



CONTRAINTES MUSCULO-SQUELETTIQUES ET PERFORMANCE EN TRAIL RUNNING

QUELLE PLACE POUR LA CHAUSSURE ?

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Amer Sports Innovation and Sport Sciences Lab, Salomon, Annecy



Le modèle de performance en trail running.

J Appl Physiol 113: 507–509, 2012;
doi:10.1152/japphysiol.00016.2012.

Perspectives

VIEWPOINT |

Sacrificing economy to improve running performance—a reality in the ultramarathon?

G. Y. Millet,¹ M. D. Hoffman,² and J. B. Morin¹

¹Université de Lyon, Saint-Etienne, France; and ²Department of Veterans Affairs, Northern California Health Care System and University of California Davis Medical Center, Sacramento, California

« (...) Minimizing damage to lower limb tissue, muscular fatigue, and symptoms associated with prolonged running through measures that can increase running economy becomes crucial in ultramarathons. »

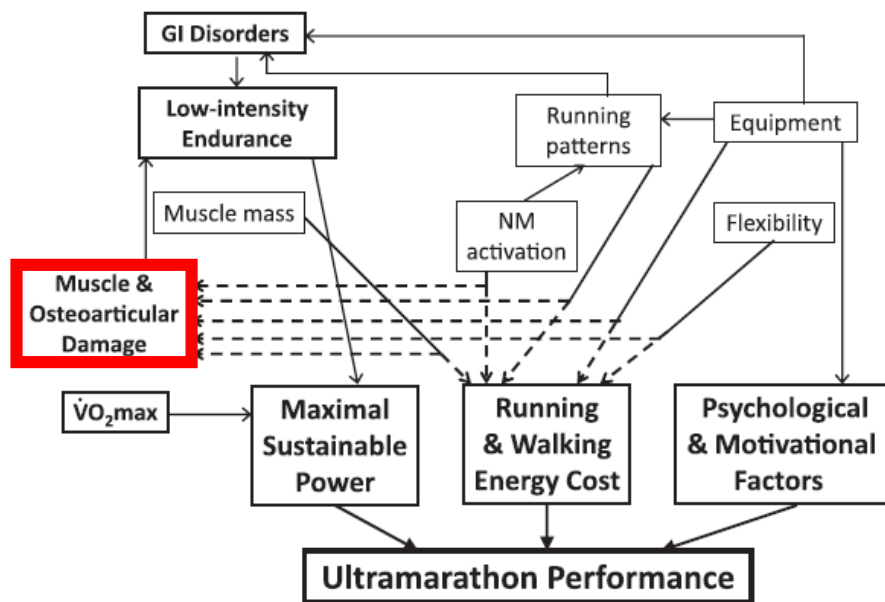
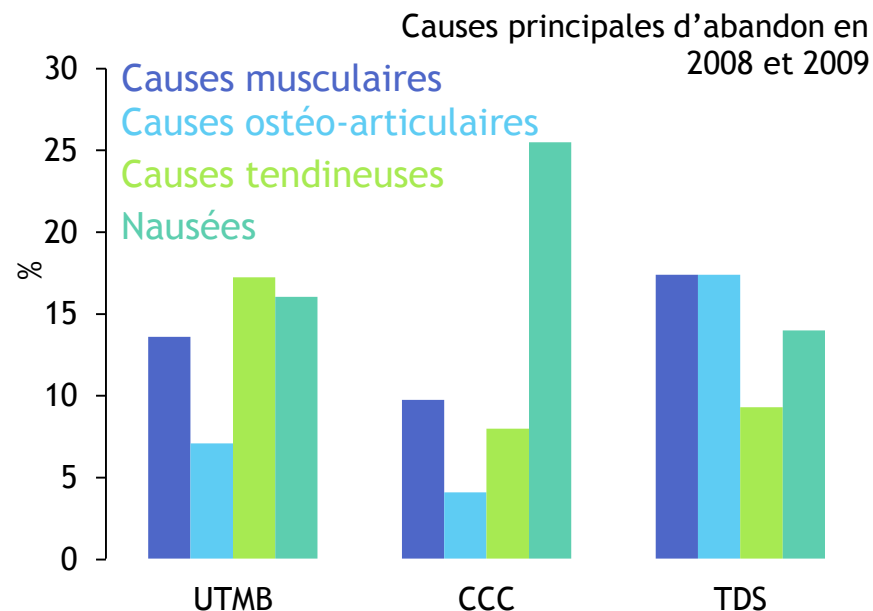


Fig. 1. Determinants of performance in ultramarathons that may be subjected to a compromise between energy cost and lower limb tissue injury (dashed lines). GI, gastrointestinal; NM, neuromuscular. Most important factors for ultramarathon performance are in bold.



Source : Club Mont Blanc Cœur et Sport
<http://www.ultratrailmb.com/page/65/Coeur.html>



Prévalence des blessures musculo-squelettiques en trail running.

OPEN ACCESS Freely available online

PLOS ONE

Health and Exercise-Related Medical Issues among 1,212 Ultramarathon Runners: Baseline Findings from the Ultrarunners Longitudinal TRacking (ULTRA) Study

Martin D. Hoffman^{1*}, Eswar Krishnan²

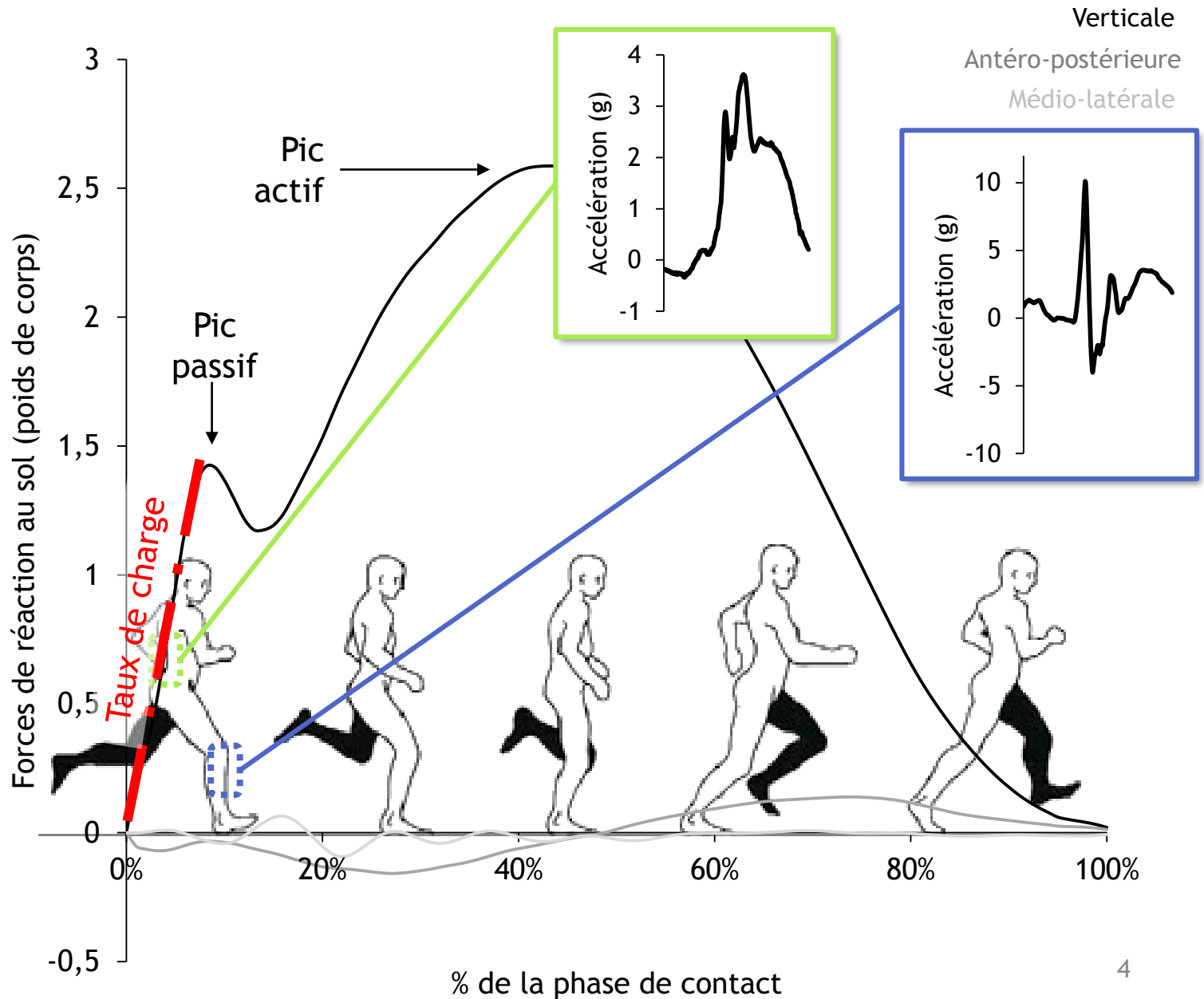
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Blessures liées au genou : 24%
Syndrome de l'essuie-glace : 15.8%
Douleurs au dos : 12.1%
Blessures aux mollets : 13.1%
Tendinites du tendon d'Achilles : 10.8%
Fasciites plantaires : 10.6%
Fracture de fatigue : 5.8%

- Incidence annuelle des blessures ostéo-articulaires : **29.5%**
- Apparition des fractures de fatigue ↔ volume kilométrique annuel



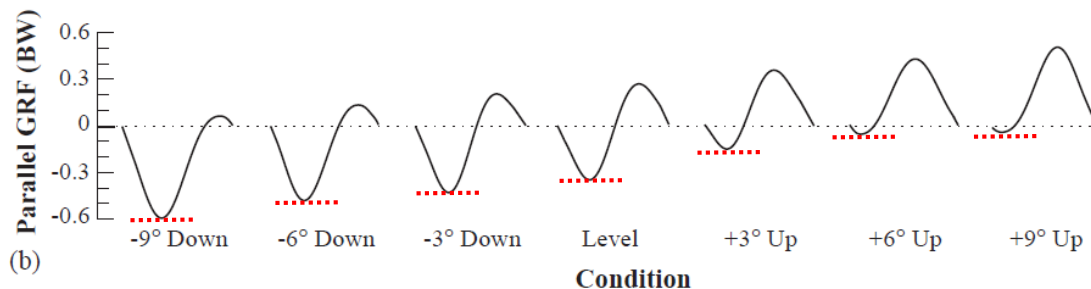
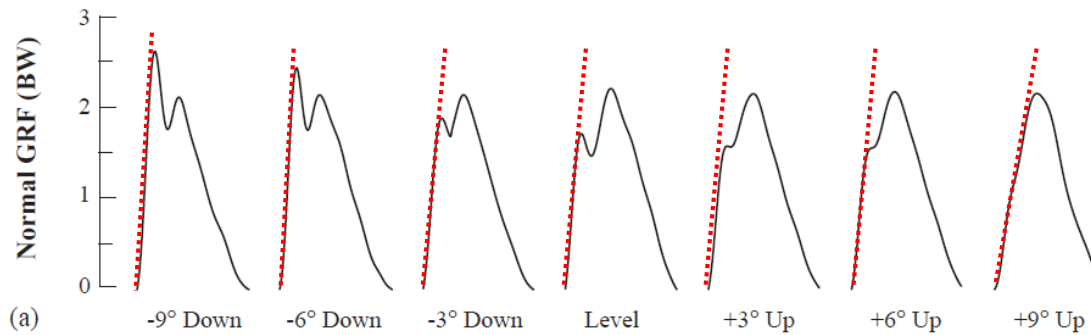
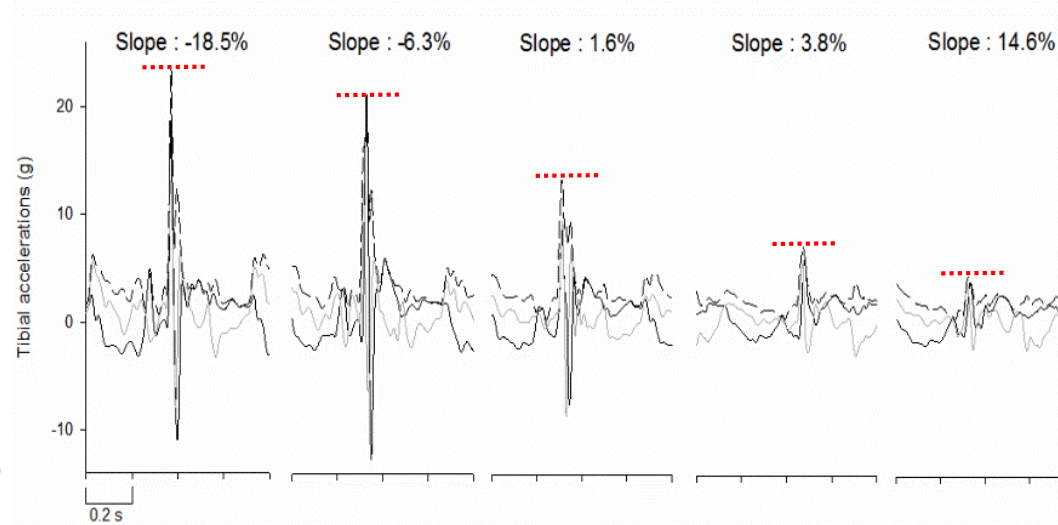
Impact et contraintes articulaires en course.





Les descentes, les sections les plus traumatisantes mécaniquement.

Giandolini et al. 2015



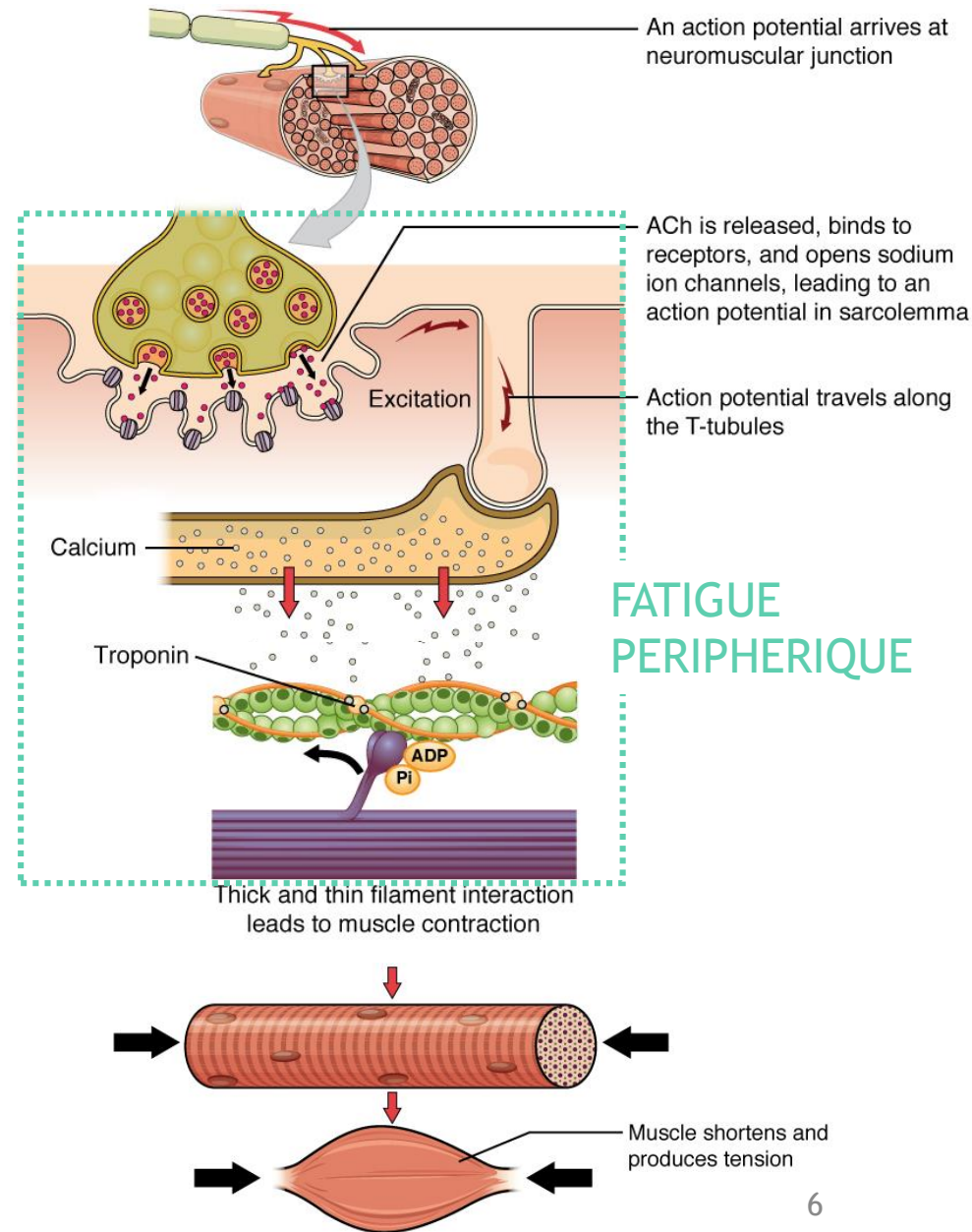
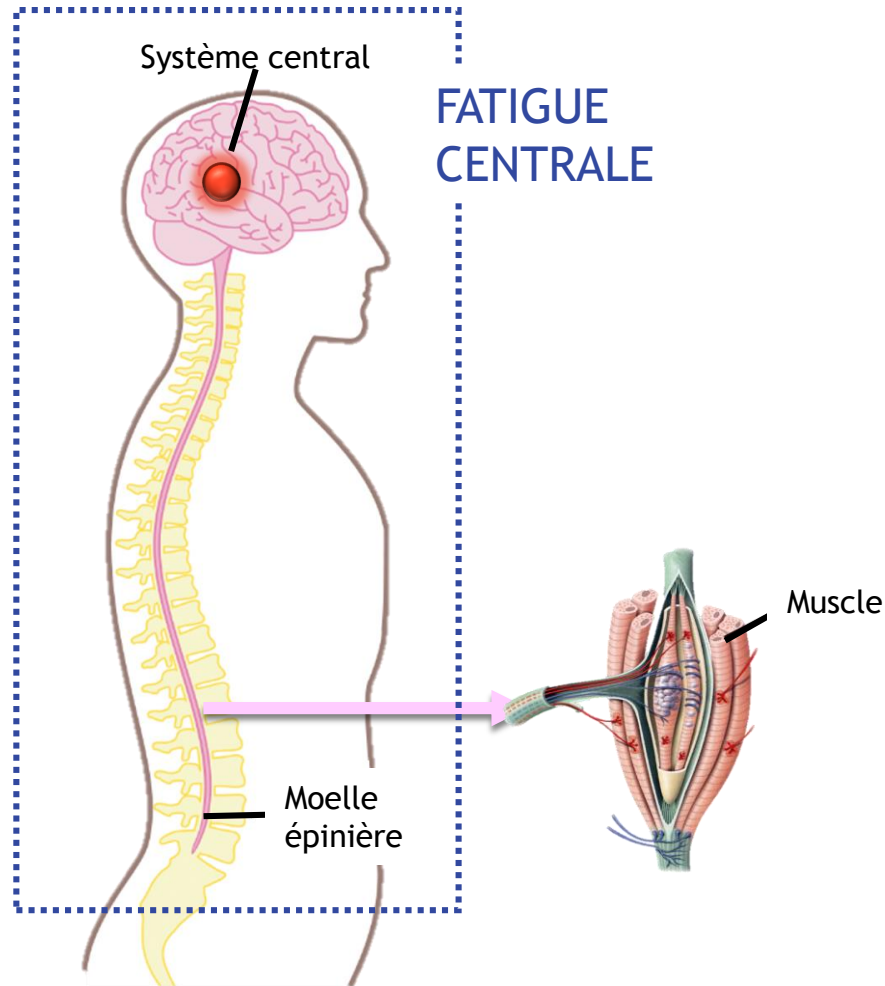
Gottschall & Kram 2005

LE FRÂILEUR



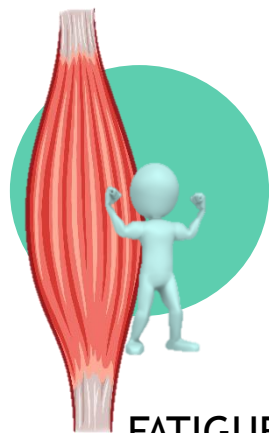


Les différents sites de la fatigue en course.

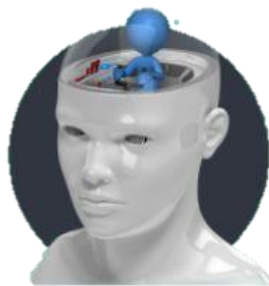




Les descentes, les sections les plus traumatisantes musculairement.

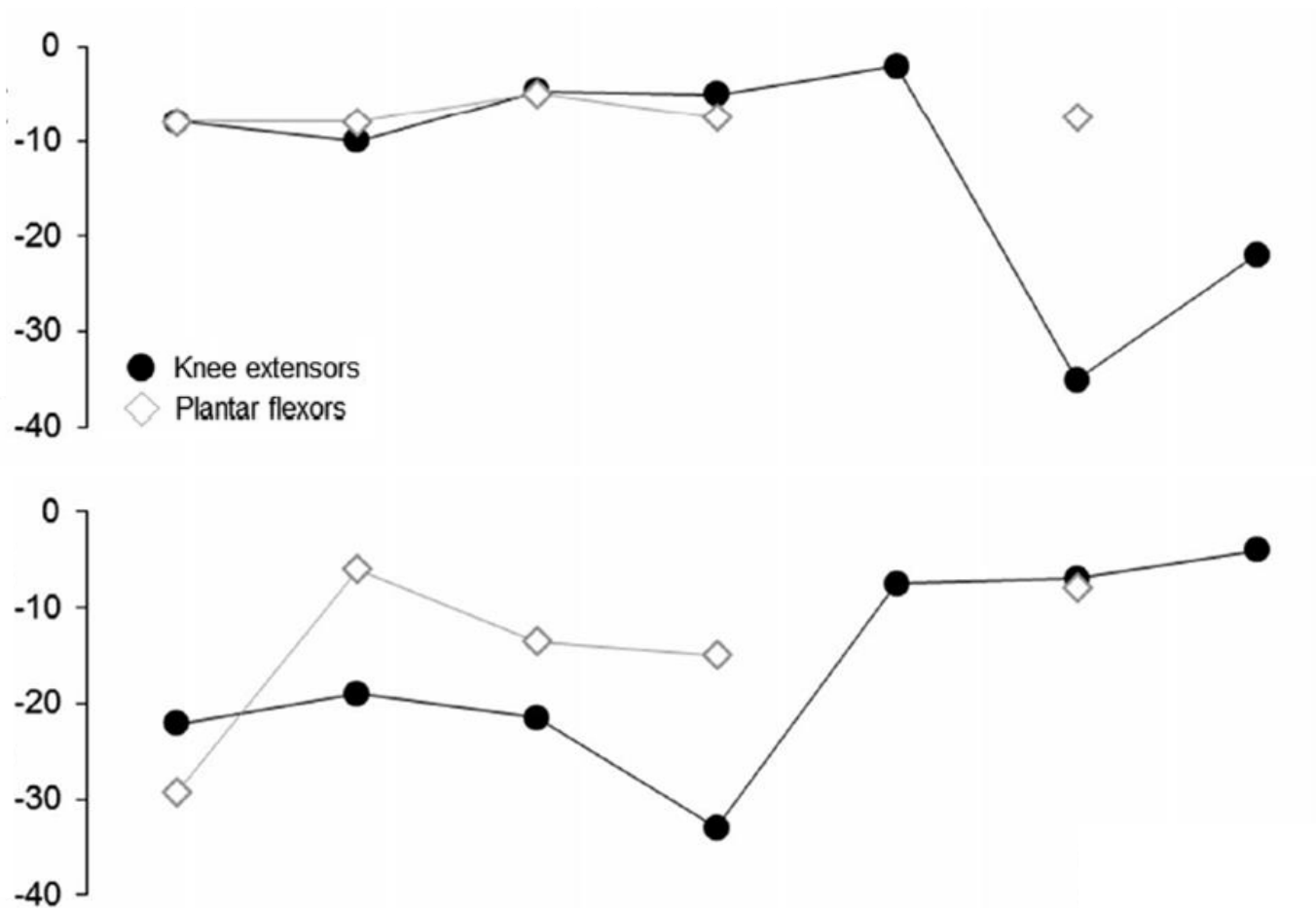


FATIGUE
PERIPHERIQUE



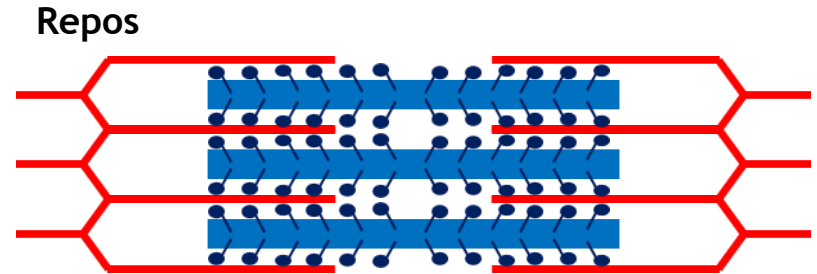
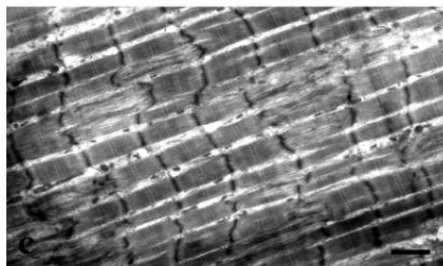
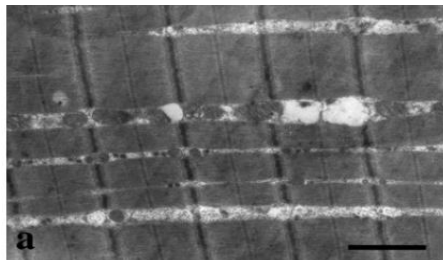
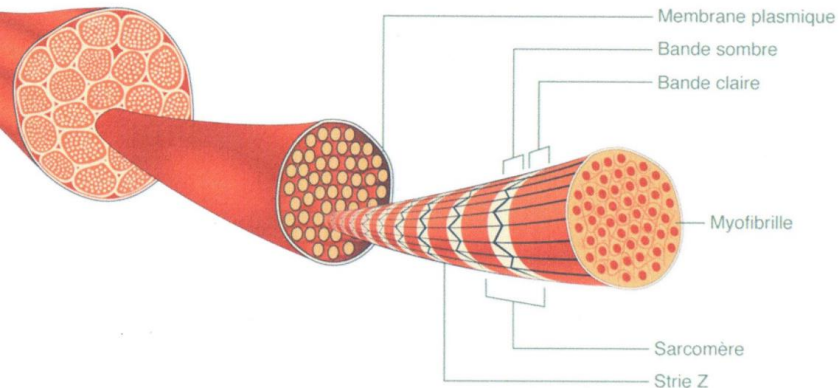
FATIGUE CENTRALE

Tor des Géants® UTMB® 2009 UTMB® 2012 24-h level run 30-km trail running race **Downhill run** Uphill run

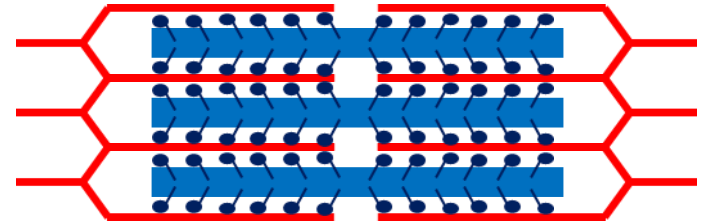




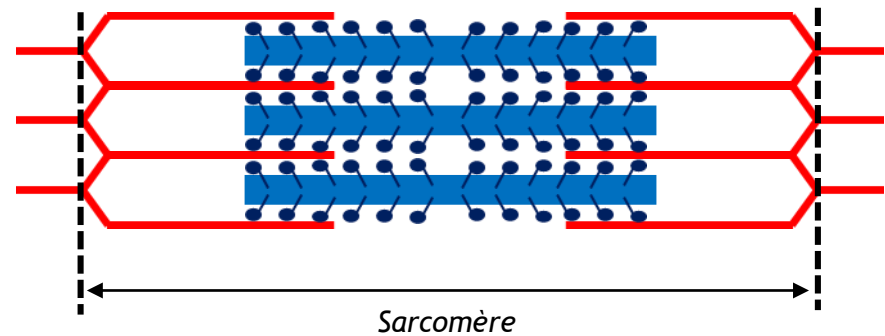
Les descentes, les sections les plus traumatisantes musculairement.



Contraction concentrique



Contraction excentrique





Technique de pose de pied : quelle influence sur les contraintes musculo-squelettiques ?

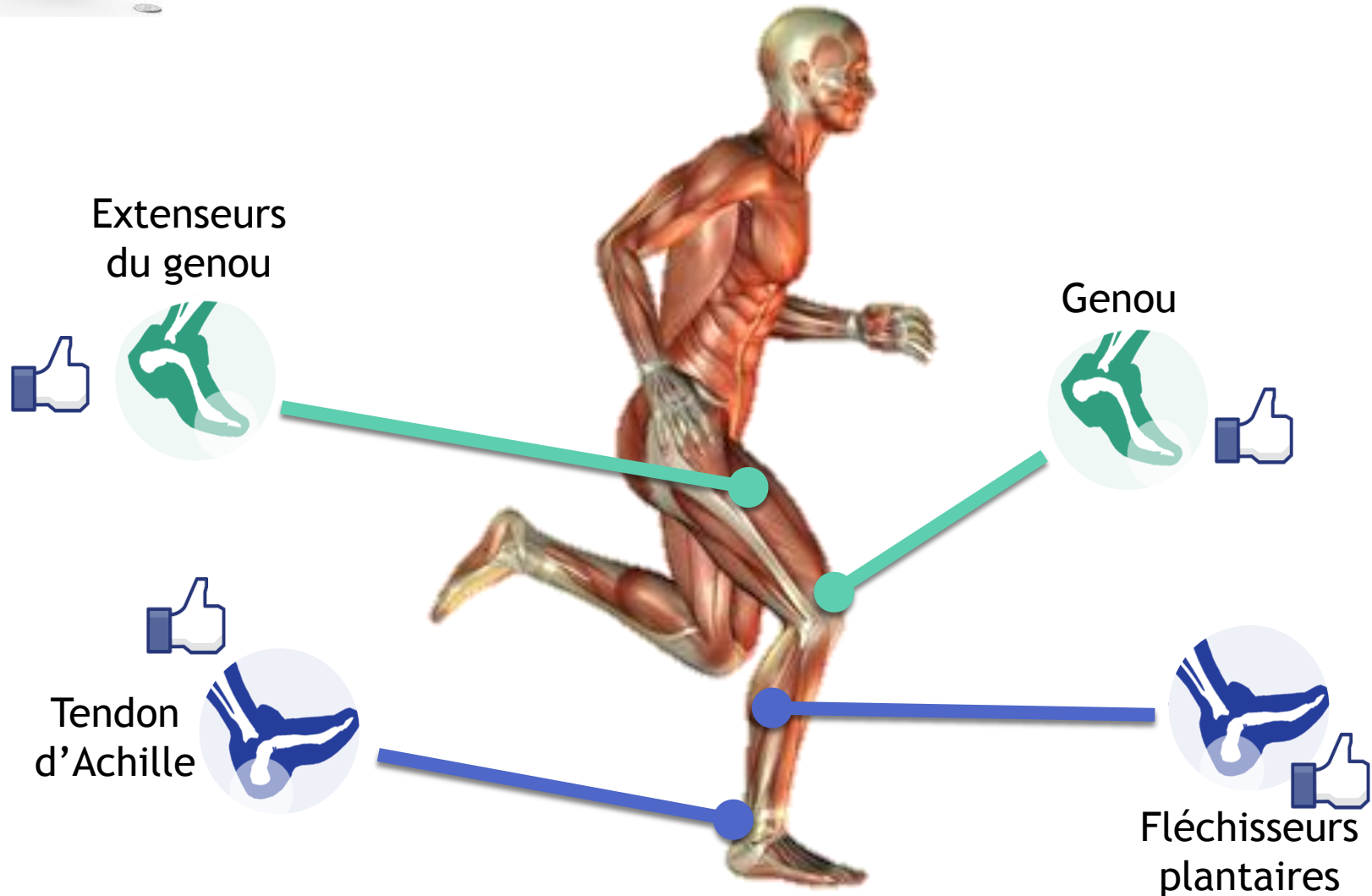


Demi-fond	27%
Semi-marathon	75-89%
Marathon	88-94%

Breine et al. 2014, Hayes & Caplan 2012,
Hasegawa et al. 2007, Larson et al. 2011, Kasmer et al. 2013

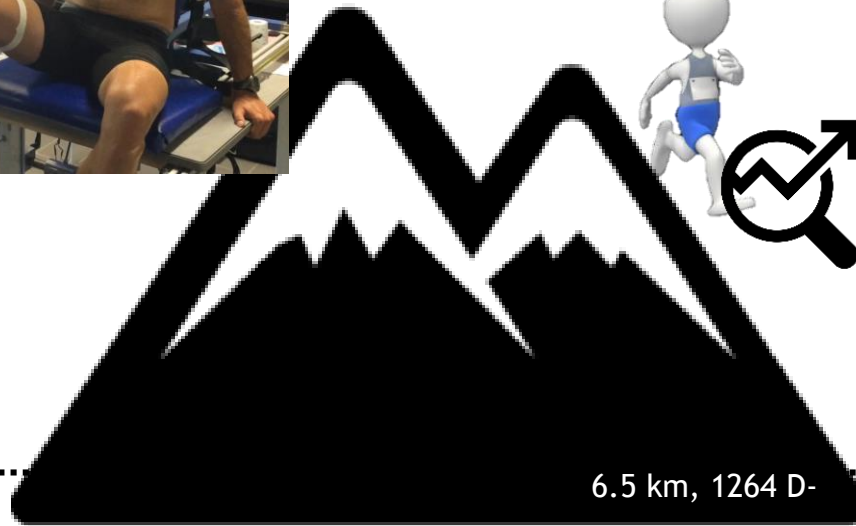


Technique de pose de pied : quelle influence sur les contraintes musculo-squelettiques ?





En descente, la technique de pose de pied influence également la fatigue et le stress mécanique.

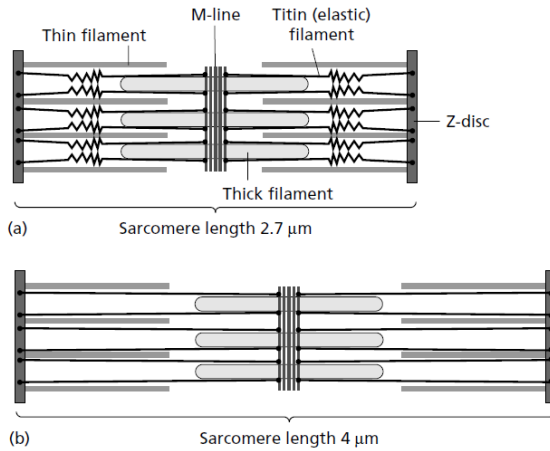


6.5 km, 1264 D-

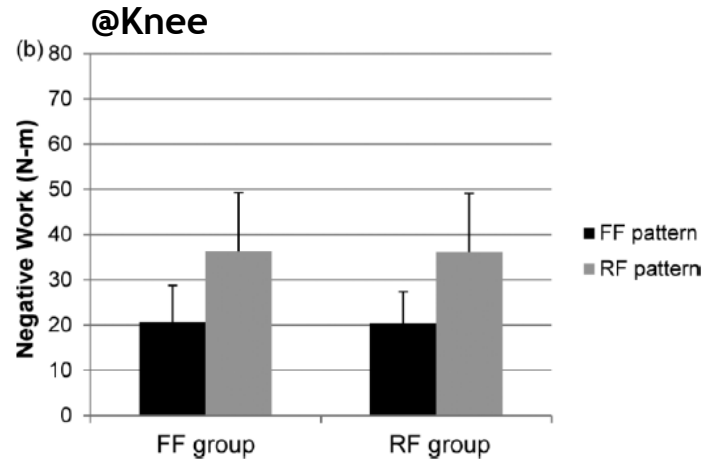




En descente, la technique de pose de pied influence également la fatigue et le stress mécanique.



Billeter & Hoppeler 2010



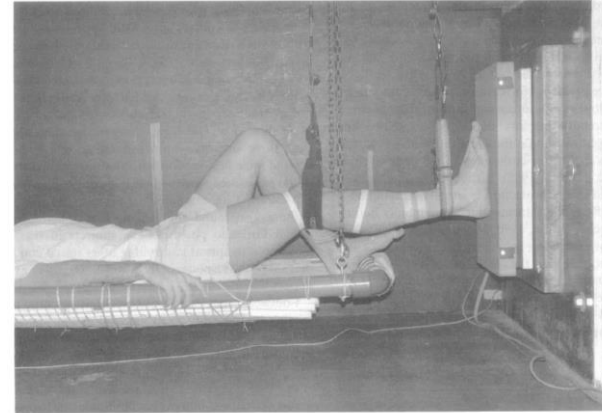
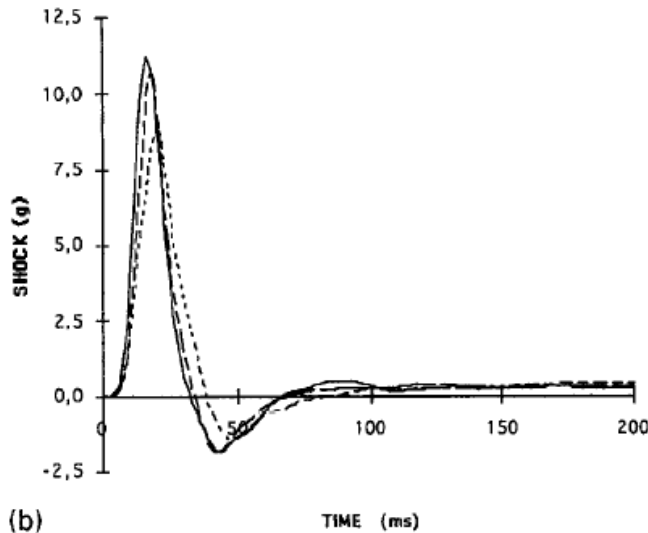
Hamill et al. 2014



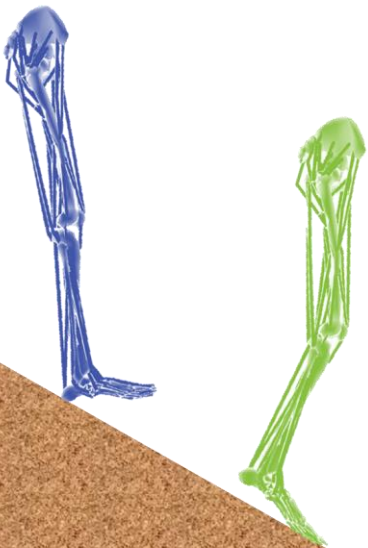
- Chez les personnes attaquant par l'avant-pied.
- Chez les personnes mixant les poses de pied.



En descente, la technique de pose de pied influence également la fatigue et le stress mécanique.



Lafortune et al. 1996

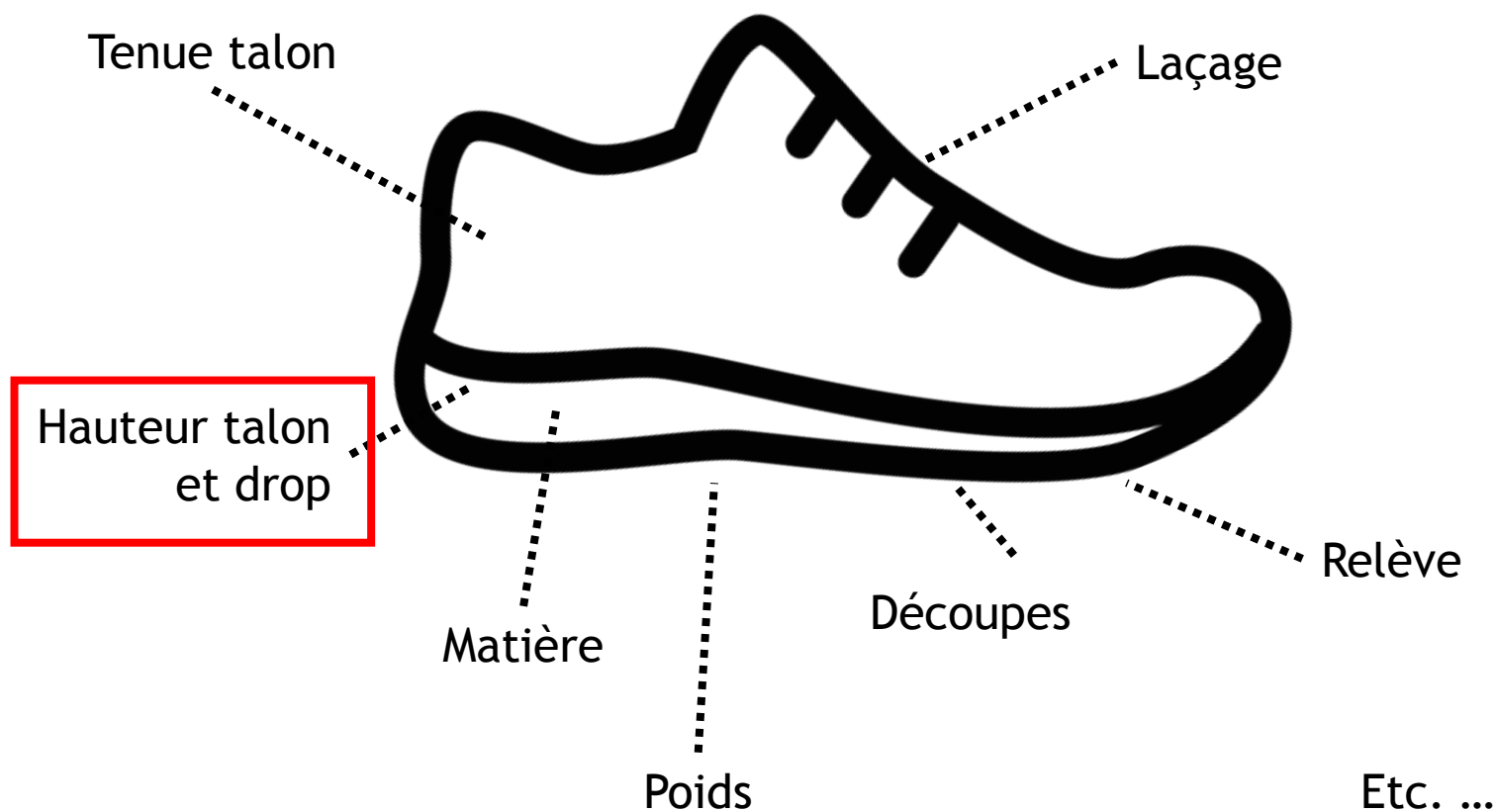


ATTENUATION DU CHOC
ET DES VIBRATIONS

➤ Chez les personnes attaquant par l'avant-pied.



Quelle implication dans le choix du chaussant ?





Quelle implication dans le choix du chaussant ?

Vol 463 | 28 January 2010 | doi:10.1038/nature08723

nature

LETTERS

Foot strike patterns and collision forces in habitually barefoot versus shod runners

Daniel E. Lieberman¹, Madhusudhan Venkadesan^{1,2*}, William A. Werbel^{3*}, Adam I. Daoud^{1*}, Susan D'Andrea⁴, Irene S. Davis⁵, Robert Ojiambo Mang'Eni^{6,7} & Yannis Pitsiladis^{6,7}

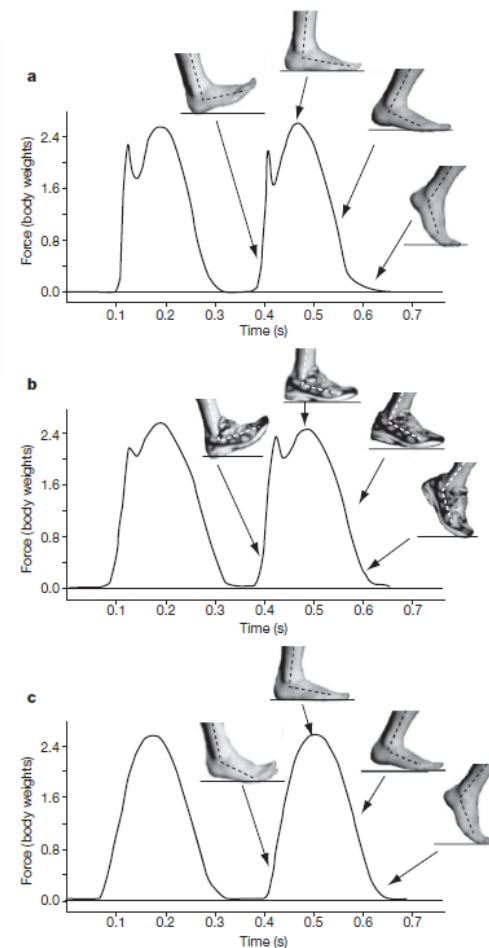
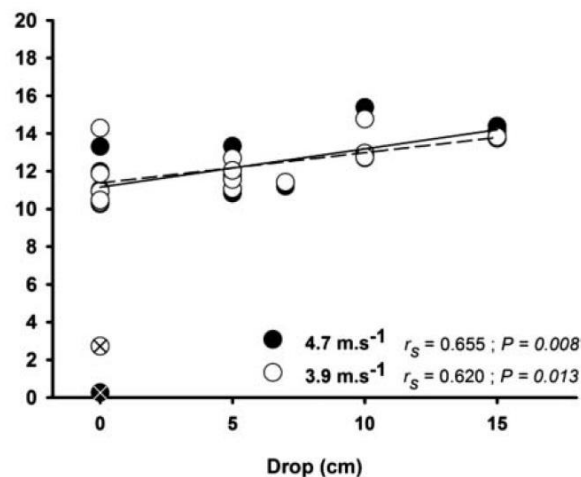
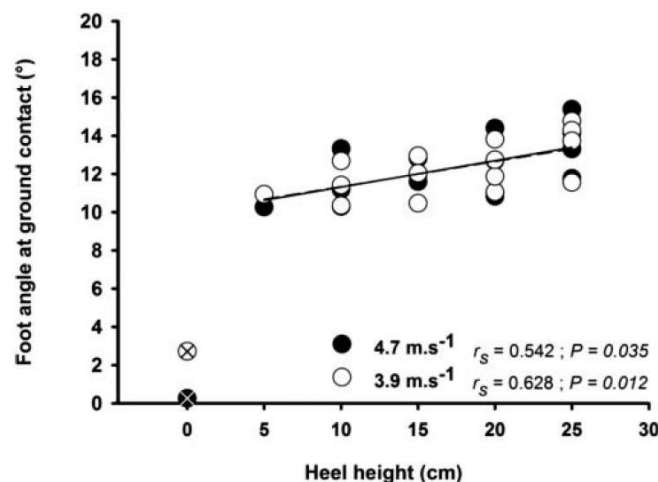


Figure 1 | Vertical ground reaction forces and foot kinematics for three foot strikes at 3.5 m s⁻¹ in the same runner. a, RFS during barefoot heel-to-toe running; b, RFS during shod heel-to-toe running; c, FFS during barefoot toe-to-heel running. Both RFS gaits generate an impact transient, but shoes slow the transient's rate of loading and lower its magnitude; FFS generates no impact transient even in the barefoot condition.

Horvais & Samozino 2013

La géométrie de la semelle influence la technique de course.



Quelle implication dans le choix du chaussant ?

Effects of Footwear and Fatigue on Running Economy and Biomechanics in Trail Runners

FABRICE VERCRUYSEN¹, MARCUS TARTARUGA², NICOLAS HORVAIS^{3,4}, and JEANICK BRISSWALTER^{1,5}

¹Laboratoire Motricité Humaine Expertise Sport Santé (LAMHESS), Université de Nice Sophia Antipolis/Université de Toulon, Toulon, FRANCE; ²LABIER, Midwest State University of Paraná, Guarapuava, BRAZIL; ³SALOMON SAS, Amer Sports Footwear Laboratory of Biomechanics and Exercise Physiology, Annecy, FRANCE; ⁴Laboratory of Exercise Physiology, University Savoie Mont Blanc, Le Bourget-du-Lac, FRANCE; and ⁵School of Exercise Science, Murdoch University, Perth, AUSTRALIA



Salomon XT Wings
Masse : 330g
Hauteur talon : 20mm
Drop : 10mm



Salomon Sense SLAB
Masse : 210g
Hauteur talon : 13mm
Drop : 4mm



Salomon Sense SLAB
Masse : 340g
Hauteur talon : 13mm
Drop : 4mm



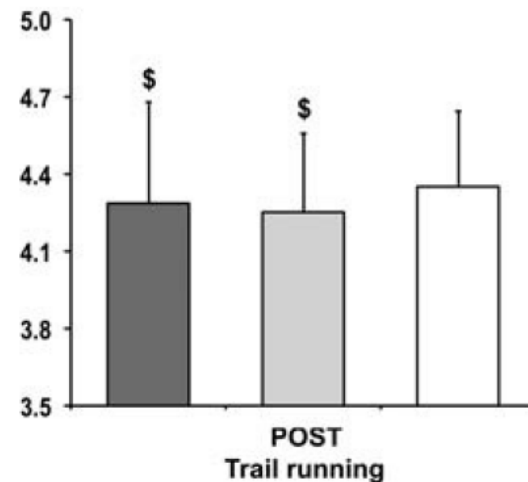
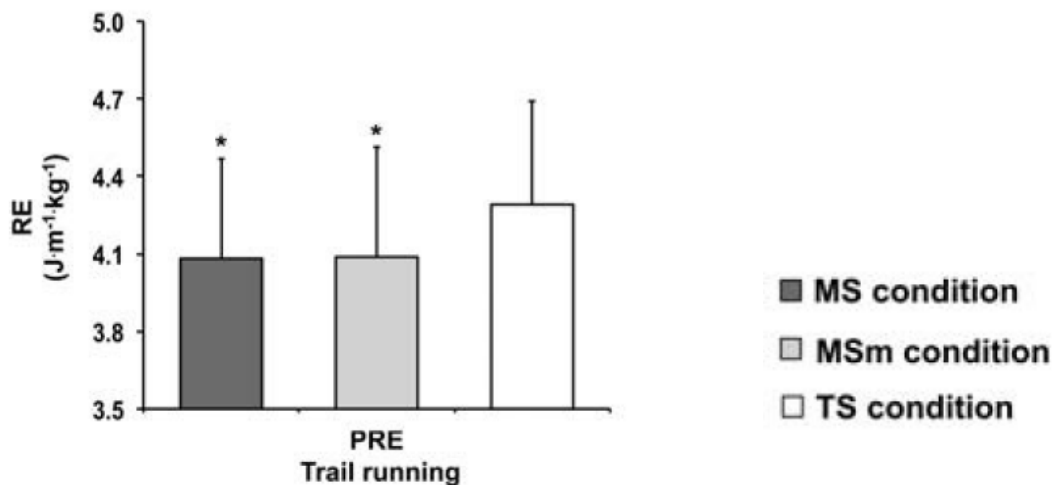
Quelle implication dans le choix du chaussant ?



Amélioration de l'économie de course.

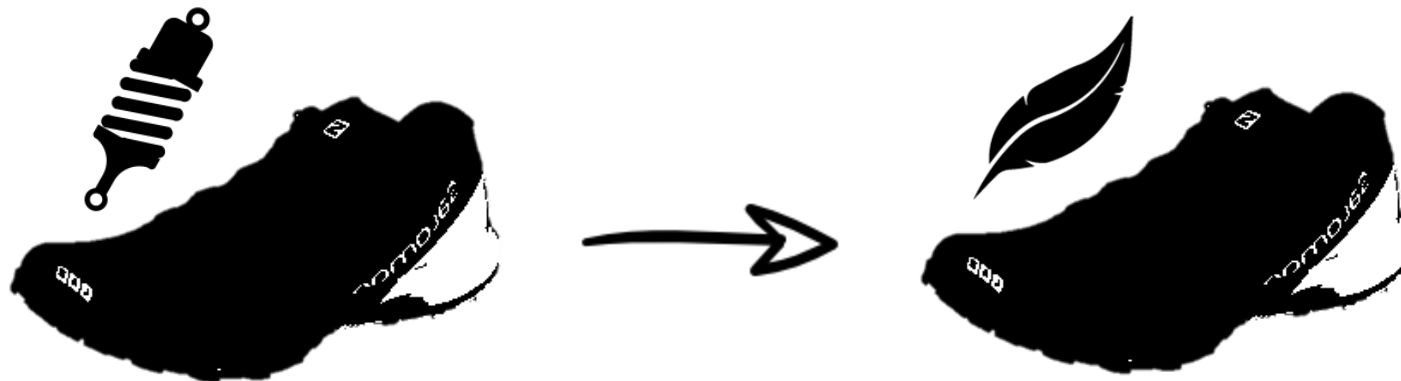


Dégradation plus importante de l'économie de course et de la foulée.





Quelle implication dans le choix du chaussant ?



↗ douleurs aux mollets

↗ risque de périostites tibiales et tendinites achilléennes

Giandolini et al. 2013

Vercuyssen et al. 2016



Nécessite un programme spécifique et progressif de transition.

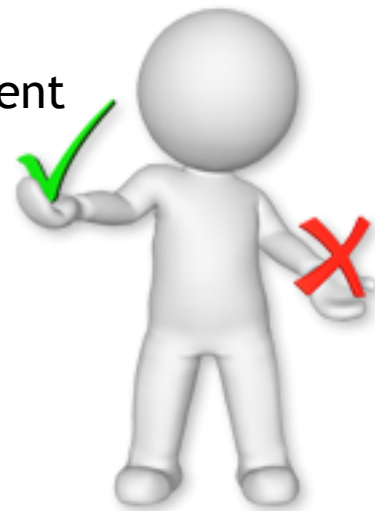
Rotschild et al. 2012



Quelle implication dans le choix du chaussant ?

La technique de course et donc le chaussant influencent la localisation et l'intensité des contraintes.

➔ **IMPORTANCE DE LA VARIABILITE**



Scand J Med Sci Sports 2013; ** : ***
doi: 10.1111/sms.12154

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SCANDINAVIAN JOURNAL OF
MEDICINE & SCIENCE
IN SPORTS

Can parallel use of different running shoes decrease running-related injury risk?

L. Malisoux¹, J. Ramesh¹, R. Mann¹, R. Seil^{1,2}, A. Urhausen^{1,2}, D. Theisen¹

Facteurs réduisant le risque de blessures en course à pied :

- ✓ Le port de plusieurs paires de chaussures
- ✓ La pratique de différentes activités

(n = 264, étude prospective de 22 semaines)



Takehome messages.



Minimiser les douleurs musculo-squelettiques est déterminant pour la performance en trail running.



Les descentes sont les sections les plus traumatisantes.



La sévérité du stress musculo-squelettique est influencée par la technique de course, elle-même influencée par la chaussure.



Il n'existe pas de technique de course, et donc de chaussure, universelle !

Varier les techniques/chaussures/activités permettrait d'éviter de surcharger certaines articulations et/ou certains groupes musculaires.



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Marlene.giandolini@salomon.com

