Advancements in classification, treatment and outcome of radial head fractures
Guitton, T.G.

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Part VI: Summary

Summary
INTRODUCTION
The advancements in analyzing techniques, 3D imaging and modeling, increased interest in psychosocial aspects of treatment and the recent availability of multiple long-term outcome studies gives us the opportunity to further investigate the classification, treatment and outcome of radial head fractures. This all could lead to improved treatment and possible better outcomes for patients. The aim of this thesis was to apply these advancements to the radial head in order to: 1) gain further insight in classification, treatment and outcome of radial head fractures and 2) function as a model for general improvements in orthopedic trauma surgery.

CHAPTER 2
QUANTITATIVE MEASUREMENTS OF THE VOLUME AND SURFACE AREA OF THE RADIAL HEAD
This chapter investigated if quantitative Q3D-CT modeling technique based on anatomical and demographic data that can measure size, shape, and proximal articular surface area could be used to develop formulas that could predict the volume and proximal surface area of the intact radial head in patients with fractures of the radial head. To our knowledge, measurement of proximal articular surface area and radial head volume has not been attempted. We produced equations capable of estimating the volume and proximal articular surface area of the intact radial head—on the basis of parameters usually available in fractured radial heads—with an average relative percent difference of 0.5%. The ability to estimate the volume and surface area of the bone prior to fracture provides useful information when we analyze a fractured radial head. For instance, it allows us to measure the percentage of the surface area involved in the fracture, which is one criterion in Broberg and Morrey’s modification of Mason’s classification. We will be using this technique to study fracture fragment size and injury pattern.

CHAPTER 3
QUANTITATIVE THREE-DIMENSIONAL COMPUTED TOMOGRAPHY MEASUREMENT OF RADIAL HEAD FRACTURES
This chapter analyzed radial head fracture fragment morphology on Q3D-CT images in terms of size, shape, and articular surface area. Quantitative analysis of 3D-CT scans proved to be a useful technique for analyzing articular fracture pattern and morphology. Using this technology we identified that partial head (Mason 2) fractures frequently involve less than a third of the radial head surface area; that partial head fractures have more small and difficult to repair fragments than whole head fractures (Mason 3); and that whole head fractures with more than 3 fragments are relatively uncommon, but some 3 fragment-fractures have small fragments. These findings may influence our conception and classification of radial head fractures.

CHAPTER 4
DIAGNOSTIC ACCURACY OF TWO-DIMENSIONAL AND THREE-DIMENSIONAL IMAGING AND MODELING OF RADIAL HEAD FRACTURES
This chapter investigated if classification and characterization of fractures of the radial head is more accurate with 3D-CT and 3D models than 2D-CT and radiographs, using a prospective study design with intraoperative inspection as the reference standard. We found that increasing levels of sophistication in imaging/modeling: 1) improved the sensitivity for diagnosis of numerous fracture characteristics; and 2) decreased observer variation between surgeon and first assistant. We found that fracture classification and characterization based on three-dimensional imaging and models is more accurate and reliable, essentially helping to narrow the experience and training gap.

CHAPTER 5
INTEROBSERVER RELIABILITY OF RADIAL HEAD FRACTURE CLASSIFICATION: TWO-DIMENSIONAL VS. THREE-DIMENSIONAL COMPUTED TOMOGRAPHY
This chapter investigated in a large web-based collaborative of experienced orthopaedic surgeons if 3D reconstructions of CT scans improved the interobserver reliability of the classification of radial head fractures according to the Broberg and Morrey modification of the Mason classification. Three-dimensional CT images led to small but significant decreases in variation between observers for fracture classification and some fracture characteristics compared to 2D-CT, but a notable amount of variation remained even with more sophisticated imaging. We believe that 3D-CT images are easier for surgeons to interpret. Nonetheless agreement was only fair or moderate at best even with 3D-CT. Furthermore, some might interpret this data as showing much less influence on interobserver variation than one might guess. Reducing interobserver variation seems to depend on something more than better imaging.

CHAPTER 6
ATTITUDE TOWARDS STRETCH PAIN OF THE ELBOW AFTER RADIAL HEAD
This chapter investigated if agreement with the idea that “stretching of the elbow beyond the point were it becomes painful is important in recovery” leads to greater elbow range of motion one month after injury. We found that a negative attitude towards stretch pain during recovery from fracture of the radial head is associated with less elbow motion one month after injury.
CHAPTER 7
INCIDENCE AND RISK FACTORS FOR THE DEVELOPMENT OF
RADIOGRAPHIC ARTHROSIS AFTER TRAUMATIC ELBOW INJURIES
This chapter assessed the risk factors for posttraumatic elbow arthrosis on radiographs after elbow injury in the long-term. We found that injury type was the only significant independent predictor of moderate or severe radiographic arthrosis. Radiographic arthrosis was not related to follow-up time, age, hand dominance, occupation, gender, or mechanism of injury. This suggests that post-injury activities and occupation are not important risk factors for the development or advancement of radiographic arthrosis. Fractures of the radial head and olecranon are less prone to moderate or severe radiographic arthrosis in the long term than fractures of the distal humerus (both columnar and capitellum/trochlea) and elbow fracture–dislocations.

Conclusions
This thesis shows that advancements in technical analysis, imaging modalities, increased interest in psychosocial aspects of treatment and the availability of long-term outcome data can help improve classification, treatment and outcome in fractures of the radial head. It is science that created these advancements and through adequate scientific evaluation of these advancements we can continue creating more effective treatments for patients.