INTRODUCTION: The ulnohumeral joint is an inherently stable joint. Fractures of the coronoid process of the ulna may destabilize this articulation by disrupting its congruent architecture and compromising attached soft tissue stabilizers (1,2). Coronoid process fractures are uncommon and rarely occur as isolated injuries. Typically they occur in association with capsuloligamentous disruptions and/or fractures of the radial head, olecranon process, or epicondyles resulting in complex elbow instability (3,4). Anatomic restoration of the ulnohumeral articulation is critical following these complex elbow injuries (2-5).

Methods: Ten fresh frozen cadaveric upper extremities were disarticulated at the radiocarpal joint and dissected free of all soft tissues except for preservation of the annular ligament, interosseous membrane, distal radioulnar joint, and the tendinous insertions of the brachial, biceps, and triceps muscles. The humerus was transected 12 cm proximal to the tip of the medial epicondyle and potted in polymethylmethacrylate. Using custom made fixtures, the humerus was rigidly mounted in a horizontal position on the testing platform with the medial epicondyte oriented vertically. The medial aspect of the ulnar shaft was coupled to an Instron 1321 servohydraulic materials testing machine equipped with a 100 lb S-shaped load cell. 4 kg, 2 kg, and 2 kg weights were secured to the triceps, biceps, and brachialis tendon insertions, respectively, providing a joint compressive load to facilitate initial reduction of the elbow joint (7,8). Forearm supination and pronation was left unconstrained. The Instron actuator provided 1 cm of varus excursion, equivalent to approximately 3 degrees of varus elbow rotation in this protocol, at a rate of 15 mm/min. The load resisting varus displacement at this position was recorded, and the difference between the starting and ending loads was defined as the constraining load required to impart varus angulation. Each specimen served as its own control, with tests performed at 30, 45, 60, 90, and 120 degrees of elbow flexion with an intact coronoid process. Tests were repeated at all flexion angles after incremental resection of 25, 33, 40, 50, 75, and 100% of the coronoid using a custom cutting jig. Results were analyzed using a two way repeated measures ANOVA and Tukey-Kramer post-hoc pairwise comparison with significance defined at p<0.05.

RESULTS: Figure 1 is representative of the data, demonstrating the decrease in constraining load with incremental coronoid resection. Within each of the five flexion angles, removal of 75% and 100% of the coronoid produced a significant decrease in constraining load when compared to the 0, 25, 33, 40, and 50% resection levels (p<0.02), except at 120 degrees where significance was not reached for 75%. Additionally, the 100% and 75% cut levels were different within 90 degrees of flexion (p<0.01). Within each flexion angle there was a trend for decreasing load after 50% removal. The mean decrease in load across all flexion angles was 16%, 57%, and 70% after removal of 50%, 75%, and 100%, respectively (Figure 2).

DISCUSSION: The coronoid process was found to be a significant varus stabilizer in the elbow. In this study the ability of the ulnohumeral joint to resist a varus load did not decrease significantly until loss of more than 50% of the coronoid process. However, the trend for decreasing stability observed after loss of 40-50% correlates with current clinical knowledge regarding fractures of the coronoid. Clinical reports have highlighted the instability associated with all types of coronoid fractures, even some seemingly insignificant type I (loss of less than 25% of the coronoid) and type II (loss of 25-50%) fractures (2-4). Coronoid fractures, especially in the setting of complex instability, are associated with high rates of early and late complications, including acra-adventitious, chronic instability, non- and malunion, heterotopic ossification, and arthrosis (10-12). The data presented here emphasize the role of the coronoid process in varus elbow stability and provide a biomechanical basis for aggressive treatment of coronoid fractures.

REFERENCES:

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