

Eversion of the foot at touchdown

Non Peer-reviewed author version

NARAIN, Faridi; VAN ZWIETEN, Koos Jaap; Lamur, K. S.; LIPPENS, Peter; SCHMIDT, Klaus; Piskun, O. E.; Varzin, S. A.; ZOUBOVA, Irina & Zinkovsky, A. V. (2010) Eversion of the foot at touchdown. In: Varzin, S.A. & Loktionova, V.V. & Tarasovskaya, O.Y. (Ed.) FIFTH ALL RUSSIAN SCIENTIFIC-PRACTICAL CONFERENCE WITH INTERNATIONAL PARTICIPANTS "HEALTH - THE BASE OF HUMAN POTENTIAL: PROBLEMS AND WAYS TO THEIR SOLUTION", MATERIALS OF THE CONFERENCE. p. 308-309..

Handle: <http://hdl.handle.net/1942/11477>

Eversion of the foot at touchdown

*F. H. M. Narain*¹, *K. J. van Zwieten*², *K. S. Lamur*¹, *P. L. Lippens*², *K. P. Schmidt*²,
*O. E. Piskun*³, *S. A. Varzin*³, *I. A. Zoubova*³, *A. V. Zinkovsky*³

- ^{1.} *Department of Anatomy, Anton de Kom University of Suriname, Paramaribo, Suriname*
- ^{2.} *Department of Anatomy, BioMed, University of Hasselt, transnational University Limburg, Diepenbeek, Belgium*
- ^{3.} *Department of Biomechanics and Valeology, Saint-Petersburg State Polytechnic University, Saint-Petersburg, Russia*

Normal bipedal human walking over a flat surface, divided in a stance phase and a swing phase for each leg, is characterized by (among others) heel strike at the beginning of stance (1). To prepare for each following heel contact, the foot is extended at the ankle joint, at the end of the swing phase. The strong ankle extensor muscle *m. tibialis anterior* however, responsible for this movement, simultaneously causes foot inversion too (2). Foot inversion is defined as turning the sole of the foot inward, while eversion is turning the sole of the foot outward. Normally, heel contact is immediately followed by an eversion of the foot, to prevent a walking person so to say to land on the lateral side of his foot which easily leads to a so-called “inversion traumatism” (3). Because inversion traumatisms constitute e.g. the most frequent sport traumatisms (3), while at the same time foot eversion is considered as being typical for human plantigrade walking (4), it may be interesting to analyse walking strategies in non-cursorial mammals, such as primates and predecessors like the marsupial opossum (*Didelphis*) whose terrestrial locomotion is plantigrade-quadrupedal (5). Various higher primates lack initial heel contact in stance (6), as do lower primates and opossum (2). Regarding extinct marsupials moreover, it is clear that “Thylacynidae (had) feet small with spreading toes” and “In gait, the Santa Cruz thylacynes were probably plantigrade” (7). Thylacine footage reveals spreading of toes indeed, during its swing phase (8). This had been observed already, it was explicitly described in *Didelphis* (9, 10). Here abduction and extension of toes does include foot eversion. The latter is the more relevant, in view of the extreme inversion of the opossum foot at end-stance (11, 12). In general, *mm. fibulares* are held responsible for repositioning the foot from inversion to eversion. *M. fibularis tertius*, acting simultaneously with toe extensor muscles, deserves particular attention, especially in man (13). In the swing phase *m. fibularis tertius* “levels the foot and helps the toes to clear the ground” (4).

As a practical application of some of the above observations and analyses we cite a recent report concerning strength-training, applied to *mm. fibulares* in particular, in youthful gymnasts (14). This training, performed as a warming-up, produced longer periods of continuous *mm. fibulares* activity (compared to non-trained gymnasts), to prepare for efficient foot eversion at touchdown.

REFERENCES

- 1) Inman V. T. (1966) Human Locomotion. Canadian Medical Association Journal, 94, 1047-1054
- 2) Van Zwieten K. J., Biesmans S., Reyskens A., Robeyns I., Vandersteen M., Schmidt K. P., Lippens P. L., Narain F. H. M., Mahabier R. V., Lamur K. S. (2009) Non-sagittal plane foot movement during late swing. 171ste Wetenschappelijke Vergadering Nederlandse Anatomen Vereniging, 9-10 januari 2009, 23
- 3) Van Zwieten K. J., Robeyns I., Vandersteen M., Lippens P. L., Mahabier R. V., Lamur K. S. (2007) Foot muscles preventing inversion traumatism. Medicine and Science in Tennis, 12, 2, 34-35
- 4) Joshi S. D., Joshi S. S., Athavale S. A. (2006) Morphology of Peroneus Tertius Muscle. Clinical Anatomy, 19, 611-614
- 5) Wilemon B. L. (2008) Mammals of Mississippi 1:1-8 Virginia Opossum (*Didelphis virginiana*). Published by the Department of Wildlife and Fisheries, Mississippi State University
- 6) Berillon G., Daver G., D'Août K., Nicolas G., de la Villetanet B., Multon F., Digrandi G., Dubreuil G. (2010) Bipedal versus Quadrupedal Hind Limb and Foot Kinematics in a Captive Sample of *Papio anubis*: Setup and Preliminary Results. International Journal of Primatology, 31, 159-180
- 7) Sinclair W. J. (1905) The Marsupial Fauna of the Santa Cruz Beds. Proceedings of the American Philosophical Society, Philadelphia, 49, 73-81
- 8) Campbell C. (2006) Natural Worlds, The Thylacine Museum, 4th section. www.naturalworlds.org
- 9) Van Zwieten K. J., Lippens P. L., Honinckx M. (1991) Gripping mechanism in *Didelphis* includes prehensive patterns. Belgian Journal of Zoology, 121, 1, 49-50
- 10) Van Zwieten K. J., Lippens P. L. (1993) Aspects of prehensive patterns in opossums. European Journal of Morphology, 31, 3, 222-223
- 11) Narain F. H. M., Van Zwieten K. J., Lippens P. L., Lamur, K. S. (2003) Aspects of arthrology in the lower leg of the opossum. European Journal of Morphology, 41, 1, 68
- 12) Lemelin P., Schmitt D., Cartmill M. (2003) Footfall patterns and interlimb co-ordination in opossums (Family Didelphidae): evidence for the evolution of diagonal-sequence walking gaits in primates. Journal of Zoology, London, 260, 423-429
- 13) Raheja S., Choudhry R., Singh P., Tuli A., Kumar H. (2005) Morphological description of combined variation of distal attachments of fibulares in a foot. Surgical and Radiologic Anatomy, 27, 158-160
- 14) Brauns A., Lemmens K. (2010) Spieren die het inversietrauma van de enkel (zouden) kunnen voorkomen (Muscles that (might) prevent the inversion traumatism of the ankle). BMSc Degree Research Paper, Faculty of Medicine, University of Hasselt, Belgium