

Stress fractures of ankle and wrist in childhood: nature and frequency

Alan E. Oestreich · Nicholas Bhojwani

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Abstract

Background Stress fractures of many etiologies are found not infrequently in various tarsal bones but are less commonly recognized in carpal bones.

Objective To assess the distribution of tarsal and carpal stress fractures.

Materials and methods During the last three decades, the senior author collected locations of tarsal and carpal bone stress fracture callus seen on plain radiographs.

Results 527 children with tarsal and carpal stress fractures were identified (88 children had multiple bones involved). The totals were: calcaneus 244, cuboid 188, talus 121, navicular 24, cuneiforms 23, capitate 18, lunate 1, and scaphoid 1. Stress fractures were more frequently seen once we became aware each particular bone could be involved.

Conclusion Tarsal and carpal stress fractures in children are not rare. Careful perusal of these bones is urged in all susceptible children with limping or wrist pain.

Keywords Stress fracture · Carpal bones · Tarsal bones · Capitate · Children

Introduction

Stress fractures occur in children and in adults, resulting from either a repeated new form of exercise or trauma to weakened bone. Bone often loses strength as the first stage to becoming strengthened by a new activity (also called a fatigue fracture). The fractures also occur as the result of increased or normal activity involving bones that have become osteoporotic either from immobilization in a cast or from a generalized condition that led to osteoporosis, such as long-term steroid use.

Stress fractures of many etiologies are found not infrequently in various tarsal bones [1] (Fig. 1), and are now frequently diagnosed, especially by pediatric radiologists. Interestingly, the occurrence of similar radiographic patterns in the carpal bones is less well known, and we observe stress fracture in carpal bones far less often (usually in the capitate), in children who have recently had forearms in a cast for fractures (Fig. 2). Perhaps some type of repeated wrist activity is responsible, analogous to the spirited running of children released from leg or foot cast immobilization.

Materials and methods

During the last three decades, the senior author collected locations of tarsal and carpal bone stress fracture callus seen on plain radiographs. The project was approved by the hospital IRB. Each initial instance that a tarsal or a carpal bone showed callus from a stress reaction on radiographs, it was recorded for our tabulation. Although our records state all the tarsal or carpal bones involved for each patient, our tabulation and percentages for this report did not distinguish between solitary and multiple (88 children; synchronous or metachronous) stress fractures per individual.

A. E. Oestreich (✉)
Department of Radiology,
Cincinnati Children's Hospital Medical Center,
MLC 5031, 3333 Burnet Ave,
Cincinnati, OH 45229–3039, USA
e-mail: alan.oestreich@cchmc.org

N. Bhojwani
University of Cincinnati College of Medicine,
Cincinnati, OH, USA

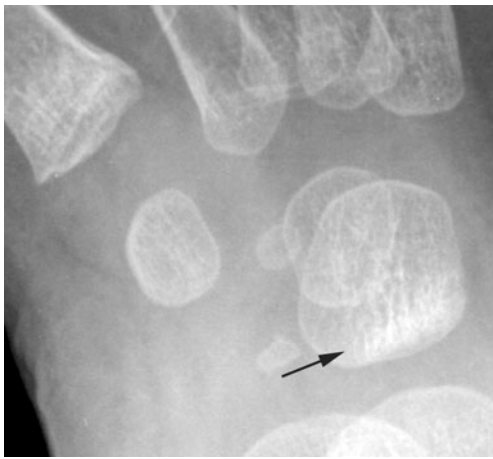


Fig. 1 Representative stress fracture of a tarsal bone, the cuboid. Note the callus (*arrow*). Osteoporosis is evident from the greater than normal conspicuity of the zones of provisional calcification forming the outer margins of the tarsal bones

Results

The frequency percentages are shown in Fig. 3, in which each involved bone is tallied. The totals were calcaneus 244, cuboid 188, talus 121, navicular 24, cuneiforms 23, capitate 18, lunate 1, and scaphoid 1 (total 527 children, 88 of whom had injury to multiple bones). Stress fractures were more frequently seen once we became aware each particular bone could be involved.



Fig. 2 Representative stress fracture of a carpal bone, the capitate. Note the callus within the proximal capitate (*arrow*). Osteoporosis is evident from the greater than normal conspicuity of the zones of provisional calcification forming the outer margins of the carpal bones

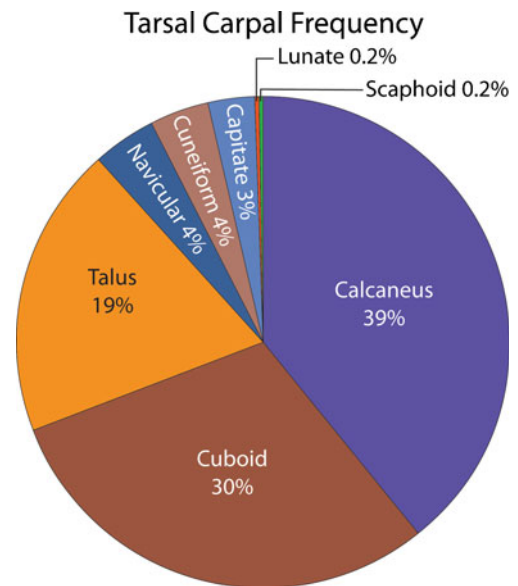


Fig. 3 Pie chart diagram of the relative incidence of stress fractures of tarsal and carpal bone in our series (without consideration of whether one or more bones were involved)

Discussion

It has been our longstanding experience that it takes about 10 days, in children as well as in adults, for callus or periosteal reaction from any fracture to become sufficiently calcified to be visible on conventional radiographs. Because the carpal and tarsal bones grow only by enchondral growth, stress fractures of these bones will elicit no periosteal reaction, such that callus is the only available calcified evidence of stress fracture (unlike the shafts of tubular bones that develop periosteal reaction visible after 10 days to the perceptive imager.) As a consequence, stress fractures of tarsal and carpal bones are not visible before 10 days. Thus, the examples of stress fracture callus discussed in this report are all at least 10 days after the initial injury. Earlier evidence of healing can be deduced from positive bone scans, for example in 3 of 4 cuboid stress fractures in one series [2].

In many of our children with stress fractures, earlier images without endosteal callus could be found in their file. These earlier images included initial images at the time of nearby frank fractures, often of tibia or fibula shafts. Other earlier images were during casting for the other fracture; some were the first image after a cast was removed. A typical scenario seemed to be enthusiastic ambulation following cast removal with bones still osteoporotic from the immobilization. Then, local pain occurs, and, after at least 10 days, a radiograph will reveal the callus of the new stress fracture. This scenario was reported to authors by a pediatric radiology colleague in the case of his own son (one of the cases here tabulated).

Although reambulation stress fracture is a frequent occurrence for tarsal bones, the explanation does not seem so straightforward for capitate and other carpal stress fractures after cast removal for wrist or forearm fractures (Fig. 1). The toddler or pretoddler might be weightbearing about the wrist, but older children, unless they are doing pushups or are the front partner of “wheelbarrow” ambulation, are presumably just excessively using their newly uncasted osteoporotic wrists.

Before the senior author was aware of stress fracture callus on radiographs of tarsal bones other than calcaneus or occasionally talus, he saw none (for many years). Similarly, his colleagues often overlooked such callus in children radiographed for limping until he started to point out the finding. Only in recent years did he ever perceive carpal bone stress fractures in children after casting for trauma. Therefore, the statistics we report are skewed toward the posterior tarsal bones because they include the years in which the more anterior tarsal bones and the carpal bones were not sufficiently perused.

Conclusion

From our investigation, we emphasize the range of tarsal and even carpal bones that can manifest stress fractures on radiographs. In the child with a limp of unknown cause, careful perusal of all the tarsals is urged. Osteoporotic bones following immobilization by cast are a frequent scenario, especially after enthusiastic reambulation. However, if a bone is radiographed fewer than 10 days after a stress incident, callus will not yet be visible on plain radiographs.

References

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