EFFECTS OF CUSTOM INSOLES ON LOWER-LIMB NEUROMUSCULAR FATIGUE PROGRESSION DURING AIR PISTOL SHOOTING

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Purpose: This study aimed to examine whether custom insoles modulate lower-limb neuromuscular fatigue progression during prolonged standing in air pistol shooting.

Methods: Six trained athletes completed a 60-shot shooting task under two conditions: custom insoles and habitual insoles. Integrated electromyography (iEMG) was recorded from the gastrocnemius, tibialis anterior (TA), rectus femoris, and biceps femoris muscles. Fatigue progression was operationally defined as the linear trend of normalized iEMG amplitude across shots. Linear regression analysis was performed with shot number as the independent variable, and the regression slope was used to quantify time-dependent changes in neuromuscular activation demand.

Results: Results showed that the custom insole condition exhibited significantly attenuated fatigue progression compared to the habitual insole condition. Specifically, the regression slope of normalized iEMG amplitude in the tibialis anterior was significantly lower under the custom insole condition compared to the habitual insole condition (−0.101 ± 0.083 vs. 0.016 ± 0.085, $p = 0.018$, Cohen's d = −1.41).

Conclusion: Custom insoles significantly attenuated fatigue progression in the tibialis anterior during prolonged shooting. Given the TA's role in ankle stabilization and postural control, reduced activation drift may reflect improved distal stability and load redistribution. These findings align with previous evidence suggesting that footwear conditions influence lower-extremity neuromuscular responses (Zhang et al., 2023). Footwear optimization may therefore contribute to enhanced neuromuscular efficiency during sustained precision standing tasks.

Keywords: *custom insoles, air pistol, biomechanics, electromyography*

References: Zhang, Y., Zhang, Z., Kim, S., & Kim, Y. (2023). A Comparative Study of the Fatigue of the Lower Extremities According to the Type of Shoes Worn When Firing a 10 m Air Pistol. *International Journal Of Environmental Research And Public Health*, 20(2), 1363. https://doi.org/10.3390/ijerph20021363