





# Indian Hand Anthropometry: First Web Space Angle Measurement in A Population of 800 Subjects

Parag B. Lad<sup>1</sup> Mukund R. Thatte<sup>2</sup> Maryada V. Reddy<sup>3</sup>  Bipin Ghanghurde<sup>4</sup>  Venkateshwaran N.<sup>5</sup>  
Ashish Phadnis<sup>1</sup>

<sup>1</sup> Department of Orthopedics, Jupiter Hospital and Pinnacle Orthocenter, Thane, Maharashtra, India

<sup>2</sup> Department of Plastic Surgery, Bombay Hospital and Medical Research Centre, Mumbai, Maharashtra, India

<sup>3</sup> Department of Orthopaedics, Sunshine Bone and Joint Institute, Secunderabad, Andhra Pradesh, India

<sup>4</sup> Department of Plastic Surgery, B.J. Wadia Children's Hospital, Mumbai, Maharashtra, India

<sup>5</sup> Department of Plastic Surgery, Jupiter Hospital, Thane, Maharashtra, India

Address for correspondence Parag B. Lad, Diploma (Ortho), FCPS, MS (Ortho) USAIM, Pinnacle Orthocentre, 1st/2nd Floor, Blue Nile Building, Almeda Road, Panch Pakhadi, Thane (W), Maharashtra 400602, India (e-mail: orthodoc\_p@yahoo.com).

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## Abstract

**Background** The first web space of the hand plays a crucial role in determining the hand's span. Our study aims to examine and quantify the first web space angle in both hands of adult individuals within the Indian population with no upper limb pathologies. The primary objective of this study is to establish normative data. These data will be useful in surgical correction for the first web release, recommending corrective splints, and calculating the percentage of disability in hand function.

**Materials and Methods** Data from 800 individuals from various regions across India, ranging in age from 20 to 50 years who had no pathology in both upper limbs were collected. A goniometer was used to measure the first web space angle of both hands by keeping the forearm pronated<sup>3</sup>, elbow flexed, and arms adducted. The subjects from different states were divided into various zones.

**Results** In 800 subjects, the average measurement in the right hand was 97.28 degrees, and in the left hand, 99.76 degrees. In males, the average measurement in the right hand was 97.54 degrees, and in the left hand, it was 99.61 degrees. In females, in the right hand, it was 96.93 degrees, and in the left hand 100 degrees. The result was recorded in subjects from each zone in the country.

**Conclusion** The large sample size from various parts of the country makes the study more reliable. The technique of measuring the angles was easily reproducible. Our findings provide crucial normative data for clinicians and therapists.

## Keywords

- ▶ normative data
- ▶ web space
- ▶ angle

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## Introduction

The Indian Society for Surgery of the Hand (ISSH) conducted a nationwide project to gather comprehensive normative data on various aspects of human hands. This study, part of the ISSH project, analyzed and measured the first web space angle in both hands in the Indian population.

The first web space of the human hand plays a crucial role in determining the hand's span. Due to its connection with the metacarpophalangeal (MCP) joint and carpometacarpal (CMC) joint of the thumb, along with the presence of thenar muscles and stretchable skin, the first web space exhibits high flexibility and mobility. Its adaptability allows individuals to grasp and hold objects of various sizes. Notably, the functionality and strength of the hand are heavily influenced by the thumb and the first web space, as expressed in the fourth Bridgewater Treaty<sup>1</sup> by Sir Charles Bell: "The power of the human hand depends on the length, strength, free lateral motion, and perfect mobility of the thumb." Any injury or illness affecting the radial aspect of the hand, including bony or soft tissue-related pathologies can lead to contracture of the first web space. Such conditions significantly impair hand function until the underlying pathology is effectively addressed.

Our study aims to examine and quantify the first web space angle in both hands of adult individuals within the Indian population who have no upper limb pathologies. The primary objective of this study is to assess the first web space angle in both hands and establish normative data. These data will be invaluable for clinicians and therapists in evaluating their patients, facilitating surgical correction for releasing the first web space, recommending corrective splints, and calculating the percentage of disability in hand function.

## Materials and Methods

For this study, we collected data from 800 individuals from various regions across India, ranging in age from 20 to 50 years. The choice of this age group was based on the fact that it represents the actual working population in India. The adolescent age group (below 18 years) was excluded. While collecting the data, we chose individuals who were healthy volunteers, who came to the outpatient clinic as an attendee, and hospital staff. Additionally, we set the upper age limit at 50 years, as certain conditions, such as triggering of the thumb or CMC joint arthrosis of the thumb, tend to occur after this age.

To ensure the data relevance, we established specific exclusion criteria. Participants with any existing hand, wrist, forearm, or elbow pathology were excluded from the study. Only individuals with normal movements, and no history of previous bony or soft tissue trauma, surgery, deformities, or visible lumps due to any etiology from hand to elbow were included in the study cohort.

### The First Web Space Measurement Method

To measure the first web space, participants were seated in front of the investigator on a chair with both shoulders adducted, elbow flexed to 90 degrees, forearms fully

pronated, and palms as well as radial borders of both thumbs touching a flat white paper on the table (►Fig. 1). The instruction was to keep the first web space of both hands as wide as possible on white paper while extending the interphalangeal (IP) joint of the thumb to its maximum, ensuring stabilization of the MCP joint. Participants unable to maintain this position with both upper limbs were excluded from the study.

During the measurement process, three markings were made on the paper. The first point was the radial palmar point of the proximal interphalangeal joint (PIPJ) crease of the index finger. The second point was the ulno-palmar point of the IP joint of the thumb. The third point was marked by intersecting the lines from the radial border of the index finger and the ulnar border of the thumb in the first web space, keeping it as wide as possible. The outline of all three points was marked (►Figs. 2 and 3).

Two lines were then drawn on the paper. One longitudinal line connected the point of the PIPJ of the index finger to the first web space, and another line connected the point of the IP joint of the thumb to the first web space point (►Fig. 4)

### Data Collection and Analysis

The ethics committee of the institute where Lad P B practices approved the study. Informed consent was obtained from all subjects before taking measurements. A goniometer was utilized to measure the first web space's angle. The same measurement method was repeated to assess the first web space angle of the other hand. Comprehensive data were recorded for each subject, including their name, age, sex, mother tongue (for regional ethnicity), hand dominance, and contact details.

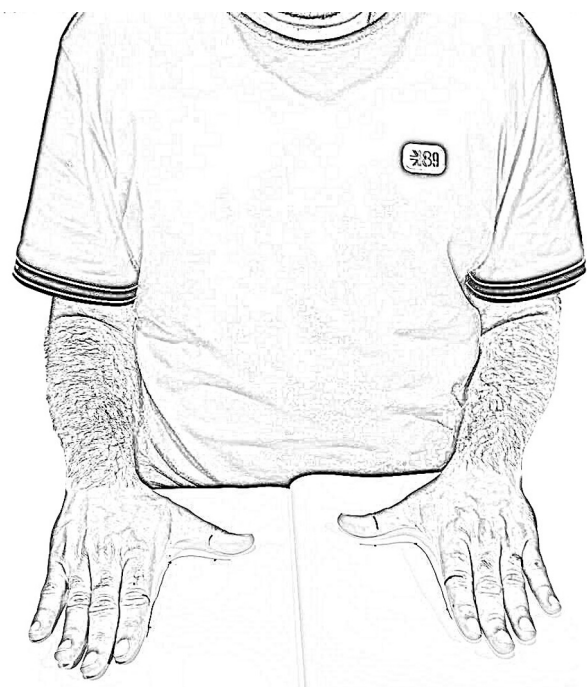
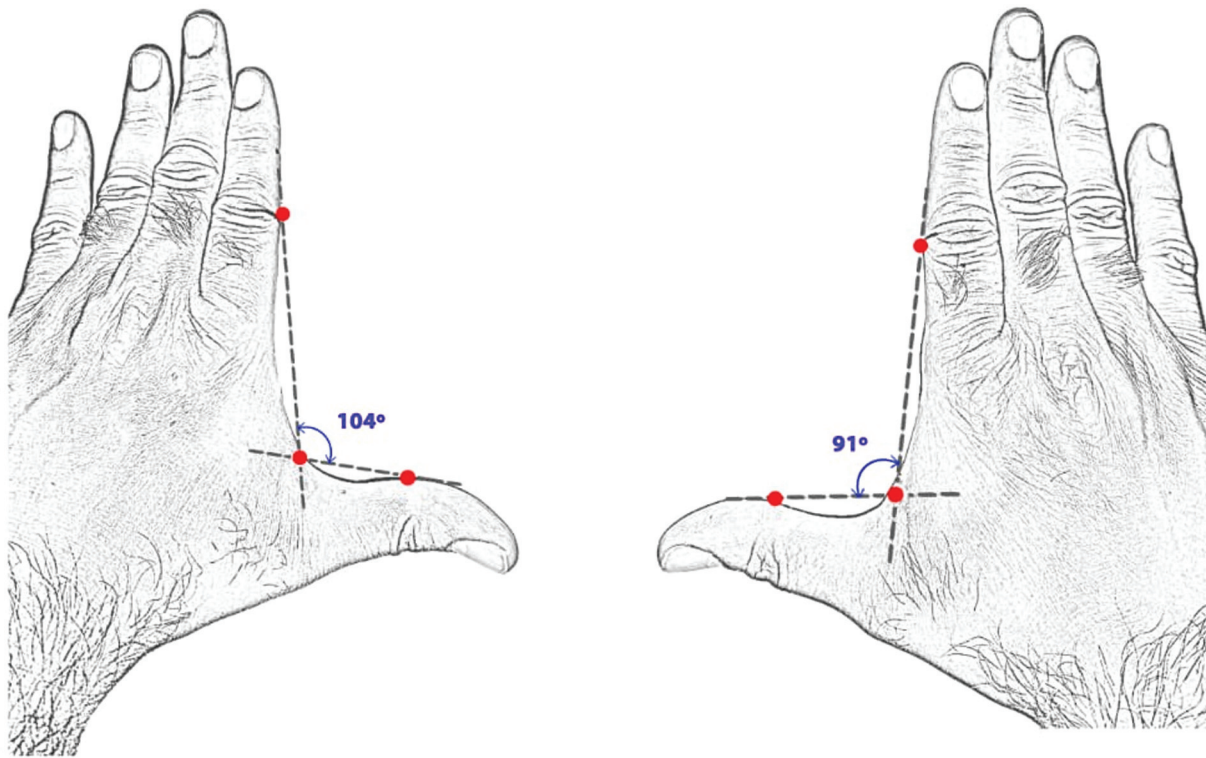


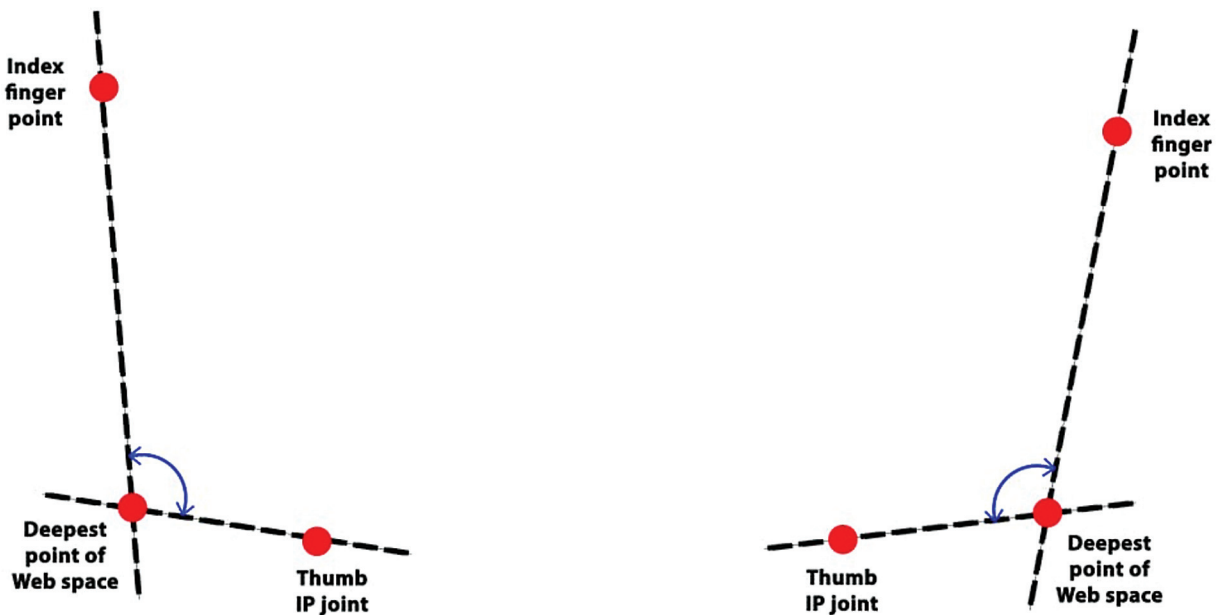
Fig. 1 Position of the hands.



**Fig. 2** Lines joining the markings.

An intraobserver and interobserver study was conducted with 80 subjects to ensure measurement accuracy. The observers measured the angles twice for each hand, and then two other authors independently performed measurements on the same subjects. The correlation coefficient in an intraobserver study in the left hand was 0.896; for the right hand, it was 0.723. The correlation coefficient in the interobserver study in the left hand was 0.851, and in the right hand, it was 0.793.

Out of 800 subjects in the study, 390 were from Maharashtra, 60 were from Gujarat, 96 were from Uttar Pradesh, 42 were from Rajasthan, 39 were from Madhya Pradesh, 31 were from Punjab, 23 were from Haryana, 20 were from Karnataka, 17 were from Andhra Pradesh, 17 were from Kerala, 12 were from Tamil Nadu, 15 were from West Bengal, 13 were from Orissa, 11 were from Goa, 8 were from Bihar, and 3 were from Delhi. 32 were from Punjab, there was one subject each from Uttarakhand and Jharkhand. Among the participants were



**Fig. 3** Markings on digits for web angle measurement. IP, interphalangeal.



Fig. 4 Web angle measurement with goniometer. IP, interphalangeal.

452 males and 348 females, with 786 being right-hand dominant and 14 being left-hand dominant.

## Results

The study population was categorized based on geographical zones in India. The west zone included Maharashtrians, Gujaratis, and people from Goa. The Central zone comprised individuals from Madhya Pradesh and Rajasthan. The North zone included Punjab, Uttar Pradesh, Bihar, Delhi, and Uttarakhand subjects. West Bengal and Orissa participants were included in the East zone, while the South zone consisted of data from Tamil Nadu, Kerala, Andhra Pradesh, and Karnataka.

The study was conducted in two centers in one city. The 800 subjects were chosen based on their ethnicity, region, and religion. In the overall sample of 800 subjects, the average measurement of the first web space angle in the right hand was 97.28 degrees, and in the left hand, it was 99.76 degrees.

Specifically, in the Central zone, with a sample size of 49 subjects, the average measurement of the first web space angle in the right hand was 97.49 degrees, and in the left hand, it was 99.59 degrees. In the North zone, comprising 163 subjects, the average measurement of the first web space angle in the right hand was 94.63 degrees, and in the left hand, it was 95.94 degrees. For the South zone, with 69 subjects, the average measurement of the first web space angle in the right hand was 100.65 degrees, and in the left hand, it was 100.39 degrees.

In the West zone, consisting of 491 subjects, the average measurement of the first web space angle in the right hand was 97.82 degrees, and in the left hand, it was 101.01 degrees. In the East zone, which included 28 subjects,

the average measurement of the first web space angle in the right hand was 99.59 degrees, and in the left hand, it was 98.96 degrees.

Furthermore, the study analyzed differences between genders and hand dominance. In males, the average measurement of the first web space angle in the right hand was 97.54 degrees; in the left hand, it was 99.61 degrees. In females, the average measurement of the first web space angle in the right hand was 96.93 degrees, and in the left hand, it was 100 degrees.

## Hand Dominance

In right-hand dominant subjects (786 out of 800), the average measurement of the first web space angle in the right hand was 97.30 degrees, and in the left hand, it was 99.84 degrees.

In left-hand dominant subjects (14 out of 800), the average measurement of the first web space angle in the right hand was 96 degrees, and in the left hand, it was 95.21 degrees.

The minimum measurement of the first web space angle in the right hand was 62 degrees, and in the left hand, it was 61 degrees across all 800 subjects. The maximum measurement of the first web space angle in the right hand was 130 degrees, and in the left hand, it was 135 degrees.

The standard deviation for the first web space angle was 12.72 for the right hand and 11.90 for the left hand in the entire sample of 800 subjects. The standard error was 0.45 for the right hand and 0.42 for the left hand. The upper limit of the confidence interval for the first web space angle was 98.16 for the right hand and 100.59 for the left hand in the entire sample of 800 subjects. While comparing males and females, the *p*-value for the right hand was 0.494, and for the left hand, it was 0.669.



## Discussion

Numerous articles have been published to date on the methods of measuring the first web space.<sup>1</sup> These measurements have been attempted through clinical or radiological approaches. However, most of these studies have used relatively small cohorts and primarily focused on comparing measurements between normal and affected hands.<sup>2</sup>

However, we could not find any similar study that measured normal hands to establish normative data.

For instance, Bhattacharya et al<sup>3</sup> conducted a study involving 65 cases to document the measurement of adduction contracture of the thumb using a similar method. However, their approach involved using dental stent mold material and ink impressions created by cutting those molds. This method was employed to monitor the correction progress and identify any recurrence tendencies.

Jensen et al<sup>4</sup> also utilized a three-point reading technique, similar to our study, but with one key difference: they used the MCP joint of the index finger instead of the IP joint. Furthermore, in their study, Jensen et al did not incorporate passive stretches to fully extend the thumb, which could impact the accuracy of their results. Their research involved individuals ranging from 14 to 77 years. In addition to measuring the first web space angle, they compared hand function in 25 volunteers by simulating web contracture using a splint.

A triangular piece of wood with premeasured or fixed angles was utilized by Shrinivasan<sup>5</sup> to estimate the approximate angle of the first web space. They created three wood blocks with angles ranging from 25 to 55 degrees in increments of 5 degrees. However, the drawback of this method was the inability to obtain precise angles, resulting in a range of possible web space angles.

In a different study by Murugkar et al,<sup>6</sup> published in the *Journal of Hand Therapy*, the intermetacarpal distance was measured by marking both metacarpal heads of the thumb and index finger. The radial styloid tip was used as a third point to calculate the derived intermetacarpal angle. This study involved 40 subjects, of which 22 had normal hands and 18 had impaired hands. The researchers concluded that measuring the web space in terms of the distance between intermetacarpal heads had a better correlation coefficient than measuring the angle. However, it was emphasized that normative data are essential for meaningful comparisons using this method.

The study conducted by Cambridge-Keeling,<sup>7</sup> which measured the web space distance between the distal palmar crease of the index finger to the IP crease or pulp of the thumb, yielded reliable findings. However, certain issues were identified in this study. One concern was the potential variability in results based on the length of the thumb and the normalcy of the IP joint of the thumb. Additionally, the lack of standardization in the method was evident due to the small sample size used in the study.

The study published by Jain and Sugumar<sup>8</sup> described the first web space arc in 241 pediatric hands. Instead of measuring the angle, they used a radius circumference gauge to

measure the first web space arc formed by the distal palmar crease and digital crease of the thumb. They found a significant statistical correlation of the first web space arc between right and left pediatric hands in addition to these measurements.

Another method described by de Kraker et al<sup>9</sup> to measure the first web space angle was by using a Pollexograph. The study has been executed on 14 hand therapists to measure palmar abduction. They found that the reliability of measuring on graph paper is more accurate than using a certified goniometer.

We did not consider measuring the height of the individuals in our study which could be the only limitation of our study. Therefore, we do not know whether the height of the person has any influence on the first web space angle. Another limitation of the study was the profession or occupation of the subjects was not notified. There could be the possibility of more flexibility of the first web space in subjects who do not perform heavy activities like laborers or industrial workers.

## Conclusion

In this study, we collected data from 800 individuals in the Indian population to measure the first web space angle in both hands. The average measurement in the right hand was 97.28 degrees and 99.76 degrees in the left hand. We utilized a certified goniometer and consistent measurement technique for accuracy. While previous methods had limitations, our findings provide crucial normative data for clinicians and therapists. Further research in terms of measuring the height of a person and documenting the profession or occupation of the subject is needed to validate and enhance our results, contributing to improved hand-related health care practices.

### Conflict of Interest

None declared.

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