

Fractures through a biphangeal toe: A pitfall to avoid

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ABSTRACT

Background: The presence of two rather than three phalanges involving a lateral toe is a common variant. This is most often seen at the 5th toe. A fracture through the expected location of the distal interphalangeal joint can mimic a normal triphalangeal toe, leading to a delayed diagnosis. Our purpose was to identify these often elusive fractures in order to evaluate and document their existence for increased clinical awareness and improved patient care. **Methods:** Over a 34 month period, records of fractures through a fused biphangeal joint were kept by all members of the musculoskeletal imaging section of a large university. At the completion of data collection, the compiled list was analyzed for demographic information, mechanism of fracture and digit involved. **Results:** Totally, 33 patients with fractures through biphangeal toes found on routine clinical examinations were included in the study. **Conclusions:** Fractures occurring at the level of an expected interphalangeal joint are easily overlooked. Prompt diagnosis can improve patient outcomes.

KEY WORDS: Biphangeal, toe, fracture

INTRODUCTION

Absence of the distal interphalangeal joint of the 5th digit (biphangeal 5th toe) is a normal variant that is extremely common. This is felt to be a result of a reduction of secondary ossification centers related to incomplete segmentation (two centers rather than three) rather than phalangeal fusion [1,2].

Fractures through the fused joint can mimic a normal triphalangeal joint and can be overlooked on radiographs if care is not taken [Figure 1a]. Failure to diagnose a fracture could potentially lead to prolonged pain, delayed, non- or malunion [Figure 1b], and/or require future surgical intervention.

To our knowledge, we report the largest case series to date of patients with biphangeal digits with subsequent fracture.

METHODS

Empirically noting a cluster of fractures through a fused interphalangeal joint in a toe, a hard copy list was kept in the musculoskeletal reading rooms for gathering medical record numbers on eligible patients between April 2011 and February 2014. Information regarding demographics, fracture side and digit number were subsequently tabulated. Clinic notes were examined to determine the mechanism injury.

RESULTS

A total of 25,023 foot and toe radiographic exams (22,876 foot and 2,147 toe) were obtained at our institution during the time period of this study. From this population, 33 patients were identified with fractures through a biphangeal toe. Standard projections include three views; anterior-posterior, lateral, and oblique. As all patients had experienced trauma with a clinical question of fracture, none of the images are weight-bearing. The age range was 18-86 years, with a mean of 44 years. There were eleven males and 22 females. Nineteen fractures involved a right toe, and 14 a left toe. 28 were at the 5th toe [Figure 1], four were the fourth, and one was the third toe [Figure 2]. All fractures were non-displaced. 16 patients were Caucasian, 13 Asian, two Hispanic, and two of other ethnicity. Clinical notes indicated acute trauma in all but one where notes failed to document events preceding the visit to the Emergency Department.

DISCUSSION

There have been scant previous reports of fractures through biphangeal fifth toes. In one, the diagnosis was initially missed, considering the fracture lucency to represent a normal interphalangeal joint [3]. In another report, two fractures were initially overlooked, resulting in a delayed union in both [4].

The first report of a biphangeal toe is credited to Leonardo da Vinci between 1492 and 1494 [5]. While the 5th toe is the most common digit to experience this anatomic variant,



Figure 1: (a) 18-year-old female whose foot was stepped on by another. A horizontal lucency is seen at the expected level of the distal interphalangeal joint, (b) 4½ month later the toe was still painful. Repeat imaging reveals that the fracture has not healed, representing a delayed union



Figure-2: 26-year-old female who “jammed” her foot. Imaging shows a fracture through the expected region of the third toe interphalangeal joint

biphalangealism may also occur at the fourth and rarely the third or even the second toe. It appears that medial biphalangealism (aside from the hallux) generally occurs when the more lateral toes also show failure of segmentation [1]. In individuals who have had the studies for bilateralism, most have reported either biphalangeal or triphalangeal symmetry [6].

The mechanism of biphalangeal 5th toe formation is felt to be a result of incomplete segmentation as opposed to phalangeal fusion [1,2]. Some evolutionary biologists have hypothesized that this variation was a response to bipedalism [7], as it is only found in humans and not in other primates. It has also been hypothesized that this variant is becoming more prevalent [8], possibly because of the increased prevalence of footwear.

Previous case series have described the incidence of biphalangeal 5th digits as 11.8% in South Indians [8], 44.4% in Europeans [9], 72.4% in Koreans [10], and 72.5% in Japanese [11].

Differences have been attributed to several factors including genetic, cultural or environmental, and evolutionary. One study of Korean families suggested that the trait might be autosomal recessive [12]. Cultural factors are thought to play into the low prevalence in the South Indian populations where footwear is not commonly used.

Noting that biphalangealism of the lateral toes is strictly a human species phenomenon, some theorize that the absence of a third ossification center leads to a reduction in the size of the lateral toes, characterizing evolution of the human foot [2]. In the normal hand, three secondary ossification centers are felt to always be present for the second through fifth digits, supporting the bipedal-related theory [13].

In conclusion, biphalangeal toes are common, especially the fifth. When dealing in a setting of trauma, careful evaluation of interphalangeal articulations is needed to avoid mistaking a fracture between non-segmented phalanges for a normal interphalangeal joint.

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