INTRODUCTION

The coracohumeral ligament (CHL) provides soft tissue restraint to external glenohumeral rotation and inferior translation in the adducted position. More recently the CHL was shown to limit external rotation in a position simulating the late cocking phase of throwing, 90\(^\circ\) of abduction and maximum external rotation, to a greater extent than the anterior band of the inferior glenohumeral ligament\(^1\). The throwing shoulder in elite overhead athletes exhibits a shift in rotational range of motion exhibiting an increase in external\(^2\) and decrease in internal\(^2\) range of motion when examined in abduction. It is thought that stretching of the anterior glenohumeral capsule leads to increased external rotation at the point of late cocking and early acceleration and aids in achievement of higher throwing velocities. Concurrently, many overhead athletes develop a postero-inferior capsular contraction leading to a glenohumeral internal rotation deficit (GIRD)\(^3\). As one of the primary restraints to external rotation in positions of glenohumeral abduction, it is likely that the coracohumeral ligament undergoes physiologic lengthening in elite overhead athletes. The purpose of the present study was to examine the kinematic effects of the coracohumeral ligament in an established throwers shoulder model.

METHODS

Five fresh frozen cadaveric shoulders were tested. Specimens were free from rotator cuff tears, degenerative joint disease or other gross pathology. To isolate the capsular and ligamentous contributions, each specimen was dissected free of overlying musculature to an intact glenohumeral capsule, coracohumeral ligament and coracoacromial ligament. Shoulders were tested in a custom shoulder testing apparatus using a 6-degree of freedom load cell and a 3-dimensional digitizing system. (Figure 1) Each specimen was positioned on the testing system with 90\(^\circ\) of scapular and 60\(^\circ\) of glenohumeral abduction for a total of 90\(^\circ\) of shoulder abduction. The humerus was maintained in the scapular plane. A compressive load of 44 N was applied for all testing conditions. Three sequential conditions were established for each specimen: 1) the intact condition; 2) the throwers shoulder model with external rotation stretching to a target increase of 10-15\% and posterior-inferior suture plication with a target reduction in IR of 5-10\%; 3) complete release of the coracohumeral ligament from the base of the coracoid process. For each of the 3 conditions, specimens underwent quantitative measurements of the rotational range of motion, the path of the humeral head apex (HHA) (Figure 2) on the glenoid at 15\(^\circ\) intervals beginning at a simulated late cocking (maximum external rotation) to simulated follow through (maximum internal rotation). Anterior and posterior glenohumeral translation was tested at 90\(^\circ\) ER with a 20N force to create a simulated load and shift test. Statistical analysis was performed using univariate repeated measures ANOVA with Tukey post-hoc.

RESULTS

Compared to the intact state, the amount of external rotation after stretching increased by 20\% (p<0.05), and remained increased by 13\% (p<0.05) after posterior plication. After sectioning of the CHL, the amount of ER increased to 20\% above the intact state (p<0.05). Aggregate anterior-posterior humeral translation on the glenoid (Figure 3) increased after stretching by 2.4mm, and remained increased by 1.5mm after plication, which was not statistically significant. After CHL sectioning, humeral translation increased by 4.6mm above the intact state (p<0.05).

In maximum ER (late cocking), the humeral head apex was displaced an average of 5.6mm posteriorly with the thrower’s model (p=0.10). After CHL release, the humeral head shifted an average of 9.3mm posteriorly (p=0.01) and 3mm inferiorly (not significant) compared to the intact state (Figure 4). In simulated follow-through, the humeral head apex was displaced anteriorly an average of 5mm (p=0.06) and inferiorly 2.6mm (p=0.15). A similar trend remained after sectioning the CHL (Figure 5). Throughout the rotational range of motion, the HHA was posteriorly displaced compared to the throwers model after CHL release (p<0.05).

DISCUSSION

This study assessed the kinematic effects of coracohumeral release in a cadaveric throwers shoulder model. Similar to prior studies\(^1\), the CHL is a significant restraint to external rotation in a simulated late cocking position. Release of the CHL leads to further posterior displacement of the humeral head apex on the glenoid, increased glenohumeral ER, and increased glenohumeral translation in 90\(^\circ\) of shoulder abduction. Laxity of the CHL may facilitate increased ER and be a component in the ensuing pathology seen in these athletes.

REFERENCES