

IS THERE A CORRELATION BETWEEN MOBILITY OF THE THUMB AND MECHANICAL HAND FUNCTION ?

I. HERCK¹, A. STEENWERCKX¹, L. DE SMET¹, G. FABRY¹

Is there a correlation between thumb mobility and mechanical hand function? The metacarpophalangeal mobility, the web, grip force and dexterity were measured on volunteers. Statistical analysis showed a good correlation between the dominant and nondominant hand. Thumb mobility shows no correlation with grip force and dexterity while the width of the webspace has a clear influence on them. We could not find a compensatory mechanism between thumb mobility and the first web.

Keywords : web angle ; grip force ; dexterity ; thumb.
Mots-clés : commissure ; force ; dextérité ; pouce.

INTRODUCTION

An important function of the hand is prehension. Besides sensibility it requires force and dexterity, which are necessary to the mechanical function of the hand. Grip force is easy to measure ; dexterity on the contrary requires more sophisticated testing. Analysis is more difficult as both dexterity and grip force are influenced by several factors.

The importance of the thumb in hand function is obvious, but great variability exists both in thumb mobility and in the width of the web space in a normal population (2, 3, 4, 7). The influence of these variations on hand function have not yet been studied systematically.

This is a survey of metacarpophalangeal flexion (MCP-flexion) of the thumb, web angle (as a measure of carpometacarpal mobility), grip force and dexterity (as measures of mechanical hand function).

MATERIAL AND METHODS

We studied 99 volunteers, 63 women and 36 men, with a mean age of 41 years, ranging from 11 to 83 years. Flexion of the MCP of the thumb was measured with a goniometer placed on the dorsal side of the metacarpal and the proximal phalanx. Readings were taken up to 1°. The width of the first web was measured according to Jebsen *et al.* (fig. 1) (3).

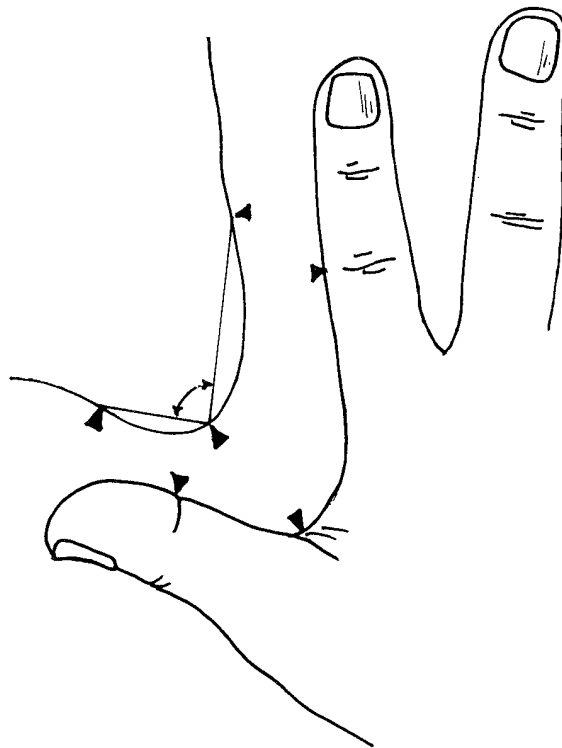


Fig. 1. — Measurement of web angle.

¹ University Hospital Pellenberg, Department of Orthopedics, K.U. Leuven, B-3212 Pellenberg, Belgium.
Correspondence and reprints : L. De Smet.

The grip force was measured with the elbow flexed to 90°, and in neutral prosupination. A standard dynamometer (Jamar-type) was used, with readings accurate up to 1 kg.

Dexterity was evaluated with the “take-5” test as described by Selinger. With this test 5 matches are picked up and positioned in a designated field (fig. 2). The time required to perform the test was measured with a chronometer (5).

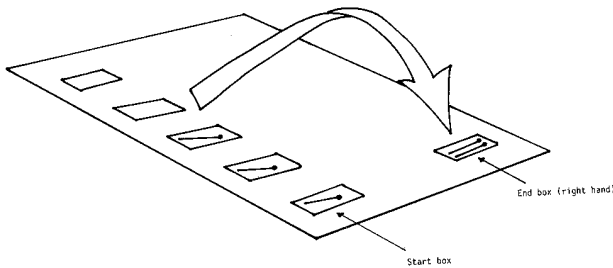


Fig. 2. — Measurement of “take 5”.

All data were statistically processed and correlations were sought using a statistics program (Kwikstat 2.12 by Alan C. Ellitott, Texasoft 1990). Statistical significance was set at $p < 0.05$.

RESULTS

Most obvious data are summarized in table I.

Statistical analysis

There was a very strong and significant correlation of all measurements on the dominant versus nondominant side (table II). A significant correlation was also found between grip force and dexterity, as an expression of the mechanical functionality of the hand ($p = 0.0001$, $\rho = 0.35$) (fig. 3).

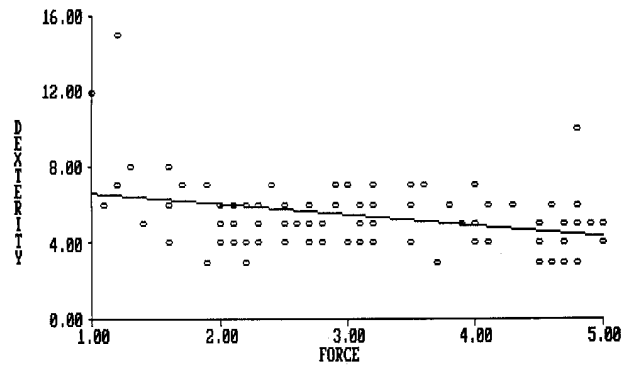


Fig. 3. — Correlation of grip force and dexterity.

Table I

	Total mean (range)	Males mean (range)	Females mean (range)
N	99	63	36
Age	41y	44y	36.89y
MCP	64°	64°	64°
Web	97°	101°	94°
Grip	30 kg	42 kg	24 kg
Take-5	5.4 sec	5.1 sec	5.6 sec

With advancing age grip force was found to decrease significantly ($p = 0.0001$, $\rho = \pm 0.41$) as does dexterity ($p = 0.0001$ and $\rho = \pm 0.55$) (fig. 4).

The relationship between grip force and dexterity with respect to MCP flexion was not significant. A significant correlation was found between web angle and force ($p = 0.0001$, $\rho = 0.35$) and also between web angle and dexterity ($p = 0.0001$, $\rho = 0.37$) (figs. 5 and 6). There was no significant correlation between MCP flexion and web angle.

Table II

	Dominant Mean (sd)	Nondominant Mean (sd)	Correlation	P
MCP	63.77	65.11	Rho = 0.2935	0.003
Web	96.99°	101.26	Rho = 0.6248	0.0001
Grip	30.47 kg	29.46 kg	Rho = 0.8915	0.0001
Take-5	5.47 sec	6.54 sec	Rho = 0.2495	0.013

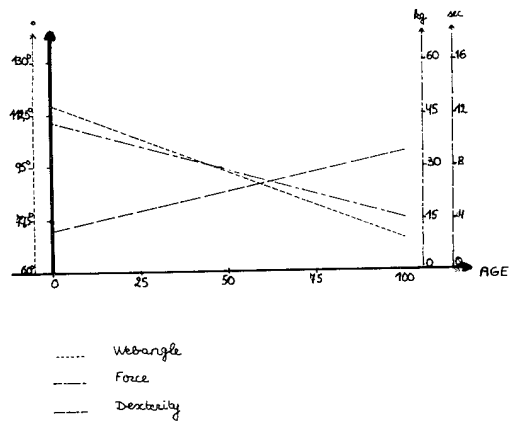


Fig. 4. — Correlation of web angle, force and dexterity with age.

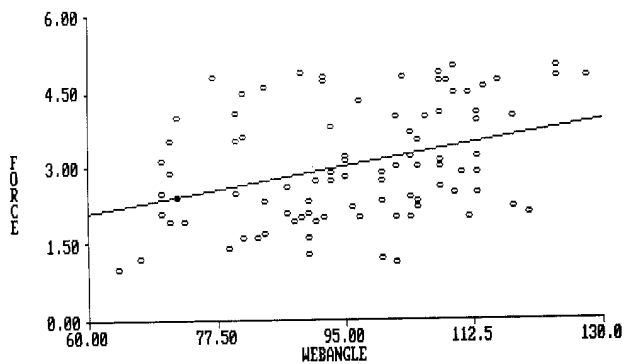


Fig. 5. — Correlation of web angle and force.

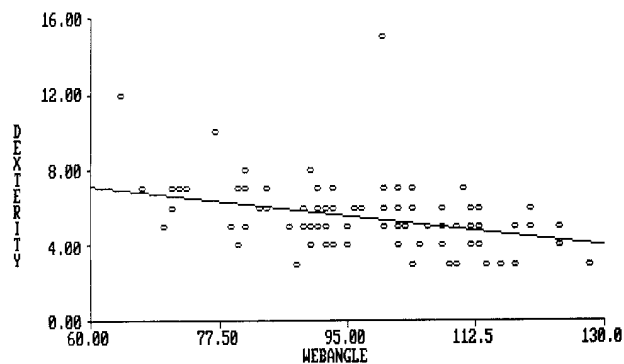


Fig. 6. — Correlation of web angle and dexterity.

DISCUSSION

As expected the close correlation between the dominant and the nondominant side allows us to use the contralateral side as a reference to guide

decisions and to evaluate mobility of the thumb or hand function (1).

There is no compensatory increased motion in the MCP for narrowed webs and vice versa, as we could not find any correlation. The importance of thumb MCP flexion for mechanical hand function is not very striking; on the contrary the carpometacarpal mobility, as measured by the web angle, is of more importance for grip force as well as for dexterity. The variability of MCP flexion has recently been studied and shown to correlate with a higher vulnerability to ligamentous injury (1, 6).

Further refinements of this survey are required, but it can serve as a basis for further study and comparison in diseased or injured hands.

REFERENCES

1. De Smet L., Urtus M., Spriet A., Fabry G. Flexion of the metacarpophalangeal and interphalangeal joint of the thumb: influence of sex and age, relation to ligamentous injury. *Acta Orthop. Belg.*, 1993, 59, 357-359.
2. Harris H., Joseph J. Variation in extension of the metacarpophalangeal and interphalangeal joint of the thumb. *J. Bone Joint Surg.*, 1949, 31-B, 547-560.
3. Jensen C., Rayan G., Davidson R. First web contracture and hand function. *J. Hand Surg.*, 1993, 18-A, 516-520.
4. Joseph J. Further studies of the metacarpophalangeal and interphalangeal joint of the thumb. *J. Anatomy*, 1951, 85, 221-229.
5. Selinger R., Mitz V., Lemerle J. P., Vilain R. Un nouveau test d'évaluation fonctionnelle de la main et son apport dans l'étude des transferts d'orteil: le test des 5 allumettes dit «take five». *Ann. Chir. Main*, 1991, 10, 124-137.
6. Shaw S., Morris P. The range of motion of the metacarpophalangeal joint of the thumb and its relation to injury. *J. Hand Surg.*, 1992, 17-B, 164-166.
7. Van Wetter P. Biométrie et physiologie du pouce. *Acta Orthop. Belg.*, 1971, 37, 403-443.

SAMENVATTING

I. HERCK, A. STEENWERCKX, L. DE SMET, G. FABRY. Is er een correlatie tussen de duimmobiliteit en de mechanische handfunctie?

De metacarpophalangeale mobiliteit, de web, de grijpkracht en de behendigheid werden gemeten bij vrijwilligers. Uit de statistische evaluatie blijkt dat er een goede correlatie is tussen de dominante en niet do-

minante hand. De duimmobiliteit blijkt weinig invloed te hebben op de grijpkracht en de behendigheid in tegenstelling tot de grootte van de web. Wij kunnen dan ook in deze normale populatie geen compensatoir mechanisme aantonen tussen duimmobiliteit en grootte van de web.

RÉSUMÉ

I. HERCK, A. STEENWERCKX, L. DE SMET, G. FABRY. Y-a-t-il une corrélation entre la mobilité du pouce et la fonction mécanique de la main ?

La mobilité de l'articulation métacarpo-phalangienne, l'ouverture de la première commissure, la force et la

dextérité ont été mesurées chez des volontaires. L'analyse statistique montre que la corrélation entre le côté dominant et le côté non-dominant est importante. La mobilité métacarpo-phalangienne n'influence ni la force ni la dextérité tandis que l'ouverture de la première commissure joue un rôle important. Il n'y a pas d'équilibre compensatoire entre la mobilité métacarpo-phalangienne et l'ouverture de la première commissure.