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Fifth Metacarpal Stress Fracture in a Female Softball Pitcher

Andrew D. Jowett, M.B. B.S., M.Sc. and Peter D. Brukner, M.B., B.S.

Olympic Park Sports Medicine Centre, Melbourne, Australia

Abstract:

Purpose: This article describes a previously unreported fifth metacarpal stress fracture.

Case summary: A female softball pitcher presented with gradual development of dorsal pain in her pitching hand. A radioisotope scan showed increased uptake in the fifth metacarpal. This supported a clinical diagnosis of a stress fracture, and the patient was treated with a period of relative rest. At 6 weeks, the patient was able to return to pitching with technique modification.

Discussion: Seven cases of metacarpal stress fractures have been reported, yet none involved the fifth metacarpal. The causes of a fifth metacarpal stress fracture differ from those of other metacarpals and may be a combination of extrinsic forces from the ball and intrinsic forces from muscle pull. Although treatment involves the standard rest period, technique must be assessed and appropriately adjusted.

Relevance: Metacarpal stress fractures should be considered in athletes with persistent hand pain where repetitive grip function is used.

Key words: Stress fracture—Metacarpal bone—Softball.
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Stress fractures in athletes usually involve the lower limb. Stress fractures of the upper limb either occur in sports where the arms are weight-bearing [weight-lifting (3), gymnastics], or sports involving racquets (11) or throwing (1) in which high limb velocities are achieved, including two cases of stress fractures of the ulna in fastpitch softball pitchers (7,9). A literature review revealed seven reported cases of metacarpal stress fractures, four in sports people (6,8,13) and three occupationally related (2,4,15). Four of these affected the second metacarpal and one the third metacarpal bone. In the remaining two cases cited in large series of stress fractures (8), the exact site is not described. The following case describes a stress fracture of the fifth metacarpal in a softball pitcher. A postulated mechanism for the development of this stress fracture is described and comparisons are made to metatarsal stress fractures. With such an understanding, it is hoped that such injuries may be prevented and appropriately managed with attention to technique and equipment factors.

CASE REPORT

An 18-year-old, right-handed, female fastpitch softball pitcher was first seen 6 weeks after the gradual development of dorsal right fourth and fifth metacarpal pain when pitching and gripping the ball. The patient was playing twice a week and practicing four times per week in preparation for national championships. She described a similar problem (5 months previously at the World Junior Championships) that responded to rest and physiotherapy. No specific traumatic injury could be recalled by the patient, and she would only get the pain when pitching or throwing, especially with her curve-ball grip. She had increased her pitching of curve balls and altered her grip for this pitch by increasing the abduction of her fifth finger. She described no pain gripping a bat. Two days before presentation, her pain was exacerbated during a game such that she was unable to pitch, extend her fingers, or put on her gloves.

On physical examination, the patient was tender over the distal half of the fifth metacarpal shaft and also at the base of the fourth and fifth metacarpals. She could actively move her fingers and wrist through a full range of movement; however, fifth finger extension and abduction was painful. Examination of the neck, shoulder, and elbow revealed no abnormality.

Initial plain radiographs showed nothing abnormal. A technetium-99 nucleotide scan showed increased uptake in the fifth metacarpal on delayed bone images, localized to the head of the bone and midshaft (Fig. 1). Treatment involved 2 weeks of rest from sports activities and a total of 4 weeks not pitching. Healing was monitored clinically by the presence of bony tenderness and pain. Six weeks after initial consultation, the patient was symptom free and able to participate in the championships with a modified curve-ball grip, involving a lesser degree of fifth finger abduction.

DISCUSSION

Stress fractures reflect an imbalance between bony resorption and formation, primarily as a result of exces-

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Address correspondence and reprint requests to Dr. A. Jowett at Olympic Park Sports Medicine Centre, Swan Street, Melbourne, Vic 3004, Australia.

FIG. 1. Stress fracture of the fifth metacarpal as shown by increased uptake on delayed phase of technetium-99 bone scan.

sive load across a bone from repeated muscular force (intrinsic) or mechanical stress (extrinsic). Stress fractures most commonly occur in the weight-bearing lower limbs, 95% in the early series described by Orava et al. (8) and 100% in Matheson et al. (5). Those affecting the upper limb often have a weight-bearing component such as stress fractures of the ulna in gymnasts. Among throwing sports, such as baseball and softball, stress fractures have been reported in the humerus (1,12) and ulna (7,9).

The second metacarpal is the longest and has the largest base of all the metacarpals, articulating at the base with the trapezoid, trapezium, capitate, and third metacarpal. Movement at the second carpometacarpal joint is limited in directions other than flexion/extension. The fifth metacarpal articulates with other bones only on the lateral aspect of the base (fourth metacarpal and hamate), whereas its medial surface is nonarticular and presents a tubercle for the insertion of extensor carpi ulnaris. The conformation of its base allows for a greater range of motion than the second, third, and fourth metacarpals in directions other than flexion/extension (14).

Similarities between the metacarpal and metatarsal bones are apparent. The relative frequency of stress fractures of the second metatarsal reflects the immobility at its base, whereas the fifth metatarsal is only articular at part of its base and has insertion from the powerful peroneus brevis tendon. The latter is the site of an important stress fracture, the Jones fracture, which has specific features relating to the peroneus brevis insertion.

Metacarpal stress fractures are among the rarest bones affected by this injury, with only seven previous cases in the literature and none in the fifth metacarpal. The occupational cases described involve extrinsic pressure from a solid object such as an ice-cream scoop (4) or a pen (2) exerting a force on the second metacarpal. The cases of the tennis players may be similarly attributed to the racquet, with the second metacarpal bone providing a fulcrum for an external compressive load, as shown in biokinetic studies by Plagehoef (10).

The two reported cases (6,13) of stress fractures of the second metacarpal in tennis players described an increase in training volume and intensity, as well as an alteration in technique. This patient also exhibited an increase in training intensity in preparation for a major competition. Technique factors are also involved in that the grip for a certain pitch (the curve ball) exacerbated her problem. This grip involves an increased degree of abduction of the fifth finger and delivery of the ball with the fingers perpendicular to the direction of the pitch, thus increasing abduction forces.

It may be speculated that the relative immobility of the second metacarpal combined with its position adjacent to the prehensile thumb makes it vulnerable to extrinsic compression forces that have the potential to cause stress reaction and fracture. The extensor carpi ulnaris muscle is a powerful muscle that is especially important in synergistic action with the finger flexors in gripping objects. In the case described here, it is postulated that the abduction forces involved in the grip and release of the ball along with the muscle pull exerted by extensor carpi ulnaris in gripping a softball in this player may have played a role in overloading the normal dynamic balance of bony resorption/formation in the fifth metacarpal. Management requires an understanding of these factors for rehabilitation and long-term prevention.

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