

A New Radiographic Classification for Distal Shaft Fifth Metatarsal Fractures



Ronald L. Soave, DPM, FACFAS¹, Scott Bleazey, DPM, AACFAS², Asher Rudowsky, DPM², Roxann V. Clarke, DPM, MS, AACFAS², Attilio Avino Jr., DPM², David J. Kuchar, DPM, FACFAS²

¹ Chief of Podiatry and Director, Podiatry Residency Program, New York Methodist Hospital, Brooklyn, NY

² New York Methodist Hospital, Brooklyn, NY

ARTICLE INFO

Level of Clinical Evidence: 5

Keywords:
diagnosis
diaphysis
injury
radiograph
tent sign
trauma

ABSTRACT

In the present report, a new radiographic classification for distal shaft fractures of the fifth metatarsal is presented. The classification system is based on a review of 79 spiral oblique fractures of the distal shaft of the fifth metatarsal. The sample was grouped into “grades” of deformity according to the configuration of the fracture and the amount of displacement observed for each injury. Four distinct fracture configurations emerged as a result of our radiographic analysis, and these were categorized as grades I, IIA, IIB, and III. Grade II fractures were most prevalent and accounted for 49% of the cases reviewed. Grade I and III fractures accounted for 29% and 22% of the distal fifth metatarsal fractures, respectively. To our knowledge, a classification system for fractures of the distal shaft of the fifth metatarsal has not been previously reported. The radiographic classification that we have proposed is intended to aid surgeons treating and discussing fractures localized to the distal portion of the fifth metatarsal.

Published by Elsevier Inc. On behalf of the American College of Foot and Ankle Surgeons.

The fifth metatarsal is the most frequently fractured metatarsal, with reported rates of 45% to 70% (1). The classification systems of these fractures have been based on the anatomic region and radiologic findings (2). Distal metatarsal fractures have been defined as fractures occurring distal to the mid-diaphyseal junction. Unlike fractures involving the proximal third of the fifth metatarsal, injuries of the distal shaft have received little attention.

According to O'Malley et al (3), the reactive forces of gravity that act distally against a stable proximal base where triplanar torque is produced result in the distal fracture configuration. This is analogous to a ballet dancer rolling over the outer border of the foot from the demi pointe position or when the dancer fails to land squarely on the forefoot after a leap.

Few investigators (3,4) have focused on fractures involving the distal portion of the fifth metatarsal shaft. Fracture classification schemes of the fifth metatarsal have thus failed to incorporate injuries of the distal portion of the metatarsal shaft. Thus, few clinical and biomechanical data have been available to guide surgeons evaluating and treating this particular injury. Thus, previously reported fifth

metatarsal fracture classification schemes, including those of Stewart (5), Torg et al (2), and Dameron (6), have failed to describe the injury patterns localized to the distal portion of the fifth metatarsal fractures. Dameron (6) formulated a fracture classification scheme in which the proximal portion of the fifth metatarsal was categorized into 3 anatomic zones of injury. Konkel et al (7) described distal metatarsal fractures as oblique or transverse fractures in the distal third of the diaphysis starting within 1.5 cm of the fifth metatarsal head.

The AO Foundation categorizes metatarsal fractures as localized to the first, second through fourth, or fifth metatarsals. The AO Foundation further subdivides central metatarsal fractures into those localized to the proximal metaphysis, diaphysis, and subcapital regions, as well as base (Jones) and long oblique and multifragmental diaphyseal fifth metatarsal fractures (<https://www2.aofoundation.org/wps/portal/surgery?showPage=diagnosis&bone=Foot&segment=Metatarsals>).

Distal shaft fifth metatarsal fractures can present with cortical disruption that ranges from unicortical oblique fractures to “through and through” oblique fractures, with varying degrees of displacement. Because few clinical data are available concerning the classification and terminology of these fractures, we sought to categorize fractures of the distal portion of the shaft of the fifth metatarsal with the aim of increasing awareness of the typical patterns of injury in this location. Therefore, we undertook a retrospective review of the radiographs of a cohort of patients who had sustained a fracture of the distal portion of the fifth metatarsal.

Financial Disclosure: None reported.

Conflict of Interest: None reported.

Address correspondence to: Ronald L. Soave, DPM, FACFAS, Podiatry Residency Program, New York Methodist Hospital, 506 Sixth Street, Brooklyn, NY 11215.

E-mail address: rls9001@nyp.org (R.L. Soave).

Table 1
New radiographic classification of distal fifth metatarsal fractures (N = 79 fractures)

Grade	Radiographic Description of Distal Shaft Fracture
I	Unicortical, nondisplaced fracture starting at the distolateral aspect of the neck, extending proximally to the medial cortex
IIA	Bicortical fracture with ≤ 3 mm of displacement (gap) starting at the distolateral aspect of the neck, extending proximally through the medial cortex, resulting in 2 separate fragments
IIB	Bicortical fracture with ≥ 3 mm of displacement (gap) starting at the distolateral aspect of the neck, extending proximally through the medial cortex, resulting in 2 separate fragments
III	Bicortical fracture with ≥ 3 mm of displacement (gap) starting at the distolateral aspect of the neck, extending proximally through the medial cortex, such that a retrograde buckling force resulted in a “butterfly” fragment (“tent sign”), with the distal fragment migrating proximally and medially and deviated laterally

Materials and Methods

A review of the radiographs of distal fifth metatarsal spiral oblique metatarsal fractures was conducted at New York Methodist Hospital (Brooklyn, NY) during an 18-year period from July 1994 to July 2012. These cases were obtained through a manual search of the records from the emergency department, outpatient podiatry clinic, and operating room. Patients with a history of a previous fifth metatarsal fracture (at any level) were excluded. Newly diagnosed oblique fractures involving the distal shaft of the metatarsal were considered for the present investigation. One of us (R.L.S.) reviewed all the radiographs and determined which radiographs met the inclusion criteria. Next, 5 of us (S.B., A.R., R.V.C., A.A., D.J.K.) reviewed the selected radiographs and grouped them in accordance with the proposed classification. Each radiograph was viewed and graded on 2 separate occasions (3 months apart). For each case, the anteroposterior and medial oblique views were assessed using the SkyVue® (Cerner, Kansas City, MO) picture archiving communication system. The reviewers determined whether the fracture of the distal fifth metatarsal base was unicortical or bicortical. Displacement of the fracture fragments was then measured using the picture archiving communication system linear measurement on the anteroposterior and medial-oblique view.

Using these inclusion criteria, 79 distal shaft fractures were identified and evaluated for classification. The fracture was deemed displaced if it was bicortical and the segmental gap was ≥ 3 mm on the medial-oblique view. From our review of the radiographs, 4 distinct distal fifth metatarsal fracture patterns were identified (Table 1).



Fig. 2. Medial-oblique view showing a grade I, unicortical and nondisplaced, fracture of the distal shaft of the fifth metatarsal.

A grade I fracture (Figs. 1 and 2) consisted of a unicortical, nondisplaced fracture starting at the distolateral aspect of the neck, extending proximally to the medial cortex, with no shortening, rotation, or break in the medial cortex. A grade IIA (Figs. 3 and 4) fracture consisted of a bicortical fracture with ≤ 3 mm of displacement (gap) starting at the distolateral aspect of the neck, extending proximally through the medial cortex, resulting in 2 separate fragments, without shortening. A grade IIB fracture (Figs. 5 and 6) consisted of a bicortical fracture with ≥ 3 mm of displacement

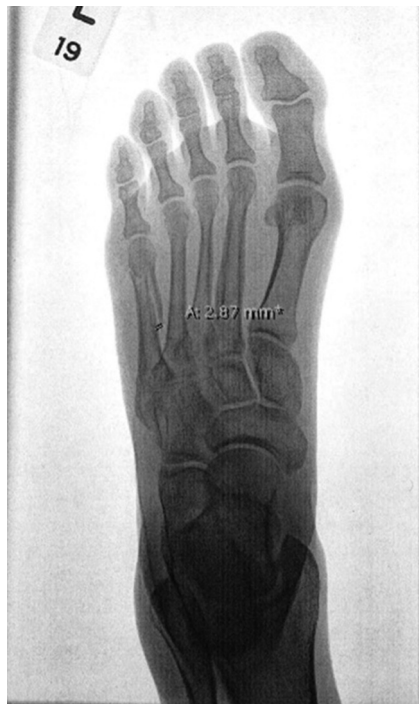


Fig. 1. Anteroposterior view showing a grade I, unicortical and nondisplaced, fracture of the distal shaft of the fifth metatarsal.



Fig. 3. Anteroposterior view of a grade IIA fifth metatarsal fracture, bicortical with < 3 mm of displacement between fracture fragments.

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