

Ligament Contribution to Patterns of Complex Articular Fractures of the Olecranon

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INTRODUCTION:

The proximal ulna has a varus as well as a dorsal angulation. Moreover, the ulna has a unique ligamentous anatomy, and due to Wolff's law the bone density is higher at the site of the ligamentous and tendinous attachments. The attachments to the proximal ulna are the triceps at the olecranon, the articular capsule to the lateral intermediate facet, the annular ligament to the lesser sigmoid notch, the ulnar collateral ligament to the medial intermediate facet, and the brachialis distal to the tip of the coronoid. The purpose of this study was to evaluate how intra-articular fractures of the proximal ulna relate to its bony anatomy and ligamentous attachments to ultimately aid in operative planning in restoring critical structures for elbow stability.

METHODS:

This is a retrospective cohort study evaluating preoperative CT scans from 140 patients with intra-articular, comminuted fractures of the proximal ulna. Median age at time of CT was 57 years (IQR 27) and 60% (84/140) were female. The articular space of the proximal ulna was divided into 5 zones – the olecranon process, the lateral intermediate facet, the lesser sigmoid notch, the medial intermediate facet, and the coronoid fragment. We evaluated the zones involved in each fracture and the directions of the fracture lines.

RESULTS:

The fractures affected the zones at differing rates: 68% involved the olecranon process (95/140), 56% involved the lateral intermediate facet (78/140), 30% involved the lesser sigmoid notch (42/140), 60% involved the medial intermediate facet (84/140), and 38% involved the coronoid fragment (53/140). In 41% of the fractures, a concomitant proximal radius fracture was apparent (58/140). The most common fracture pattern, found in 32% (45/140) of the fractures, was a combination of the olecranon process, lateral intermediate facet, and medial intermediate facet. The fractures in dislocated elbows on average involved significantly more zones in each fracture than the [subluxation](#) and normal alignment groups (4.22 zones compared to 3.82 and 3.14 zones respectively). Of the patients with a lesser sigmoid notch fracture, 74% (31/42) had a radial head fracture. Furthermore, proximal ulna fractures with concomitant radial head fractures on average involved significantly more zones than elbow fractures without involvement of the radial head. Regarding the directions of the fracture lines, 74% had a fracture line starting proximally anterior and exiting distally posterior (103/140), and 64% had a fracture line starting proximally on the ulnar side of the trochlear notch and exiting distally on the radial side (89/140).

DISCUSSION AND CONCLUSION:

This study suggests that fracture lines occur according to the bony anatomy and ligamentous attachments of the proximal ulna. Approximately two-thirds of the fracture lines occurred in the olecranon process, half occurred in the medial and lateral intermediate facets, and half are accompanied by a proximal radius fracture. The most common fracture patterns of the proximal ulna which occurred in approximately a third of the fractures involved the olecranon process, lateral, and medial intermediate facets. An elbow dislocation disrupted the ligamentous attachments to the proximal ulna to a higher degree, leading to association with further intra-articular comminution. Knowledge of this largely consistent and predictable fracture geometry can assist surgeons in planning fixation strategies to fix the fragments suitably so as to restore proximal ulnar anatomy, in an effort to optimize functional recovery of the elbow and forearm articulations.

