

Fig. E-1

Technique for the measurement of the mobility of the first ray (the Klaue technique)^{9,11,12,57}. The Klaue device is an external caliper attached to a modified ankle-foot-orthosis. The foot and ankle are held securely in the device with straps with the ankle in a position of neutral dorsiflexion. The micrometer is used to measure the mobility of the first ray. With this device, the first ray is left free so that the first metatarsal head can be manipulated in a dorsal-plantar (sagittal) plane. The micrometer is centered on the dorsum of the first metatarsal head just medial to the tendon of the extensor hallucis longus, and it measures the total range of first ray excursion in millimeters. Manual force is applied in a dorsal-plantar direction until a soft end point is noted in either direction²⁵. While the entire lateral part of the foot rests on an attached foot plate, the first ray is left free for manual examination. The first ray is grasped between the thumb and index finger of the examiner and is translated in a dorsal-plantar direction; the sagittal excursion of the first ray is measured with the micrometer.

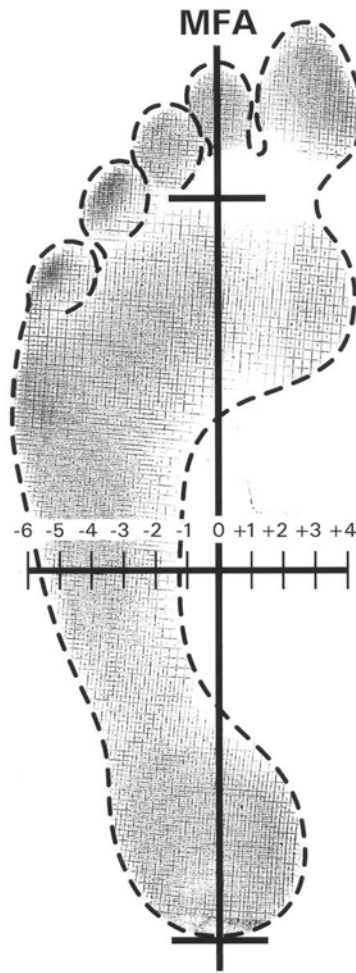


Fig. E-2A

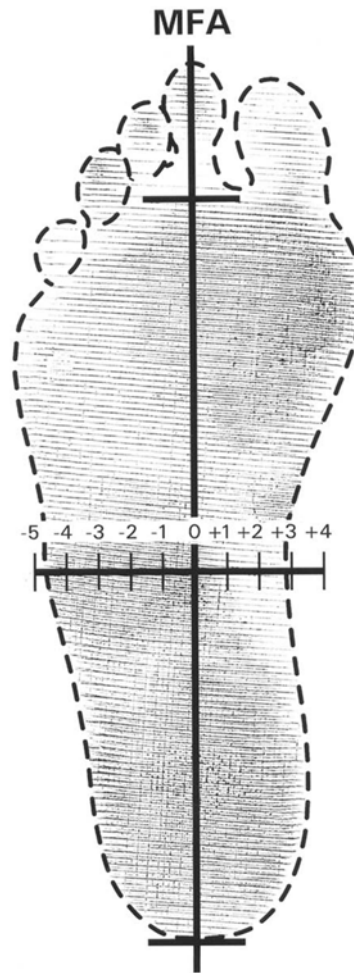


Fig. E-2B

Figs. E-2A and E-2B Technique of the Harris mat imprint measurement^{12,30,32}. **Fig. E-2A** Normal arch. **Fig. E-2B** Flat foot. A midline foot axis (MFA) is drawn from a point placed at the center of the tip of the second toe imprint extending through the center of the heel imprint^{23,43,44,59}. Transverse lines are drawn at the distal and proximal extent of this axis. At the midpoint between these two marks on the midline foot axis, a perpendicular line is drawn medial and lateral to the axis; 1-cm marks are labeled as +1, +2, +3, etc., for points that fall medial to the axis, and as -1, -2, -3, etc., for points that fall lateral to the axis. A foot with a low arch stains medial to the MFA (positive values), and a high arch stains lateral to the MFA (negative values). For staining between incremental marks, the greater value is chosen. Negative values indicate a normal or increased arch height. A +1 value indicates a mild flat foot, +2 and +3 indicate a moderate flat foot, and over +3 indicates a severe flat foot or low arch.

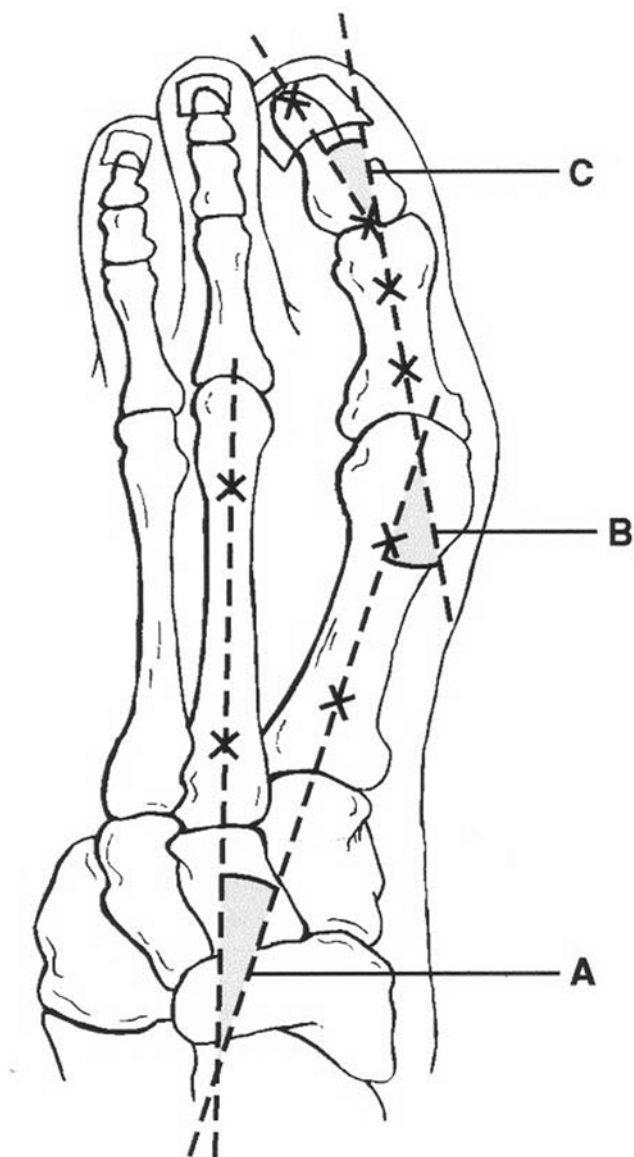


Fig. E-3

Technique for angular measurements of the first and second ray^{33,46}.

First and second ray angular measurements are drawn with use of mid-diaphyseal reference points placed on the proximal phalanx and the first and second metatarsals. These points are placed 1 to 2 cm from the distal or proximal articular surfaces and are connected by a line which forms the axis for each specific bone. For the distal phalanx, a reference point is placed at the distal tip of the phalanx and at the mid-point of the articular surface of the distal phalanx. A line connecting these points is then drawn, and it forms the longitudinal axis of the distal phalanx. The intersection of this axis with the longitudinal axis of the proximal phalanx forms the hallux interphalangeal angle (angle C); the intersection of the longitudinal axis of the proximal phalanx and the axis of the first metatarsal forms the hallux valgus angle (angle B); and the intersection of the longitudinal axes of the first and second metatarsals forms the first-second intermetatarsal angle (angle A).

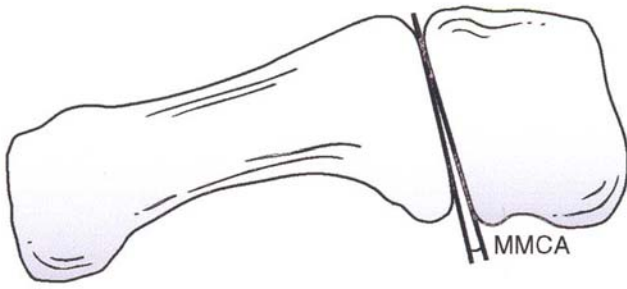


Fig. E-4

Measurement of the first metatarsal-medial cuneiform angle. On the weight-bearing lateral radiograph, the first metatarsal-medial cuneiform angle (MMCA) is the angle subtended by lines drawn along both the proximal first metatarsal articular surface and the distal articular surface of the medial cuneiform. The angle, based inferior, measures the dorsiflexion of the first metatarsal-cuneiform joint in degrees²⁰. Any increase in the angle of $>0^\circ$ indicates plantar gapping.

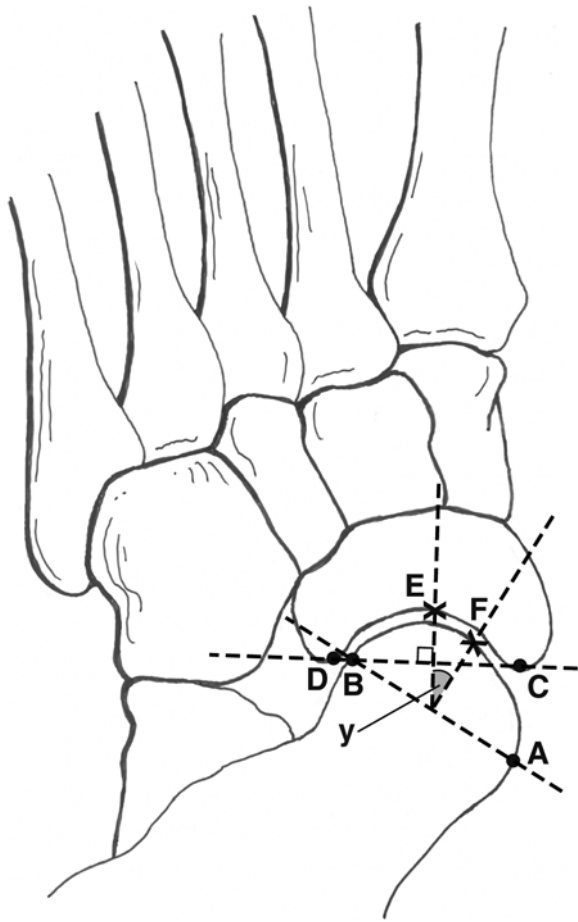


Fig. E-5A

Figs. E-5A and E-5B The technique of hindfoot angular measurements. The anteroposterior radiograph and lateral radiograph were inspected for evidence of pes planus. **Fig. E-5A** On the anteroposterior radiograph, the talonavicular coverage was measured. Line A-B bisects the talar head. Point E bisects the navicular articular surface; through point F, a perpendicular line is drawn from the bisection line of the talar head. The angle formed by the axes through points E and F forms the talonavicular coverage angle (angle y), which becomes larger with increased pes planus. An increasing angle denotes increasing pes planus. The talonavicular coverage angle of $\geq 17^\circ$ is normal²⁰.

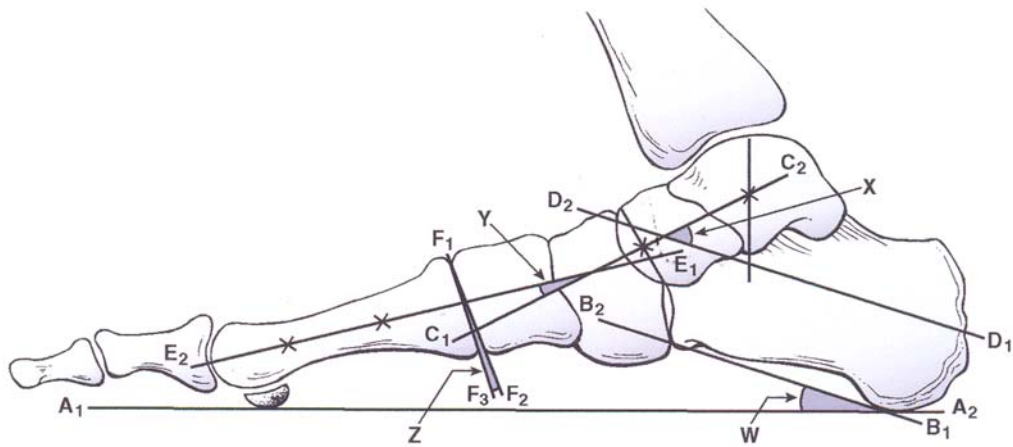


Fig. E-5B

On the lateral radiograph, the intersection of line A1-A2 and B1-B2 forms the calcaneal pitch angle (angle w). A normal angle measures 20° to 30° ⁶¹, while an angle of $<20^{\circ}$ denotes pes planus. The intersection of line C1-C2 and E1-E2 form the talometatarsal angle (Meary's line) (angle y). An angle of between -4° and $+4^{\circ}$ is normal, while an angle of $>4^{\circ}$ denotes pes planus^{20,61}. The intersection of line C1-C2 and D1-D2 forms the lateral talocalcaneal angle (angle x). Normal is 25° to 50° ^{28,61}, and an angle of $>50^{\circ}$ denotes pes planus. The intersection of line F1-F2 and F2-F3 (angle z) measures the plantar gap (first metatarsal-medial cuneiform angle). Any divergence is abnormal.