

## THE RELATIONSHIP BETWEEN INNERVATION DENSITY AND DYNAMIC BALANCE FUNCTION

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**Abstract:** Functional reach (FR) significantly increases with additional sensory information from the fifth metacarpal surface of the dominant hand. The purpose of this study was to determine the relationship between the innervation density of the skin above the fifth metacarpal surface of the palm and the increase of FR with an additional light touch. The results show a moderate negative correlation between innervation density and the increase of FR with light touch.

**Key Words:** Balance, Functional Reach, Innervation Density

### INTRODUCTION

Posture serves two main functions. First, it has a mechanical antigravity function, whereby the reference posture is built up, which requires the centre of gravity projection to remain within the supporting surface. Second, it serves as a reference frame for perception and action with respect to the external world [1]. Kinaesthetic signals include the contribution of input from the skin. It has been shown that a light touch, of a force less than that necessary to provide mechanical support, steadies the upright posture. The studies of Jeka and Lakner [2, 3] showed that the information about body sway arising from fingertip contact could be used to reduce body sway amplitudes. Balance is not only required for maintenance of an upright posture, but also during movement. Functional reach (FR) was developed as a clinical measure of the margins of stability above a fixed support surface. The subject stands comfortably, makes a fist, raises the arm to the horizontal position and reaches forward as far as possible without losing his or her balance [4]. We previously investigated the influence, measured as FR, of a light touch on the fifth metacarpal region of the hand on movement above a fixed support surface. The results showed a significant increase of reach with the additional sensory information from the fifth metacarpal surface of the dominant hand, while no biomechanical correlation was found [5].

The purpose of this study was to determine the relationship between the innervation density of the skin above the fifth metacarpal surface of the hand and the increase in FR with an additional light touch for healthy young subjects.

## METHODS

Forty young subjects (35 female and 5 male) aged between 18 and 25 (average age  $21.4 \pm 1.3$ ) participated in this study, which was approved by the National Medical Ethics Committee. The FR test was used as a measure of the margins of stability over the fixed support surface. The subjects performed the FR test twice, first without touch and then with a light touch. The second time the subjects slid on the white board with the fifth metacarpal surface of the dominant hand. To determine innervation density, the dynamic two-point discrimination test (TPD) was performed using Disk-Criminator™.

## RESULTS

The results show that the average difference between the FR tests was  $2.0 \pm 1.3$  cm. The paired t test confirmed that the difference was statistically significant ( $t=15.3$ ,  $p<0.001$ ). The most frequent value in the two point discrimination test was 8 mm (average value  $7.2 \pm 1.4$  mm). The Pearson's correlation coefficient between the FR and TPD tests indicated a moderately negative correlation ( $r=-0.35$ ;  $p=0.03$ ). As only 5 men were included in our study, gender difference was not considered.

## DISCUSSION

The results show a moderate correlation between the innervation density and the increase in FR with a light touch. This speaks against the primary peripheral mechanisms involved in the enlargement of FR with a light touch. It appears that the central nervous system uses additional tactile information in the same way as other proprioceptive inputs, and incorporates it into the reference frame used in motor planning.

## CONCLUSION

Additional information seems to reduce a given person's safety factor when attempting to reach his or her margins of stability.

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