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Normative Values for Thumb Length in Central Indian Adult Population

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Abstract

Introduction This article aims to establish the relative thumb length in comparison to the index finger in central Indian adults.

Materials and Methods Five hundred normal adult hands (1,000 thumbs), 316 men and 184 women, mean age 30 years, were included in the study. The relative length of the thumb was measured using the length of the proximal phalanx of the index finger (thumb–proximal phalanx index) and the distance between the proximal digital crease and proximal interphalangeal crease of the index finger (thumb–digital crease index).

Results The tip of a normal adducted thumb extends to 69% of the length of the proximal phalanx of the index finger and 38% of the distance between the two proximal creases of the index finger. The tip of a normal adducted thumb extends to 68% for male and 69% for female of the length of the proximal phalanx of the index finger. For the dominant hand the tip of a normal adducted thumb extends to 68%, while for nondominant hand it reaches 71% of the length of the proximal phalanx of the index finger. The difference between the laterality, gender, and hand dominance was not statistically significant.

Conclusion The tip of a normal adducted thumb extends to 69% of the length of the proximal phalanx of the index finger and 38% of the distance between the two proximal creases of the index finger. Relative normal thumb length is independent of gender, laterality, or hand dominance.

Keywords
- normative data
- thumb length
- central Indian adult
- anthropometry

Introduction

Adequate length and mobility of thumb is mandatory for overall function of hand.[1] There is no agreement on normal length of thumb in the literature. Some reports says the tip of the adducted thumb is expected to reach somewhere between half the proximal phalanx or up to the skin crease of the proximal interphalangeal joint of the index finger.[2,3]

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However, we do not have any large Indian study measuring the relative length of the thumb in adults and more information is required for the identification of the normal thumb length. The aim of this study was to establish a normal database of relative normal thumb length with respect to the index finger in Indian adult population dependent on age, gender, and hand dominance.

Materials and Methods

This prospective observational study was conducted over a period of 10 months from January 2023 to October 2023 in the department of plastic, hand and reconstructive surgery in central India. Institutional ethical committee permission and informed consent from participants were taken. Five hundred normal adult hands (1,000 thumbs), 316 men and 184 women, mean age 30 years (range: 18–40 years), were included in the study. Patients with congenital hand anomalies, past history of injuries, arthritic changes, infection, or bone or soft tissue disease of the hand are excluded from the study. Thumb length was measured as follows.[4]

First line was drawn along the long axis of the index finger and a dot (P1) was placed at the distal pulp tip. A second dot (P2) was then placed at the most proximal flexion crease over the proximal interphalangeal joint. The distance between these two dots (P1 to P2) represents the sum of the lengths of the middle and distal phalanges.[2] Digital bones follow the Fibonacci sequence therefore the distance between P1 and P2 must equal the length of the proximal phalanx.[5] Thus, having estimated the length of the proximal phalanx a third dot (P3) was placed along the axis of the digit at a distance equal to the length of the proximal phalanx from P2. The next step was to drop a perpendicular line from the tip of the adducted thumb to the axis of the index finger. The point where these two lines meet was termed "X." Finally, the point where the axis of the index finger meets the proximal digital crease was marked as "D" (►**Figs. 1** and **2**). All measurements were made using calibrated tape with the hand placed flat; palm facing upward and fingers/thumb were adducted.

Once all the dots and lines were marked the distance between X and P3 (T1), the distance between X and D (T2), distance between P2 and P3 (PP, the length of the index proximal phalanx), and the distance between P2 and D (DC, the distance between the proximal digital crease and proximal interphalangeal crease of the index finger) were measured to calculate the two indices.

1. Thumb–proximal phalanx index (TPP index = T1/PP), indicates how the distal tip of the adducted thumb extends along the proximal phalanx of the index finger.
2. Thumb–digital crease index (TDC index = T2/DC), indicates how the distal tip of the adducted thumb lies between the proximal digital crease and proximal interphalangeal crease of the index finger.

The data was analyzed using SPSS version 20 and expressed in mean and standard deviation and calculated for different age, gender, laterality, and hand dominance.

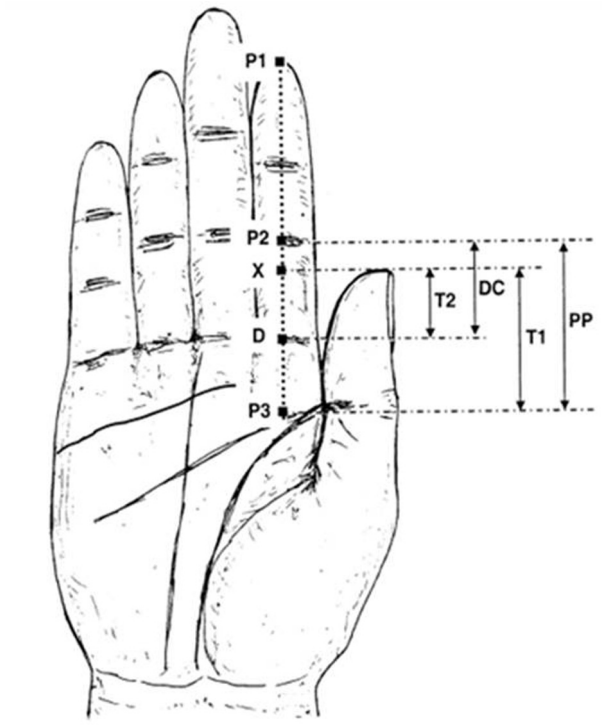

Fig. 1 Line diagram showing various lines and points to calculate the thumb–proximal phalanx (TPP) and thumb–digital crease (TDC) indices.

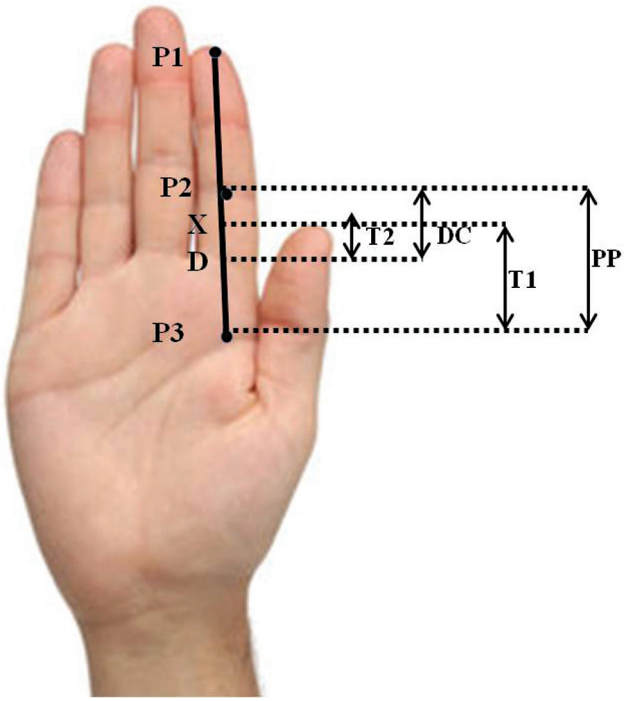

Fig. 2 Clinical photograph with digital markings to calculate the thumb–proximal phalanx (TPP) and thumb–digital crease (TDC) indices.

Results

Our study sampled 500 participants (1,000 thumbs); their demographics like gender, age, and hand dominance are shown in ►**Table 1**.

Overall mean TPP and TDC index was 0.69 and 0.38. The mean TPP and TDC index was 0.68 and 0.38 in males, and 0.69 and 0.40 in females. For dominant hand the mean TPP and TDC index was 0.68 and 0.37, respectively, while for the nondominant hand it was 0.71 and 0.43. The mean TPP and TDC index was 0.68 and 0.37 for the right thumb and 0.69 and 0.39 for the left thumb, respectively (►**Table 2**). Mean TPP and TDC index for different age groups is shown in ►**Table 3**. There was no statistical difference in both the indices in age group from 18 to 40 years. The difference between the right and left hands, gender, and hand dominance was not statistically significant for both the indices. The descriptive statistics of all the participants is shown in ►**Table 4**.

Discussion

Our prospective observational study has captured the normative data for thumb length in central Indian adult population. Moreover, it shows that the relative normal thumb length is independent of gender, laterality, or hand dominance. The tip of a normal adducted thumb extends to 69% of the length of the proximal phalanx of the index finger and 38% of the distance between the two proximal creases of the index finger.

Thumb function depends on the adequate length and mobility; thus, one must know the ideal thumb length for reconstruction. Generally, there is no objective and reliable method for the thumb length assessment. One can compare it with the contralateral thumb, however, when the opposite thumb is absent or abnormal as a result of a congenital defect, trauma, or infective pathology this may not be possible. We have evaluated relative thumb length in adults using two

Table 1 Demographic details of population

Age (Years) (n)	Gender		Hand dominance	
	Male	Female	Right	Left
	N (%)	*N* (%)	*N* (%)	*N* (%)
18–20	38 (12.0)	23 (12.5)	59 (12.5)	2 (6.9)
21–30	144 (45.6)	77 (41.8)	204 (43.3)	17 (58.6)
31–40	134 (42.4)	84 (45.4)	208 (44.2)	10 (34.5)
Total	316	184	471	29

Table 2 Mean TPP and TDC indices according to laterality, gender, and hand dominance

Index, mean ± SD	Laterality		Gender		Hand dominance	
	Right	Left	Male	Female	Dominant	Nondominant
TPP index	0.689 ± 0.075	0.695 ± 0.085	0.688 ± 0.082	0.699 ± 0.076	0.688 ± 0.075	0.713 ± 0.054
TDC index	0.378 ± 0.099	0.399 ± 0.110	0.38 ± 0.098	0.40 ± 0.112	0.379 ± 0.099	0.432 ± 0.082

Abbreviations: SD, standard deviation; TDC, thumb–digital crease; TPP, thumb–proximal phalanx.
Note: TDC, the distance between the proximal digital crease and proximal interphalangeal crease of the index finger; TPP, length of the proximal phalanx of the index finger.

Table 3 Mean TPP and TDC indices according to age groups

Age group	Gender	TPP index		TDC index	
		Right	Left	Right	Left
		Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
18–20	F	0.67 (0.08)	0.69 (0.09)	0.35 (0.12)	0.36 (0.12)
	M	0.69 (0.08)	0.70 (0.09)	0.35 (0.08)	0.41 (0.10)
20–30	F	0.70 (0.08)	0.71 (0.07)	0.40 (0.10)	0.40 (0.13)
	M	0.68 (0.08)	0.68 (0.08)	0.37 (0.10)	0.39 (0.11)
30–40	F	0.69 (0.08)	0.70 (0.07)	0.41 (0.10)	0.43 (0.11)
	M	0.69 (0.07)	0.70 (0.10)	0.37 (0.09)	0.39 (0.10)

Abbreviations: F, female; M, male; SD, standard deviation; TDC, thumb–digital crease; TPP, thumb–proximal phalanx.
Note: TDC, the distance between the proximal digital crease and proximal interphalangeal crease of the index finger; TPP, length of the proximal phalanx of the index finger.

Table 4 Descriptive statistics

Age, y	Right hand				Left hand				TPP index		TDC index	
	T1	T2	PP	DC	T1	T2	PP	DC	Right	Left	Right	Left
18	22.00	3.00	39.00	18.00	20.00	2.00	38.00	16.00	0.47	0.43	0.05	0.10
40	44.00	21.00	56.00	31.00	46.00	22.00	57.00	33.00	1.00	1.38	0.83	1.05
Mean ± SD	32.38 ± 4.16	8.71 ± 2.24	46.95 ± 3.48	23.09 ± 2.23	32.62 ± 4.34	9.12 ± 2.37	47.01 ± 3.60	23.10 ± 2.42	0.68 ± 0.07	0.69 ± 0.085	0.37 ± 0.09	0.39 ± 0.11

Abbreviations: SD, standard deviation; TDC, thumb–digital crease; TPP, thumb–proximal phalanx.
Note: DC, the distance between the proximal digital crease and proximal interphalangeal crease of the index as measured along its axis (i.e., the distance between P2 and D); PP, the length of the index proximal phalanx (distance between P2 and P3); T1, the distance between X and P3; T2, the distance between X and D.

simple clinical parameters (TPP and TDC indices) that can help quantify thumb length and serve as a guide for reconstruction.

A study on normative data for relative thumb length in pediatric population has reported that these relative lengths remain constant throughout from infancy into adulthood and there was no significant difference from age 1 through 18 years.[6,7] Our study also indicated that these relative lengths did not demonstrate significant differences in adult population.

Estimation of thumb length by estimating the TPP index is better because it uses the bony landmark such as length of the proximal phalanx. The TDC index uses skin creases as reference points, which are likely to be variable. However, use of TDC index may be required in situations where the length of the proximal phalanx cannot be obtained due to partial amputation of the index finger. One study showed that anthropometric measurements for calculation of relative thumb length can be taken from dorsal or palmer sides of the hand, without affecting the results.[8] Other studies have also measured the relative thumb length using similar clinical indices and reported TPP index (0.80–0.69) and TDC index (0.41–0.60) which is comparable with our study.[4,6,8,9]

Estimation of normal thumb length is useful in the diagnosis of congenital hand malformations, planning the treatment, and evaluation of thumb reconstructions by different methods. These normative data help in determining the length of reconstructed thumb. This is particularly helpful if bilateral thumb defects are present.[10,11] Normative data of thumb length is also useful in the estimation of stature and gender of human remains as a part of any medicolegal investigation. Many studies have shown association between stature and gender with the length of thumb.[12,13] Additional value of normative data for thumb length can be used to ascertain vertical occlusal dimension in edentulous patients.[14]

Thumb length can be calculated using radiographs of hand, plain Xerox photocopy of hand, or measurement using Vernier caliper.[9,10,15] However, taking radiographs of normal hand is unethical, Xerox photocopy of hand or measurement using Vernier caliper the compressibility of skin over these anatomic landmarks cannot be avoided, so there may be some degrees of errors in measurement. We have used simple clinical measurements to create normative data for thumb length which does not require any costly equipment and can be done in outpatient clinic without need for any imaging.

Limitations of the study include that our findings are not supported radiologically, nonuniform small sample size, and the inherent problem with normative data is to determine individual normative data. Furthermore, the normative values and ranges should be interpreted in the context of limitations associated with instrument and techniques used for collecting normative data.

Conclusion

The tip of a normal adducted thumb extends to 69% of the length of the proximal phalanx of the index finger and 38% of

the distance between the two proximal creases of the index finger. Relative normal thumb length is independent of gender, laterality, or hand dominance.

Authors' Contributions

P.A. was responsible for data collection, data analysis, manuscript writing, and editing. M.R.T. contributed to conceptualization, data analysis, manuscript writing, and editing. M.S. focused on data collection and data analysis, while R.B. also handled data collection and data analysis. D.S. took part in manuscript writing and editing, and J.S.D. was involved in data analysis.

Conflict of Interest

None declared.

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