Human foot outperforms the hand in mechanical pain discrimination

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Abstract

Tactile discrimination has been extensively studied, but mechanical pain discrimination is more poorly characterised. Here, we investigated the psychophysical and peripheral neural mechanisms underlying mechanical pain discrimination. Twenty healthy participants underwent a two-alternative forced choice paradigm, using force-calibrated punctate stimuli (Semmes-Weinstein monofilaments) with different forces applied to the hand and foot dorsa. Perceptual sensitivity was assessed using the Weber fraction (WF). The results demonstrate significantly better capacity for discriminating noxious mechanical forces in the foot than in the hand (WF: foot, 0.51; hand, 0.88; $p < 0.0001$), and lower mechanical pain thresholds in the foot than in the hand (645 mN vs 951 mN; $p < 0.0001$). To explore whether this body region difference could be explained by differences in the sensitivity of primary afferent nociceptors, microneurography was employed to record from A-fibre (10 radial and 11 peroneal) and C-fibre (10 radial and 7 peroneal) high-threshold mechanoreceptive afferents. No difference was found between the hand and foot in the discrimination performance of either class of nociceptors ($p = 0.2095$ and $p = 0.6215$, respectively). In conclusion, the human foot exhibits higher sensitivity for mechanical pain discrimination. However, this difference cannot be explained by the responses of primary afferent nociceptors, inviting speculation that skin biophysics or central mechanisms may be involved.

Keywords: force discrimination, von Frey, psychophysics, microneurography, human

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