INTRODUCTION
The use of posterior capsular plication to decrease capsular volume and reduce capsular laxity for treatment for posterior instability, multidirectional instability, or as an additional technique in the treatment of anterior instability is common. Although it is well known that capsular stitches hold well in the labrum and anterior capsule, the posterior capsule is thinner, less robust biomechanically, and may not provide an optimal fixation construct. While multiple suturing techniques have been described, relatively little is known regarding the biomechanical stability afforded by various approaches. The purpose of the present study was to determine the biomechanical properties of suture plication of the posterior-inferior quadrant of the glenoid, performed using various repair constructs to an intact labrum.

METHODS
Twenty-one fresh-frozen shoulders with a mean age of 57.7 ± 12.3 years were dissected to the glenohumeral capsule and the humeral head was disarticulated from the glenoid. Each glenoid was visually inspected and specimens were excluded for any of the following reasons: 1) significant degenerative changes, 2) any absent labral tissue, and 3) labral or capsular damage to the inferior aspect including cracks, splitting, and fissures. To assess the potential influence of bone density, each specimen also underwent dual-energy x-ray absorptiometry (DEXA) bone density testing with a bone densitometer.

Specimens were randomized into capsulolabral plication of the posterior-inferior quadrant using either simple stitch configuration, horizontal mattress configuration, or figure-of-eight configuration. The specimen was potted into a custom-made jig and secured with a custom soft tissue freeze clamp. Each shoulder was mounted onto a materials testing machine (MTS Insight 5, Eden Prairie, MN, USA), preloaded to 5N for 2 minutes, cycled from 5N to 25N for 100 cycles (1 Hz), and then loaded to failure at 15 mm/min (Figure 1). Capsular displacement from the glenoid was determined optically using digital video analysis of markers affixed to the respective tissue surfaces. The recorded video (48 frames/sec) was analyzed with Digital Motion Analysis Software (Spica Technology Corporation, Maui, HI), which was synchronized to the force and actuator displacement data from the MTS software. Data recorded included mode of failure, ultimate load to failure, load at 2 mm of displacement, as well as displacement during cyclical loading (during the entire 100 cycles and during the final cycle only). One-way analysis of variance (ANOVA) was used to analyze data from the three different groups utilizing SPSS software (Chicago, IL), with statistical significance at p<0.05. Chi-square testing was used to analyze modes of failure between the testing groups, with statistical significance at p<0.05.

RESULTS
DEXA results confirmed no significant differences in BMD across groups. There was a statistically significant difference (p<0.0001) in mechanism of failure among the three groups with the simple stitch group failing more often in the capsular tissue compared to the mattress and figure-of-eight sutures, which more commonly failed at the glenolabral junction (Figure 2). Specifically, in the simple stitch group, failure occurred by capsular rupture outside the construct, between the clamp and the stitch in 4 specimens (57.1%) and by tearing at the glenolabral junction in 3 specimens (42.9%). In the horizontal mattress group, failure occurred at the gleno-labral junction in all but 1 specimen (85.7%) whereas a single specimen failed by capsular rupture (14.3%). In the figure-of-eight group, failure at the gleno-labral junction again accounted for all but 2 failure (71.4%) while rupture of the capsule was responsible for 2 failures (28.6%). The ultimate load to failure in the simple stitch, horizontal mattress, and figure-of-eight groups was 290.1 ± 142.0 N, 246.5 ± 155.0 N, and 246.1 ± 93.2 N, respectively, which was not statistically significant. Similarly, both the load required to reach 2mm of displacement during the failure testing as well as gapping after cyclical loading were similar (p>0.05) among the 3 groups.

DISCUSSION
The optimal fixation construct for posterior glenohumeral capsular laxity has not yet been determined and several different techniques have been described. In the present study, we determined that there was no difference between capsular plication with simple stitch, horizontal mattress, or figure-of-eight repairs in terms of gapping of the capsulolabral complex, load at 2mm of displacement, and ultimate load to failure. From a biomechanical perspective, the results of the current study imply few differences among the three stitch configurations for capsular plication. The simple stitch capsular plication may be preferred as it is technically less difficult to perform and is also less traumatic to the capsulolabral tissue. However, in vivo capsular healing following arthroscopic plication and effect of stitch configuration have yet to be determined.

REFERENCES