) was also measured from these scans using a single region of interest corresponding to the intersection of the gelenoid rim and a user defined 4x4x4mm cube.

After imaging, gelenoids were potted and randomized to either a bioresorbable punch type anchor (Bioraptor 2.9mm, Smith and Nephew, Memphis, TN) or a metallic screw type anchor (Twinfix Ti 2.9mm, Smith and Nephew, Memphis, TN). 3.0mm preholes were drilled and anchors were placed by one author according to manufacturer’s instructions. Loops were formed around a 2° dowel by tying 5 square knots. The gelenoids were then loaded in a biaxial materials test frame at 10 to 45N for 500 cycles at 0.5mm/s, followed by a pull to failure test at 0.5mm/s. First and last cycle stiffness, displacement during cyclic loading and failure load were calculated and compared across anchor types using 2-way ANOVA. Mechanical parameters were then correlated with bone ultrastructural parameters using (nonparametric) Pearson’s product moment correlations.

### RESULTS:
The bioresorbable anchors were particularly prone to early failure, and among the anchors that survived cyclic testing, they had a lower last cycle stiffness and higher displacement during cyclic loading. Results of biomechanical testing is summarized in Table 1. The bone quality of the specimens in the metallic screw type group tended to be higher, despite randomization of specimens, as summarized in Table 2.

### DISCUSSION:
Despite the popularity of suture anchors, knowledge of how different anchor types behave in different bone quality is limited and recommendations as to the optimal anchor type for different bone types are few. In this study, the metallic screws were less likely to fail during cyclic loading and had a higher last cycle stiffness and lower displacement. The bone quality for the metallic screw anchor specimens tended to be better than the gelenoids in the bioabsorbable punch group, despite randomization of specimens, and as the tissue quality differed between the gelenoids of the metallic screw type anchors, significant correlations were seen between bone mineral content and failure load (p=0.06). For the metallic screw type anchors, significant correlations were seen between trabecular thickness and first cycle stiffness (p=0.06) and near significant correlations were seen between bone mineral content and first cycle stiffness (p=0.07), cortical thickness and failure load (p=0.06) and cortical thickness and displacement (p=0.11).

### REFERENCES: