

RESEARCH ARTICLE

Progression of Heterotopic Ossification around the Elbow after Trauma

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Abstract

Background: This study addresses the null hypothesis that there is no expansion of heterotopic ossification (HO) in the elbow beyond what can be seen early on.

Methods: The area of HO was measured on lateral radiographs of 38 consecutive patients that had operative treatment of HO between 2000 and 2013. Measurements from radiographs obtained between 3 to 7 weeks were compared to measurements from radiographs made 3 months or more after injury.

Results: There was no significant difference between the average area of HO on the first (median 2.8 square centimeters, Q1: 1.5, Q3: 5.1) and later radiographs (median of 2.8 square centimeters, Q1: 1.4, Q3: 5.0) ($P = 0.99$).

Conclusion: According to our results the area of HO does not expand beyond what can be seen early in the disease process.

Keywords: Disease progression, Elbow, Heterotopic, Injuries, Ossification

Introduction

Patients with elbow trauma or burn injuries often develop heterotopic ossification (HO) that limits elbow motion (1, 2). Proposed risk factors for developing HO after injury include the severity of the injury, the presence of dislocation, and the timing of surgery (3, 4). Among surgically treated fractures and fracture-dislocations involving the proximal aspect of the radius or ulna about 20% of patients develop HO that interferes with motion (1, 2).

It is our experience that the extent of HO seems apparent within a few weeks. HO tends to ossify and become radiographically visible before fracture callus. It is our impression that HO does not "expand" beyond what can be seen early on. Abrams and colleagues found that—among patients who eventually develop HO—it is already present on radiographs obtained 2 weeks after injury in 86% of patients (4).

This study addressed the null hypothesis that there is no difference in the area of heterotopic ossification (HO) seen on radiographs 3 to 7 weeks after injury and the area of HO seen more than 3 months after injury.

Materials and Methods

With approval from our institutional review board, 98 patients with the diagnosis code for heterotopic ossification and a billing code for elbow surgery between 2000 and 2013 were retrospectively identified.

Inclusion criteria were: (1) Patients age 18 years or greater, (2) fracture of the proximal ulna or radius or fracture of the distal humerus, (3) surgical treatment for elbow trauma, (4) surgery within 10 days after trauma to minimize influence by secondary surgery as additional trauma, (5) a lateral elbow radiograph taken between 21 and 49 days after surgery, and (6) a lateral elbow radiograph taken between 90 and 365 days after surgery. Exclusion criteria were: (1) Patients with prior injury or deformity and (2) surgery in between the study radiographs. Thirty-eight patients met these inclusion and exclusion criteria.

The mean age of the study population was 50 years (SD 13, range 24 – 74). There were 25 male patients (66%) and 19 right-sided fractures (50%).

The injury patterns included 12 posterior dislocations with radial head and coronoid fractures (terrible triad),

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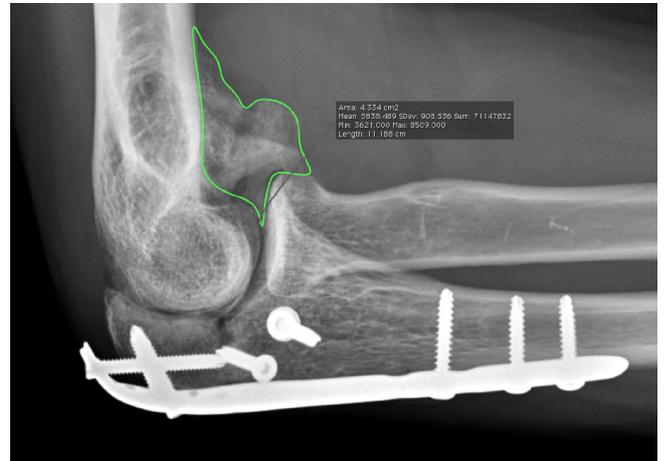
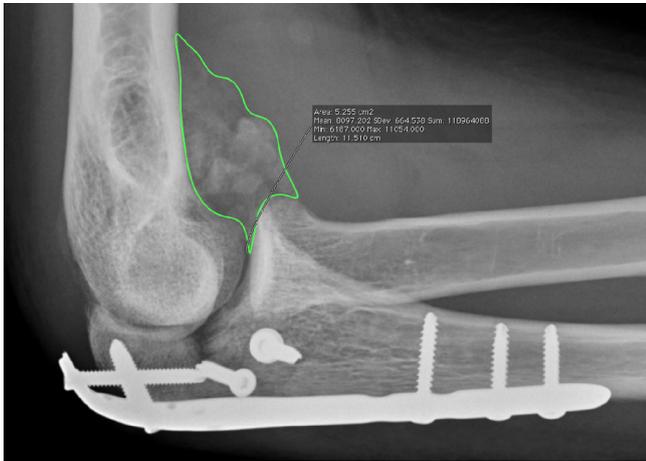


Figure 1. Lateral radiographs a few weeks (A) and several months (B) after open reduction and internal fixation of an olecranon fracture-dislocation shows little change in the area of heterotopic ossification.

9 columnar fractures of the distal humerus, 6 fractures of the capitellum and trochlea, 3 posterior dislocation with radial head fractures, 3 varus posteromedial rotational injuries/ anteromedial facet coronoid fractures, 2 posterior olecranon fracture dislocations, 2 anterior olecranon fracture dislocations, and 1 diaphyseal ulna fracture with a fracture of the radial head.

On average the first radiograph was taken after 35 days (SD 7, range 23 - 49) and the second after 132 days (SD 40, range 91 - 266). The average number of days between the first and second radiograph was 97 (SD 41, range 50-231).

Radiographs were retrieved as DICOM (Digital Imaging and Communications in Medicine) images and were then loaded into Osirix (v5.6, Bernex, Switzerland). In Osirix, using the regions-of-interest tool the area of HO was measured in square centimeters in both subsequent lateral elbow radiographs [Figure 1; 2]. Areas of HO overlying host bone or implants were not

measured.

Statistical Analysis

The Wilcoxon signed rank test was used to test for a significant difference in the measured area of HO area between early and late radiographs.

Results

There was no significant difference between the average area of HO on the first (median 2.8 square centimeters, Q1: 1.5, Q3: 5.1) and second (median of 2.8 square centimeters, Q1: 1.4, Q3: 5.0) radiographs ($P = 0.99$).

Discussion

We found that there is no significant difference in the area of heterotopic ossification (HO) seen on radiographs 3 to 7 weeks after injury and the area of HO seen more than 3 months after injury. In other words, heterotopic bone does not grow or expand beyond where it is initially seen early on.

When interpreting the results of this study, certain limitations should be taken into account: 1) Due to the retrospective nature of the study data was collected with

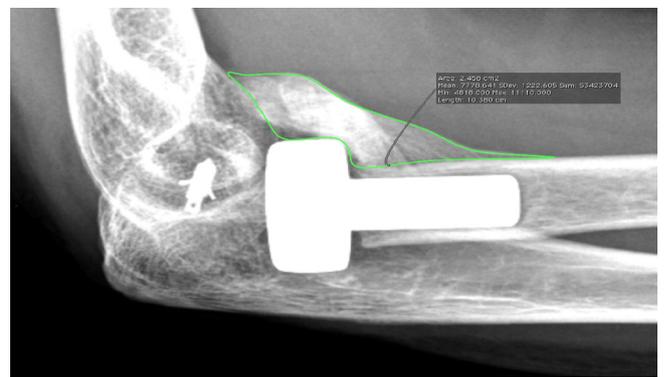
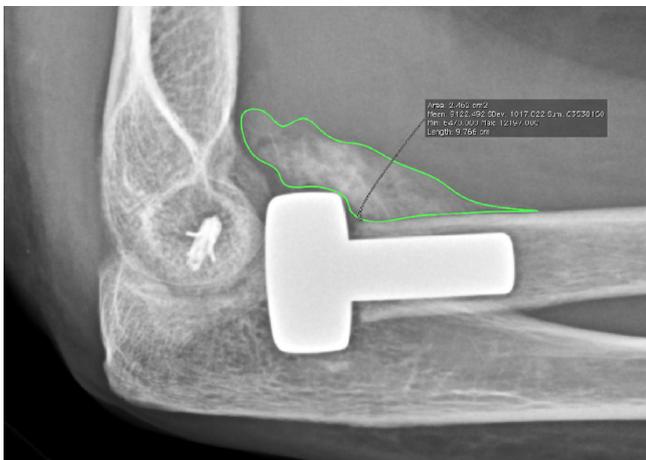


Figure 2. Lateral radiographs a few weeks (A) and several months (B) after operative treatment of a terrible triad fracture-dislocation shows little change in the area of heterotopic ossification.

a relative wide variation in time points. 2) We measured area of HO two-dimensionally, ideally measurements should be three-dimensionally (3D) to assess the volume of the HO, but that would require routine CT scanning (5). 3) Areas of HO with overlying host bone or implants could not be measured. Potential progression of HO in these areas has not been included in this study 4) Measurements were done by 1 author not blinded to timing. 5) Borders of HO were more distinct on the second set series of radiograph; this made measurements more accurate on the second set.

It is hard to predict which patients will develop HO and a major concern is that currently available prophylaxis can cause impaired wound or bone healing (6, 7). One study noted that in 86% of the patients who eventually develop HO it is already present on radiographs obtained 2 weeks after injury (4). Once HO begins to form it is unclear whether anything can or should be done to prevent further growth (8).

According to our study the area of HO on lateral

radiographs does not expand beyond what can be seen early in the disease process. This suggests that treatment with radiation or non-steroidal anti-inflammatory medication is most helpful before HO begins to form and may not have much of a role in limiting HO once it is noticed. Issues of the timing of HO excision are best decided on the basis of data regarding the safety and ease of earlier vs. a few month delayed surgery (delay provides more mobile skin with less edema and more mature bone that is easier to isolate and remove), and the risk of recurrence which is felt to potentially be higher when operating on immature HO (9).

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