

## A Relative Study of Finger nail plate Shape among Indian Population

Divya V. Kottadiyil

Forensic Science Department, Shree P. M. Patel Institute of P. G. Studies, Sardar Patel University (SPU), Anand, Gujarat, West Zone, India

Accepted 15 April 2017, Available online 18 April 2017, Vol.5 (March/April 2017 issue)

### Abstract

**Introduction**-Finger-nail features are considered as distinct and the study of nail anatomy reveals that only the nail plate is regenerated as new cells are made, the spacing between the grooves of the nail bed remains constant over the entire life of the individual. Thus, unlike face characteristics which changes with the age of an individual, the characteristics of the nail bed imitated on the nail plate can be very useful for identification over the entire lifespan of an individual. **Objectives**-Due to the immense potential of fingerprints as well as nail plate pattern as an effective method of identification an attempt has been made in the present work to analyze different finger nail plate pattern existing among human population. **Sampling and Methodology** -The study was conducted on 100 subjects above age group of 18years. Fingernail shape were collected and analyzed. **Result**- Experiment shows that males and females tend to have rectangular pattern in thumb. On index, middle and ring finger, triangular pattern dominates in both males as well as females whereas in case of little finger the pattern varies. The nail patterns on right hand repeats in left hand of an individual or vice versa. **Conclusion**-Fingernail plate shapes of hands show diversities similar to fingerprint and therefore can be utilized for identification.

**Keywords:** Nail plate shape, identification, biometric.

### Introduction

#### Nail plate

It is the thin, horny, translucent plates covering the dorsal surface of the distal end of each terminal phalanx of fingers and toes<sup>[1]</sup>. The nail plate is the hard and translucent portion of the nail, composed of keratin. A nail is a horn-like envelope covering the tips of the fingers and toes in humans, most non-human primates, and a few other mammals. Nails are similar to claws in other animals. Fingernails and toenails are made of a tough protective protein called keratin. This protein is also found in the hooves and horns of different animals. The mammalian nail, claw, and hoof are all examples of *unguis* [plural *ungues*]<sup>[2]</sup>.

#### Anatomy of Nail

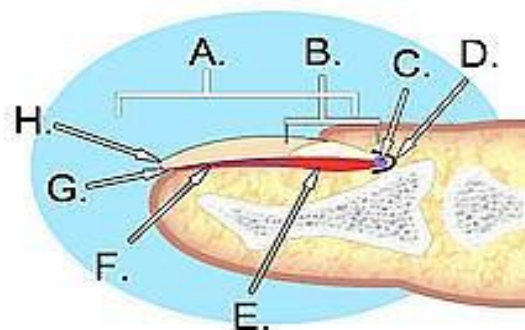
##### Nail Structure

Structure of nail is divided into six specific parts

- Nail Root,
- Nail Bed,
- Nail Plate,
- Eponychium (cuticle),

- Perionychium, and
- Hyponychium.

Each of these structures has a specific function, and if disrupted can result in an abnormal appearing fingernail.<sup>[3]</sup>



**Fig.1** A. Nail plate; B. lunula; C. root; D. sinus; E. matrix; F. nail bed; G. hyponychium; H. free margin

#### 1. Nail Root

The root of fingernail is also known as the germinal matrix. This portion of the nail is actually beneath the skin behind the fingernail and extends several millimeters into the finger. The fingernail root produces most of the

volume of the nail and the nail bed. This portion of the nail does not have any melanocytes, or melanin producing cells. The edge of the germinal matrix is seen as a white, rescent shaped structure called the lunula.<sup>[4]</sup>

2. Nail Bed

The nail bed is part of the nail matrix called the sterile matrix. It extends from the edge of the germinal matrix, or lunula, to the hyponychium. The nail bed contains the blood vessels, nerves, and melanocytes, or melanin-producing cells. As the nail is produced by the root, it streams down along the nail bed, which adds material to the under surface of the nail making it thicker. It is important for normal nail growth that the nail bed be smooth. If it is not, the nail may split or develop grooves.

3. Nail Plate

The nail plate is the actual fingernail, made of translucent keratin. The pink appearance of the nail comes from the blood vessels underneath the nail. The underneath surface of the nail plate has grooves along the length of the nail that help anchor it to the nail bed. The top is smooth and the bottom is grooved. The grooves help it stay attached to the nail bed.

4. Eponychium

The eponychium of the fingernail is also called the cuticle. The cuticle is situated between the skin of the finger and the nail plate fusing these structures together and providing a waterproof barrier.

5. Perionychium

The perionychium is the skin that overlies the nail plate on its sides. It is also known as the paronychia edge. The perionychium is the site of hangnails, ingrown nails, and an infection of the skin called paronychia. At times, your nail may grow into the perionychium, resulting in an ingrown nail or hangnail.

6. Hyponychium

The hyponychium is the area between the nail plate and the fingertip. It is the junction between the free edge of the nail and the skin of the fingertip, also providing a waterproof barrier.<sup>[5]</sup>

Free edge

This is the piece of the nail that has the whitish appearance and is painless to trim off. It is also the least protected and most vulnerable part since it no longer receives nourishment from the body. The point where the free edge connects to the fingertip or toe tip is known as the hyponychium. Like the cuticle, it keeps the connection between the nail and the skin waterproof.<sup>[6]</sup>

Growth

Actual growth rate is dependent upon age, sex, season, exercise level, diet, and hereditary factors. [7] Fingernails generally grow faster in young people, in males, and in the summer. The fingernails on the right hand of a right handed person grow faster than those on their left hand, and vice versa. Nails grow faster in the summer than in any other season. The growing part of the nail is under the skin at the nail's proximal end under the epidermis, which is the only living part of a nail. In mammals, the growth rate of nails is related to the length of the terminal phalanges (outermost finger bones). Thus, in humans, the nail of the index finger grows faster than that of the little finger; and fingernails grow up to four times faster than toenails. [8] In humans, the average growth rate for nails is 0.1 mm each day (or 1 centimeter in 100 days). Fingernails require three to six months to regrow completely, and toenails require 12 to 18 months. Contrary to popular belief, nails do not continue to grow after death; the skin dehydrates and tightens, making the nails (and hair) appears to grow. Nails grow all the time, but their rate of growth slows down with age and poor circulation. Fingernail growth tends to slow as humans age, and is also inhibited by poor circulation.<sup>[9,10]</sup>

Classification of fingernail shape

A]. Rectangle



Fig.2 A Vertical Rectangle



Fig.2 B Horizontal Rectangle

B]. Round/oval



Fig.2C Oval



Fig.2D Round

C]. Triangle



Fig.2E Triangular



Fig2 F Inverted Triangle

D]. Square



Fig.2 G Square

**Sampling**

Fingerprints and fingernail shape were collected from 50 males and 50 females. The subjects compromised above age of 18years.

*\*Exclusion Criteria*

The following subjects were excluded from study:

1. Severe injury to hands or nails (post trauma e.g. road accident or post-surgery)
2. Severe infection of finger or fingernails by fungi.
3. The wearing of artificial nails or hands.<sup>[9]</sup>

**Methodology**

For taking fingernail shape,

- Thumb Impression Ink (black)
- Adhesive tape
- Scissor
- Glass Slab
- Acetone and Cotton.

*Importance/Advantage of using Thumb Impression Ink*

- Helps to collect accurate set of prints.
- Less susceptible to smearing.
- Simple and inexpensive.

*Procedure*

The subjects were asked to clean their hands before taking the nail plate shapes. A small amount of thumb impression ink (black) was placed on glass slab. Ink was applied evenly on nails and its edges using cotton. A small strip of adhesive tape was cut and placed over the nail. Pressure was applied evenly on the surface of nail and then the tape was lifted and nail plate shape thus obtained was placed over the slip. The upper 10 shapes were taken individually starting from right hand i.e. thumb, index, middle, ring, and little fingers of each hand in the order named. After taking the nail plate shape, the nails were cleaned with cotton wool soaked in acetone. The subjects were advised to wash it again with soap and water. After whole procedure is done, the slips are filled in proper manner for observation. By using the above method, 50 samples each of same males and females (whose fingerprints were procured) were obtained.

For taking measurement of nail plate size, the distance between eponychium to distal edge of lateral nail fold is measured (an imaginary parallel line is considered between distal edges of lateral nail fold to midpoint of eponychium). [9]

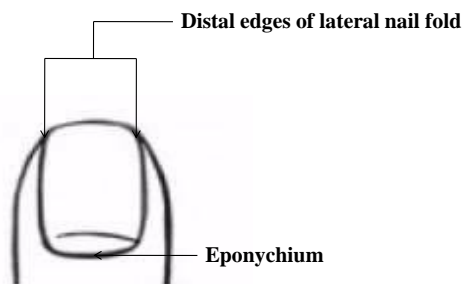


Fig.3 Lateral Nail Fold and Eponychium

**Observation**

Experiment shows that males and females tend to have rectangular pattern in thumb 61% and 66% respectively.

**Table1** Nail Pattern and Fingers

Category	Finger	Rectangle %	Triangle %	Oval/ Round %	Ssquare %
Male	Thumb	61	29	4	6
Female	Thumb	66	13	10	11
Male	Index	8	65	16	11
Female	Index	16	54	23	7
Male	Middle	11	77	6	6
Female	Middle	16	68	8	8
Male	Ring	20	65	6	9
Female	Ring	16	64	3	17
Male	Little	27	44	9	20
Female	Little	35	41	19	4

On index, middle and ring finger, triangular pattern dominates in both males as well as females whereas in case of little finger the pattern varies. The nail patterns on right hand repeats in left hand of an individual or vice versa.

**Table 2** Size of nail plate

Gender	Length	Width
Male	< 0.7	0.9 to 2
Female	< 0.3	0.6 to 1.7

**Conclusion**

Fingernail plate shapes of the hands show diversities similar to fingerprints and therefore can be utilized for identification purpose <sup>[9]</sup>. The study of nail anatomy reveals that only the nail plate is regenerated as new cells are made, the spacing between the grooves of the nail bed remains constant over the entire life of the individual. Thus, the characteristics of the nail bed imitated on the nail plate can be very useful for identification over the entire lifespan of an individual <sup>[11]</sup>. It is hoped that like finger printing the method of personal identification using fingernail plate shape and size would also rise. Even based on nail plate size we can narrow done the search to a particular gender. Finger nail recognition has been applied to identify criminals and currently it is being increasingly used for personal identification as a supportive biometric. <sup>[12]</sup>

**References**

[1]. Medical Dictionary for the Health Professions and Nursing © Farlex 2012.  
 [2]. Onumah, Neh; Scher, Richard K ). (May 2009) Nail Sugery eMedicine .  
 [3]. Jarmine Daena; December 2015 Nail Growth and nail structure.  
 [4]. Feneis; (2000). Heinz Pocket Atlas of Human Anatomy (4th ed.) Thieme. pp. 392–95. ISBN 3-13-511204-7.  
 [5]. Nail Doctor; 2005, Fingernail Anatomy.  
 [6]. Mary Lee, Archana Desai Gibaldi's Drug Delivery Systems in Pharmaceutical Care.  
 [7]. Hunter, J. A. A., Savin, J., & Dahl, M. V, (2002) Clinical dermatology, Malden, Mass: Blackwell Science. p. 173.  
 [8] .Ravosa, Matthew J.; Dagosto, Marian, (2007), Primate Origins: Adaptations and Evolution. Springer. pp. 389–90.  
 [9] Adekunle O George; Finger nail plate shape and size for personal identification – a possible low technology method for the developing world - Preliminary report [ Afr J Health Sci. 2005; 12:13-20 ]  
 [10] Jacqueline Thelian Coding Exam Success: Coder's Guide to Passing the CPC and CCS-P Exams.  
 [11] A. Morales, E. Gonzales, M. A. Ferrer, Feb. 2012, On the feasibility of interoperable schemes in hand biometrics, Sensors Special Issue Journal on Hand based Biometrics Sensors and Systems, vol. 12(2), pp. 1352-1382.  
 [12] Kavitha Jaba Malar R, Joseph Raj V. Feb. 2012, Geometric Finger Nail Matching using Fuzzy Measures International Journal of Innovative Technology and Exploring Engineering (IJITEE), ISSN: 2278-3075, Volume-4 Issue-4, September 2014