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Case Report

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Skipped Ossification Center

Donna Mohseni Mofidi[1*], Lubna Siddiqi[1] and Ian Ross[2]

[1]*Schulich School of Medicine, Canada*
[2]*Radiology, Schulich School of Medicine, Canada*

***Correspondence to:**
Donna Mohseni Mofidi
Schulich School of Medicine,
Canada.
E-mail: dmohseni@uwo.ca

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Abstract

There are six secondary ossification centers in the elbow that regularly ossify in a predictable order. The mnemonic CRITOE is used to identify the order of ossification. CRITOE stands for: Capitellum, radial head, internal epicondyle, trochlea, olecranon and external epicondyle. Knowledge of the order of ossification in useful to avoid mistaking an ossification center for a bony fragment in pediatric elbow injuries. Presented below is a case that deviates from the typical ossification order of CRITOE. A 5-year-old female presented with an ossified capitellum and internal epicondyle, but the radial head ossification was not present.

Keywords

Pediatrics, Musculoskeletal system, Elbow, Ossification center, CRITOE

Introduction

Internal epicondylar fractures are the third most common pediatric elbow fractures and comprise 10% of total pediatric elbow fractures [1].

Pediatric elbow imaging can be difficult to interpret due to the presence of unossified or incompletely ossified secondary ossification centers. Elbow injuries are common, and ossification centers can be mistaken for bony fragments and vice versa. Fortunately, there are six secondary ossification centers in the elbow which typically ossify in a predictable order. A mnemonic, CRITOE, is used to identify the sequence: capitellum, radial head, internal epicondyle, trochlea, olecranon and external epicondyle. Although there is some variation in practice, these centers tend to ossify at the approximate ages of 1, 3, 5, 7, 9, and 11 years respectively. Knowing the mnemonic helps guide radiologists in identifying appropriate ossifications, and in differentiating these from suspected fractures [2].

The factors that contribute to secondary ossifications are the child's age, sex and the order of ossification (CRITOE). While there are some differences with regards to the age of ossification, the order the bones ossify typically follow the mnemonic of CRITOE. Presented below is a case that deviates from the typical ossification order of CRITOE.

A 5-year-old female presented with an ossified capitellum and internal epicondyle, but no radial head was present.

Case Description

A 5-year-old female presented to the emergency department with a one-day history of a fall onto the left elbow. On physical exam, there was deformity at the site of injury, with no evidence of neurovascular compromise. An X-ray

was ordered which demonstrated an avulsion fracture of the medial epicondyle with soft tissue swelling and edema. A cast to immobilize the joint was placed, and referral to pediatric orthopedic surgeon was made.

Incidentally, it was noted the patient had an ossified capitellum and internal (medial) epicondyle, although ossification of the radial head was not present (Figure 1).

Discussion

As previously discussed, the mnemonic CRITOE is used to help identify normal radiographic patterns that may be incorrectly identified as fractures, dislocations, or other abnormalities. The presence or absence of the ossification centers, according to their location and patient's age, is essential for the diagnosis of traumatic injuries [3]. In the case presented above, following this mnemonic, ossification of the capitellum, radial head and internal epicondyle would be expected based on the patient's age. However, the radial head was not identified.

There have been a handful of case reports describing cases where the ossification centers do not ossify in the expected order. Miyazaki et al. [4] published a study with data from thirty participants who ranged in age from 22 days to 18 years. They determined that the radial head and internal epicondyle may appear simultaneously for the female cohort. Age of ossification of the radial head was 5.52 ± 1.60 while the age of ossification for the internal epicondyle was 5.75 ± 1.60. In addition, it was noted that there was a tendency for the olecranon center to appear before the trochlea for both sexes, although this finding was not described as statistically significant.

Patel et al. [5] analyzed the radiographs of 221 boys and 200 girls ranging from 2 months to 17 years of age. Again, it was observed that the radial head and the internal epicondyle appeared at the same age in the female cohort.

Resnik and Hartenberg [6] presented a case report where a 7 year 9 month old boy sustained a transcondylar humeral fracture during a fall. Radiographs identified a trochlear ossification center without an internal epicondylar center.

Conclusion

To conclude, while there is a great value in utilizing the CRITOE mnemonic, there are instances where the order of ossification does not strictly follow this order. As a result, it is important for radiologists to be mindful of this when interpreting imaging to avoid misdiagnosing pediatric fractures.

Figure 1: Black arrow is pointing to the capitellum, white solid arrow is pointing to the medial/internal epicondyle, and white dotted arrow is pointing to the avulsion fracture.

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None.

Conflicts of Interest

None.

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