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Clinical assessment of the relative lengths of the fingers of the human hand

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Abstract

Background: Traumatic or congenital events can result in injury and functional deficiency in the hand and we need to reconstruct the fingers at times. Studies are available in the pediatric and adult age groups to assess the length of the thumb. But to the best our knowledge no measurement of the relative clinical length of all fingers has been reported in the literature. We performed this study to assess the clinical relative lengths of the fingers of the human hand by using surface landmarks.

Methods: Fifty male and fifty female healthy participants were involved in the study. We assessed the distances between the tips of fingers from the distal wrist crease while the thumb and other fingers were held in adducted position. We also assessed the ratio of all fingers including the thumb to the middle finger.

Results: One hundred normal hands in 100 healthy volunteers were included in the study, 50 women and 50 men; the average age was 32(20- 50) years. The distance of tips of fingers from distal wrist crease were 93.6(86-120), 156.4 (142-185), 166.9 (150-200), 156.3(150-188), 132.4(114-168) millimeter in females respectively for the first to the fifths fingers and the same figures for male participants were 107.9(102-121),170.6(153-191),182.6(166-204),172.2(158-193),144.1(129-168) millimeter. The ratios of first, second, fourth and fifth fingers to the middle finger were 60 %, 94 %, 95 %, 79 % for males respectively and 59 %, 94 %, 94 %, 78 % for females.

Conclusion: The authors believe that, the relative length of fingers can help the surgeon to decide confidently in the reconstruction of hand and fingers because this method is simple and easy use.

Keywords: finger length, reconstruction, relative, hand.

Introduction

Thumb is the most important of all digits and it has been estimated that its absence will result in to loss of 40% of the hands functional capabilities.

Fingers length and their ratio are important from different aspects of view. They are important in social attitude, behavior science, sport performance and more important in the reconstruction of an injured hand [1-2-3].

Traumatic or congenital events can result in injury and functional deficiency in the hand which need to be reconstructed at times.

Studies in the pediatric age group were performed to assess the length of the thumb mostly by comparing its tip to the landmarks of the index finger [4-5]. Recently few investigators, however, have studied the relative length of the normal human thumb in adults [6-7]. But to the best our knowledge no measurements of the rel-

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ative clinical length of all fingers has been reported in the literature.

We performed this study to assess the clinical relative lengths of the fingers of the human hand by using surface landmarks.

Method

Fifty male and fifty female healthy participants were involved in the study. The volunteers were middle age (between 20 to 50 years).

Exclusion criteria included prior fracture or surgery of the hand, congenital skeletal anomaly, skeletal immaturity, joint contracture and previous connective tissue disorder.

All fingers were in adducted position without flexion of any joint. A transparent ruler was placed on the volar side of the pronated hands on a flat surface and parallel to the long axis of third finger and then a high quality digital photo was taken and printed it. The photos with suboptimal quality were excluded and only the right hands assessed. All measurements were made by one observer and to the nearest mm with the ruler. Then we assessed the ratio of all fingers including the thumb to the middle finger. The third finger was used as a reference finger due to lower incidence of its involvement in congenital ulnar or radial side deficiencies and injury during traumatic events. The following reference markings were made on each hand. First line was drawn along the axis of the middle finger and second line was drawn perpendicular to that line from the crossing point of first line to the distal wrist crease. Then the distances between the tips of fingers with the horizontal reference line of distal wrist crease were assessed. We also studied the presence of the "thenar arc" that Sunil reported in his study [7].

When the thumb was held in adducted position against the hand, the thenar crease of the palm and the thumb interphalangeal crease came to contact to one another. We called this smooth curve "greater thenar arc" which was equal to Sunil's "thenar arc". There was another smooth curve proximal to that curve between distal crease of metacarpophalangeal joint of thumb and proximal thenar crease. We called the second curve "lesser thenararc" (Fig 1). The relative length of all fingers including the thumb to the third finger was also measured.

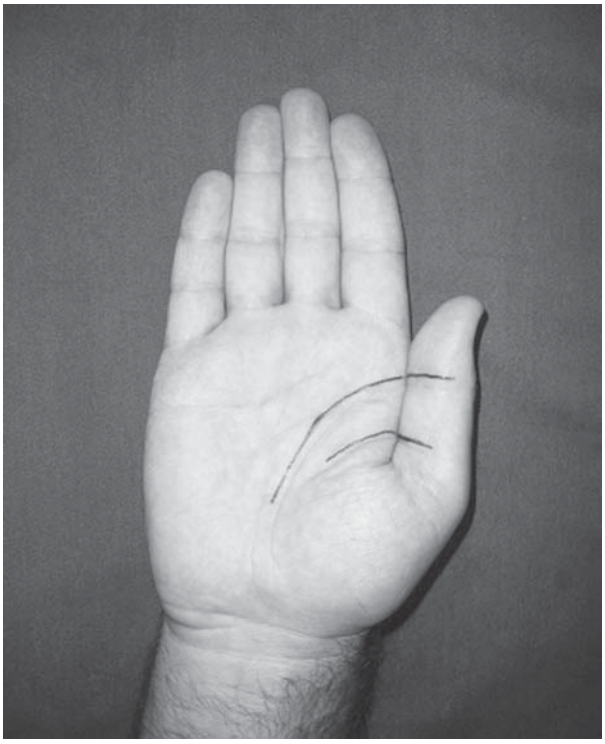

Fig. 1. The lines are parallel to the greater thenar arc in distal and lesser thenar arc in proximal. Both arcs are continuous in this case.

Results

One hundred normal hands in 100 healthy volunteers were examined in the study, 50 women and 50 men with the average age of 32 years (20- 50). Table 1 shows the distance of

Finger	D1	D2	D3	D4	D5
Length	93.6(86-120)	156.4(142-185)	166.9 (150-200)	156.3(150-188)	132.4(114-168)

D1: Thumb D2: Index finger D3: Middle finger D4: Ring finger D5: Small finger

Table 1. The length of fingers in female volunteers (in millimeter).

Finger	D1	D2	D3	D4	D5
Length	107.9(102-121)	170.6(153-191)	182.6(166-204)	172.2(158-193)	144.1(129-168)

D1: Thumb D2: Index finger D3: Middle finger D4: Ring finger D5: Small finger

Table 2. The length of fingers in male volunteers (in millimeter)

fingers from the distal wrist crease in millimeter in female participants, and table 2 represents the same results in male group. Table 3 presents the relative length of finger to the middle finger. The greater thenar arc was continuous and smooth in 86% and broken in 14% of male participants. The range of variance in the latest group varies from -2mm to + 6 mm. Negative variance indicated that the interphalangeal crease was proximal to the thenar crease and positive variance means that it was distal to the thenar crease. In females, greater thenar arc was continuous in 88% and broken in 12% of cases. Variance was similar to the male group (-2 to +6). In contrast to the greater arc, the lesser thenar arc was not exist in 16% of females and in 18% of male participants. It was continuous in 72% of female participants and 66% of male volunteers. The arc was broken in 12% and 16% of female and male participants respectively. Again the variance varied from -2 mm to +2 mm in both groups.

Discussion

Fingers length and their ratio are important from different aspects of view. Recent studies have proved that they are important in social attitude, behavior of mankind, sport (ski) performance and more important in the reconstruction of an injured hand [1-3]

Efforts have been made to elucidate different aspects of fingers length and their relation to each other [2,3,6-9].

Digit ratio (length of index finger divided by length of ring finger) is an index of exposure to prenatal testosterone [1]. Men have been found to have a smaller ratio between index and ring finger length (the D2:D4 ratio) than women [1].

The smaller index to ring finger (D2:D4 ratio) has been considered as a 'male finger pattern' and is associated with sporting ability and number of conditions [3,8].

Assuringly the relationship of different segments of fingers was assessed to verify the Fibonacci sequence [9]. According to this hypothesis, the relationship is based originally on the mathematical series defined by a sequence of numbers generated by the sum of the previous 2 numbers (0,1,1,2,3,5,8.13,21 and so forth). 9Park and his colleagues could not verify the validity of the Fibonacci relationship with respect to the bone lengths of the human hand [9].

Fingers length and their ratio have been the area of attention and research in the recent years. Thumb is the most important finger. Adequacy of thumb function depends on the thumb's length and mobility. And it is true about other fingers. There are no widely accepted objective assessment tools for thumb and other fingers aesthetic appearance during reconstruction.

At times the only available option was comparing the thumb with the contralateral thumb. This may not be possible in situations, where the opposite thumb is absent or deficient be-

Finger	D1/D3	D2/D3	D4/D3	D5/D3
Male	60 %(58%-62%)	94 %(92%-95%)	95 %(93%-97%)	79 %(74%-82%)
Female	59 %(57%-62%)	94 %(92%-95%)	94 %(91%-95%)	78 %(76%-81%)

D1: Thumb D2: Index finger D3: Middle finger D4: Ring finger D5: Small finger

Table 3. Relative lengths of fingers to the middle finger in female and male participants

cause of a congenital defect or trauma.

Few investigators however have studied the relative length of the normal human thumb [2,7]. But we did not find any study assessing the clinical length of all fingers and their ratios.

Studies are available in the pediatric age group, where the length of the thumb has been described with reference to the adjacent index finger.

Tachdjian reported that when the tip of the normal thumb is adducted it should reach half of the length of the proximal phalanx of the index finger [4]. And it has been depicted that the normal thumb extends to about the level of proximal interphalangeal joint of the index finger, hence a thumb is considered "short" if its length is less than this [5]. Hypoplasia of any or all osseous components produces a thumb that is significantly shorter than normal [5]. Sunil recently measured the relative length of the adult thumb compared with the length of the index finger in adults [7]. In his study, he assessed the length of thumb in comparing with different landmarks on the index finger. At the same time he described the smooth thenar arc which can be formed by thenar crease and thumb interphalangeal crease when thumb is in adducted to the palm. Sunil proposed several indexes to assess the thumb length and he believed that this method is simple and does not need sophisticated equipment [7].

Coldfarb et al. recently have described the relative thumb length, girth, and nail width. In their study they assessed the relative thumb length and index finger [2]. Both these studies assessed the thumb and presented nothing about other fingers.

These studies and indexes are helpful for the preoperative assessment and postoperative evaluation of the reconstructed congenital thumb but as it mentioned, there is very few information about other fingers and more detailed information is necessary for a thorough objective evaluation of not only the thumb appearance but also the aesthetic appearance of other fingers.

In this study the hand and fingers were considered as a whole structure and the clinical relative length of fingers was examined using the middle one as a reference. At the same time we re- evaluate the thenar arc in our population and introduce the lesser thenar arc as a new indicator. It seems that greater thenar arc was more constant than the lesser one. The results indicated that the variance of thenar arc of volunteers was more diverse than the Sunil's study.

We believe that our study had limitations such as:

1. No comparison made between the left hand and the right one.

2. Other dimensions of fingers like girth and nail width, were not examined.

3. Our study was not supported by radiography.

4. No comparison made between different ethnic groups.

5. The intraobserver variation of the observer was not examined.

The authors believe that, the relative length and ratio of fingers can help the surgeon in operation room to decide confidently in the reconstruction of hand and fingers because this method is simple and easy to accomplish in contrast with other presented methods. The surgeon only needs to know four reference ratios and consider the presence of the greater and lesser thenar arcs.

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