Normal pinch strength

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The normal pinch strength was determined with the Mannerfelt-Ulrich intrinsic meter in 90 men and women aged 21–65 years. The pinch strength decreased with increasing age. The ratio dominant/nondominant hand was 1.12, 0.13 (mean, SD) for both men and women. The ratio would be useful in evaluating pinch strength under pathologic conditions.

Both the grasping force of the hand and the pinch strength, pulp to pulp of the thumb and index finger, may be diminished after hand injuries. Both parameters are often measured to establish the degree of invalidity and to assess improvement, as well as to compare the effectiveness of various surgical procedures. Precise parameters are important when motivating a patient in a training program and in communication with other personnel about the patient's condition. The normal grasping force of the hand was determined by Thorngren and Werner (1979). The ratio dominant/nondominant hand was found to be a stable parameter that showed little difference for various ages as regards both men and women. Also when tested on various occasions, there was little difference in this ratio. We report the normal pinch strength in adults.

Patients and methods

The investigation included 45 men and 45 women aged 21–65 years. For each 5-year interval, 5 men and 5 women were examined. The subjects were randomly selected from among ambulatory patients and personnel at the Department of Orthopedics in Helsingborg. No previous history of trauma or pain in the upper extremity was allowed. Various occupations were represented. Ten subjects were examined on three different occasions at intervals of several weeks.

The Mannerfelt-Ulrich intrinsic meter (Heinrich C. Ulrich, Werkstätten für Medizinmechanik, 7900 Ulm-Donau, FRG) was used (Figure 1). A 100 units corresponded to 23 newtons at repeated determinations. Palmar two-point pinch was chosen because this is probably the most commonly used pinch in everyday life.

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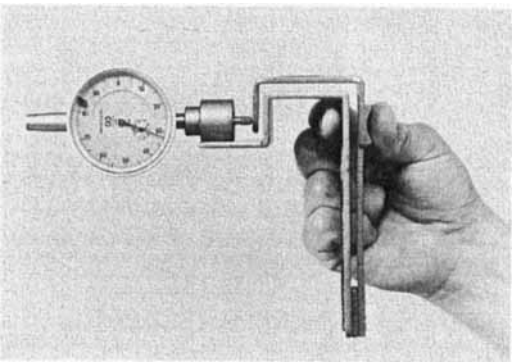

Figure 1. The Mannerfelt-Ulrich intrinsic meter.

The subject sat with the shoulder in the midsagittal zero position and the elbow flexed 90° with the forearm and wrist in the neutral position. The subject was instructed to exert maximal pressure between the pads of the thumb and the index finger keeping the middle, ring, and little fingers flexed into the palm (Figure 1). Three consecutive determinations were made alternating the dominant with the nondominant hand. The mean of the three values for each hand was determined, and the ratio dominant/nondominant hand was calculated. The Student *t*-test, regression analysis, and analysis of variance were used.

Results

The pinch strength decreased with increasing age (Figure 2), with generally higher values in the dominant hand ($P < 0.05$). Men were stronger than women ($P < 0.05$). The overall ratio dominant/nondominant hand for both men and women was 1.12 ± 0.13 (mean ±SD), with nonsignificant variations between the sexes and ages (Table 1). For one and the same individual,

Table 1. Pinch strength (units) and regression analysis in normal men and women. Strength (y) of the dominant (DH) and the non-dominant hand (NDH) for various ages (x)

		Strength		Regression analysis	
		Mean	*SD*		
Men	DH	353	*63*	y = 445 – 2.14 x	r = –0.45 **
	NDH	317	*61*	y = 412 – 2.21x	r = –0.48 ***
	DH/NDH	1.12	*0.10*	y = 1.07 + 0.001x	r = 0.14 NS
Women	DH	252	*57*	y = 316 – 1.47 x	r = –0.34 *
	NDH	229	*62*	y = 293 – 1.48 x	r = –0.31 *
	DH/NDH	1.12	*0.15*	y = 1.07 + 0.001x	r = 0.12 NS

*** $P < 0.001$, ** $0.001 < P < 0.01$, * $0.01 < P < 0.05$.

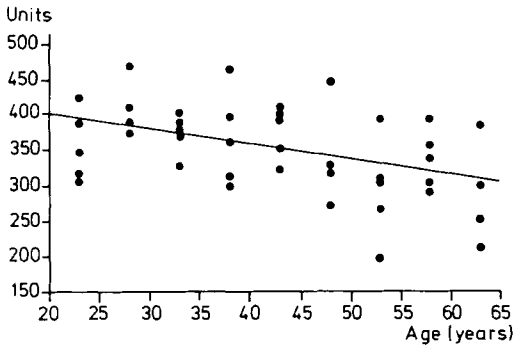

Figure 2. Regression analysis of the dominant hand in the men.

the pinch strength and the ratio dominant/nondominant hand did not change when tested sequentially with an interval of several weeks.

Discussion

Pinch strength can be measured in different ways. *Three-point pinch* includes tip and palmar pinch. In tip pinch the pinch meter is grasped between the tips of the thumb, index finger, and the middle finger (Kellor et al. 1971, Ager et al. 1984). In palmar pinch the pinch meter is grasped between the pads of the thumb, index finger, and the middle finger (Kellor et al. 1971, Mathiowetz et al. 1984, Ager et al. 1984). *Two-point pinch* includes tip, palmar, and lateral (key) pinches. In tip pinch the pinch meter is grasped between the tips of the thumb and the index finger (Mannerfelt 1966, Mathiowetz et al. 1984). In palmar pinch the pinch meter is grasped between the pads of the thumb and the index finger (Weiss and Flatt 1971, Reikerås 1983, Ager et al. 1984, Hook and Stanley 1986). In lateral (key) pinch the pinch meter is grasped between the pad of the thumb and the radial side of the middle phalanx of the index finger (Kellor et al. 1971, Weiss and Flatt 1971, Mathiowetz et al. 1984, Reikerås 1983, Ager et al. 1984).

Mannerfelt (1969) found different tip-pinch strength values depending on different angles of the wrist. Kellor et al. (1971) tested tip-pinch strength with the subject grasping the pinch meter with the tips of the thumb, index finger, and middle finger with the forearm pronated. Weiss and Flatt (1971) conducted a pilot study of pinch strength and hand size in 198 children. They found differences between the pinch strength of the dominant and the nondominant hand. A correlation between the lengths of each digit and their pinch strengths was also found. Reikerås (1983), however, did not find any difference in pinch strength between the dominant and the nondominant hand. Ager et al. (1984) found a steady increase in pinch strength that coincided with the increase in age and development in children. Hook and Stanley (1986) found the pinch grip strength to double when the remaining fingers were kept flexed as compared with when they were held extended. Finally, Mathiowetz et al. (1984) found high interrater and test-retest reliability under standardized positioning and instructions.

Our investigation showed age-correlated values of pinch strength for both the men and the women using a standardized pinch test performed in accordance with the American Society of Hand Therapists' (ASHT) recommendations (Mathiowetz et al. 1983). The only previous investigation using regression analysis of the determinations is that of Kellor et al. (1971). Because similar testing devices have not been used, a comparison of the absolute values from this investigation with the previous ones is not possible. However, we found a decreasing pinch strength with increasing age, which accords with the observations of Kellor et al. (1971). Most previous investigators have found a difference in pinch strength between the sexes, men having more

powerful pinch grips than women (Kellor et al. 1971, Reikerås 1983, Ager et al. 1984, Hook and Stanley 1986). This was confirmed in the present study. This study also showed a dominant/nondominant ratio of 1.12 ± 0.13 (mean ± SD) both in the men and women. The ratio value was a stable parameter, showing no differences for various ages in both the men and the women. Also when tested on various occasions, no differences were found. Thus, the ratio dominant/nondominant hand is an accurate means of evaluating pinch strength and can be used as a reference in evaluating pinch strength in disabled hands.

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Acknowledgements

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