

## Non-sagittal plane foot movement during late swing

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**Introduction:** Foot dorsiflexor *m. tibialis anterior* causes foot inversion too. Foot inversion turns the footsole inwards; eversion turns it outwards.

**Backgrounds:** Quadrupedalism in primates and precursors is characterized by moving forward in a parasagittal plane, while the forefoot keeps clinging to the substratum. This imposes external rotation on the lower leg, transferred to foot inversion by cardan-like functions of the ankle joint. Such rotational movements include calcaneo-cuboid pivoting in lower primates, their precursors and bipedal hominids. Axes of foot inversion run through this calcaneo-cuboid pivot in primates, and in the opossum, a predecessor. At beginning of stance, opossum and lower primates lack initial heel contact, while higher primates have heel contact from touchdown. Prerequisites for heel strike at the onset of stance include foot dorsiflexion.

**Material and methods:** In ten human anatomical specimens, prior to radiography, metal marking wires were wound around *m. tibialis anterior* tendons, indicating this muscle on radiograms. Longitudinal axes of inversion of the transverse tarsal joint were introduced in tracings of each radiogram, by drawing oblique lines connecting the lateral tubercle of *tuber calcanei* and the cuboid's *processus calcaneus*, up to the first interdigital cleft.

Measurements in orthogonal pairs of biplanar radiograms provided the distances between the line representing tibialis anterior and the axis of foot inversion at their crossing points. These distances represented tibialis anterior moment arm lengths respective to foot inversion axes.

**Results and conclusions:** Average length of the inversion moment arm of *m. tibialis anterior* in 10 anatomical specimens is about 2.3 cm, according with recently published *in vivo* data. Live foot motion reveals visibly active *m. tibialis anterior* initiating foot dorsiflexion, to cause foot inversion simultaneously.

### Reference

Lee, S., Piazza, S. (2007) In vivo measurement of the inversion-eversion moment arms of gastrocnemius and tibialis anterior. ASB 2007 Annual Conference, Stanford, Proceedings, P9-6.