Head Roll Stabilization and Muscle Mitigation Mechanism in Human Distance Running

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Accessibility
Head roll stabilization and muscle mitigation mechanism in human distance running  
Katherine K. Whitcome, Daniel E. Lieberman, Dennis M. Bramble, David A. Raichlen,  
C. Sloan

Abstract:
Humans experience relatively high ground impact forces during running that can  
destabilize the head, especially at heel strike. Although head pitch is by far the largest  
challenge, an appreciable degree of roll also occurs (as is evident when a runner’s pony-  
tailed hair swings recurrently from side to side). Here we analyze the kinematic and  
kinetic forces of head roll and how the body stabilizes angular accelerations in the  
coronal plane. At endurance running speeds, the head rolls towards the stance side  
approaching 50s$^{-1}$, reaching peak rates near midstance, well after the time of peak  
pitching rates. Our analysis identifies a roll mediating mechanism in activation of the  
swing side sternocleidomastoid muscle (SCM) just before heel strike followed by a peak  
magnitude burst of the muscle some 40-80ms before the head attains peak roll rate. The  
SCM fires on the stance side as well but with much shorter duration and lower  
magnitude, suggesting that the increased activity of the swing side SCM functions in  
head roll control. There is no apparent correspondence of unilateral activity of the cranial  
and cervical trapezius muscles with head roll.