“PALMAR DERMATOGLYPHICS IN PATIENTS WITH SPUTUM POSITIVE TUBERCULOSIS IN THE AGE GROUP BETWEEN 20-60 YEARS”

BY

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I hereby declare that this dissertation / thesis entitled **"PALMAR DERMATOGLYPHICS IN PATIENTS WITH SPUTUM POSITIVE TUBERCULOSIS IN THE AGE GROUP BETWEEN 20-60 YEARS"** is a bonafide and genuine research work carried out by me under guidance of

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LIST OF ABBREVATIONS USED

A	Arch
AFRC	Absolute finger ridge count
Di	Dissociation
F	Female
Fig	Figure
Fr	Frequency
HS	Highly Significant
Hy	Hypothenar
L_1	Left hand thumb
L_2	Left hand-index finger
L_3	Left hand middle finger
L_4	Left hand ring finger
L_5	Left t hand little finger
L_r	Radial Loop
L_u	Ulnar Loop
M	Male
No	Number
NS	Not Significant
P	Palm
R_1	Right hand thumb
R_2	Right hand-index finger
R_3	Right hand middle finger
R_4	Right hand ring finger
R_5	Right hand little finger
SD	Standard deviation
Sm	Simian Line
Sy	Sydney Line
TB	Tuberculosis
TFRC	total finger ridge count
Th	Thenar
W	Whorl

ABSTRACT

Background

Dermatoglyphics is a branch of science which deals with the study of ridge patterns on finger tips, palms, soles and toes. Dermatoglyphic traits are formed under genetic control early in the development, but may be affected by environmental factors during 1st trimester of pregnancy. They however do not change thereafter. Thus maintaining stability and personal identification. Thus represent the genetic makeup of an individual and therefore predisposition to certain diseases. Tuberculosis is a major public health problem. Genetic factors play a role in the susceptibility of an individual for tuberculosis. By analyzing various parameters of dermatoglyphics in the palms and fingers, it is possible to certain extent to predict individual's chance of acquiring pulmonary tuberculosis.

Methods and Results

The finger and palm prints of hundred diagnosed patients of sputum positive pulmonary tuberculosis in the age group between 20 to 60 years were compared with hundred controls, of the same age group, among which 50 were males & 50 were females. Screening questions were asked to exclude other genetic disorders. The quantitative study includes total finger ridge count (TFRC), absolute finger ridge count (AFRC), mean 'atd' angle.

The quantitative study includes finger print patterns (whorls, radial loops, ulnar loops and arches) and palmar pattern (simian line and Sydney line).Statistical analysis for quantitative analysis, the arithmetic mean and standard deviation will be calculated, 'Z' test will applied. For qualitative analysis, the 'Chi' square test will applied whenever necessary.

The following significant parameters have been found in the present study of palmar dermatoglyphics in patients with sputum positive tuberculosis in the age group between 20-60 years:

In both males and females:

1. Lower mean ‘atd’ angle in study group.
2. Higher Mean Absolute Finger Ridge Count (AFRC).
3. Higher Mean Total Finger Ridge Count (TFRC)

Conclusion

The significant dermatoglyphic parameters found in the study may be used to predict individual’s chance of acquiring pulmonary tuberculosis.

Key words: - Dermatoglyphics, sputum positive pulmonary tuberculosis.

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INTRODUCTION

The Man is sole creature in the animal kingdom, who has received innumerable gifts from nature. Superiority of the man is owing to his development of brain and superior extremity, wider range of movements at shoulder, pronation and supination occurring at forearm, more mobile wrist compared to ankle, opposable thumb separate from rest of digits help in utility of upper limb to large extent.[1]

The palms and soles of humans have a highly differentiated covering. It is skin that is corrugated continuously with ridges. All primates have this specialized skin, and it occurs sporadically in other mammals. Whenever this dermatoglyphic specialization exists, it is apparently associated with the prehensile use of the part. This particular differentiation of the skin probably aids in locomotion, grasping, and touch.[2]

The term Dermatoglyphics [from the Greek, Dermato = skin, glyphics = carvings] is the scientific term coined by Prof. Harold Cummins.[2] The analysis of dermal ridges and their configurations by studying prints of them is called Dermatoglyphics.[3] The term is also used as a collective name for all the features of ridged skin. The skin patterns are studied from prints or impressions.[4]

In ancient India, palmistry, an art of fortune telling by reading the pattern of friction ridges and palmar lines, dates from about 2000 B.C.[5]

Dermatoglyphic analysis can be added to the broad spectrum of diagnostic indications because[6]:

1. Ridge Configuration is genetically determined.
2. Though genetically determined the developmental environment in the uterus, gene deviants, Chromosomal aberrations alter the ridges.

3. They are ‘permanent’ in that they are formed in the fetal stage, prior to birth and remain the same throughout life, barring disfiguration by scarring, until sometime after death when decomposition sets in.

The importance of dermatoglyphic science is based upon two major facts[6]:

1. The ridges are slightly different for each finger and differ from person to person.
2. The ridges remain throughout life and survive superficial injury, in other words they are age stable, permanent and also environment stable after 21 week of intra-uterine life.

Ridges develop in relation to volar pads. These pads are evident around 6th week of gestation and reach maximal size by the 12th to 13th week. By the 4th month the epidermal ridges are nicely developed, but the process probably not complete before the 6th month of gestation.[7]

Thus ridge differentiation takes place early in fetal life. The patterns once established never change through out the life except as size. Being genetically inherited, the pattern is highly susceptible to insults during intra-uterine life genetically related disorders may thus be studied with help of dermatoglyphic. Dermatoglyphics has been studied extensively in chromosomal disorders, single gene disorders and those disorders whose genetic basis is not clear. Dermatoglyphic studies have proved quite useful in three fields; medico-legal, anthropological and clinical.[8]

Dermatoglyphics has also been used in the following studies[8]:

1. Personal Identification
2. Determination of Twin Zygosity
3. Anthropological Surveys
4. Population genetics

5. Disputed Paternity
6. Sex differences
7. Bodily Symmetry and
8. Comparative palmatology etc.

Dermatoglyphic analysis as diagnostic tool has many advantages[9] like:

1. The epidermal ridge patterns on the palm are fully developed at birth and remain unchanged throughout life.
2. Patterns are readily accessible.
3. Recording is quick, simple and inexpensive.
4. There is no trauma to the individual during recording.
5. Ridge patterns can quickly be analyzed
6. Ridge patterns can be inspected for abnormalities immediately after birth.

Tuberculosis, caused by Mycobacterium tuberculosis, remains a worldwide public health problem. It is one of the oldest diseases known to affect humans.[10]

The problem of tuberculosis is acute in developing countries, which account for about 95% of tuberculosis cases, despite the fact that the causative organism was discovered more than 100 years ago and highly effective drugs and vaccine are available. It was estimated that 1.8 million deaths from tuberculosis occurred in 2000, 98% of deaths occurred in developing countries.[10]

Tuberculosis is not a hereditary disease; however twin studies indicate that susceptibility is an important risk factor.[10] Susceptibility to pulmonary tuberculosis in India has been linked to Mannose binding protein gene.[11] Significant association has been found between IL-1 gene clusters and host susceptibility to tuberculosis.[12]

Several observations suggest that genetic factors play a key role in innate non-immune resistance to infection with Mycobacterium tuberculosis. In mice, a gene called Nramp1 has a regulatory role in resistance/susceptibility to Mycobacterium tuberculosis. The human homologue NRAMP1, cloned to chromosome 2q, may have a role in determining susceptibility to tuberculosis as is suggested by a study among West Africans. [13]

Considering the high mortality and morbidity due to tuberculosis in our country and previous studies showed that tuberculosis and genetics are linked, this study is done in order to observe the difference in dermatoglyphic pattern between sputum positive pulmonary tuberculosis patients and normal persons between 20-60 years age group and to determine the usefulness of dermatoglyphics in studying the genetic susceptibility to pulmonary tuberculosis. Thus the study can be used to predict the susceptibility to pulmonary tuberculosis.

Dermatoglyphics is a growing discipline and its easy and ready applicability renders it as a useful tool to the clinician. The relevance of dermatoglyphics is not to diagnose, but to prevent by predicting a disease; not for defining an existing disease, but to identify people with genetic predisposition to develop certain diseases[14].

OBJECTIVES OF STUDY

(1) To find out various dermatoglyphic patterns in sputum positive pulmonary tuberculosis patients in the age group of 20-60 years.

(2) To compare dermatoglyphic features of normal and pulmonary tuberculosis patients.

(3) To evaluate the significance of dermatoglyphics in tuberculosis.

REVIEW OF LITERATURE

HISTORY OF DERMATOGLYPHICS:

There is a long history in India and China of the use of fingerprints as indicators or attributes or character traits. Folk lore from both India and China have traditions of reading certain attributes or abilities from fingerprints. Before we become amused at the tendency to find significance in the counted number of prints, we note that such an approach is often used in scientific studies for searching of meaningful relationships of fingerprints as genetic and/or chronic health markers. So while the conclusions drawn in Chinese and Hindu folk ways may be quaint, their methods of analysis still persist.[15]

Dr. Nehemiah Grew, English Botanist, was the first person to describe the pores, ridges and arrangements on the palm & finger in 1684. In 1685, Bidloo, in his book on human anatomy included a short account of epidermal ridges. In 1686, in Italy, Marcello Malpighi, an Italian physiologist mentioned briefly ridges on palms and fingers in De Externo Tactus Organo. Papers by Grew, Bidloo and Malpighi described mainly the morphology of various part of the palm. Anatomists in the 18th and early 19th century continued to explore this field.[4]

During the 18th century, various accounts of epidermal ridges appeared in anatomical publications. C.J. Hintze, in 1747, was probably the first scientist to describe the papillary ridges on the feet.[4]

Mayer stated for the first time that the arrangement of skin ridges was never the same in two individuals.[2]

Purkinje, Professor of Physiology at the University of Breslau, presented his thesis in which he described nine types of patterns on the finger and named them as[4].

1) The Transverse Curve.
2) The Central Longitudinal Stria.
3) The Oblique Strip.
4) The Oblique Loop.
5) The Almond Whorl.
6) The Spiral Whorl.
7) The Ellipse.
8) The Circles.
9) The Double Whorl.

In 1858, Sir William Herschel, beginning with imprint of a road contractor's palm developed a system of fingerprinting to combat corruption and impersonation in Bengal. He took palm print with the help of home-made oil-ink which was used for official seal.[16]

In 1877 in Calcutta, Hershel first introduced the use of fingerprints of pensioners to prevent their impersonation by others after their death. He also extended this system during the processing of different legal documents. He also took the use of fingerprints into the prison[16].

In 1879, Dr. Henry Faulds, a medical missionary, in Japan started to take an interest in fingerprints. He studied fingerprints on prehistoric pottery found at Omori and many other places. In the journal-Nature, he gave an account of his investigations in the year 1880. He suggested the possibility of tracing the criminals by their fingerprints. To Faulds, therefore, goes the credit of the first publication and to Hershel, the first practical use of methods.[17]

If Cummins is "Father of dermatoglyphics", Francis Galton, cousin of Charles Darwin, is the "Inventor". Finger prints is his landmark publication. He coined a

number of new terms in the field. He described the first practical method of finger print identification, responsible for basic nomenclature (arch, loop, and whorl). He also explored studies of the hereditary aspects of fingerprints, investigating comparisons of siblings, twins and genetically unrelated individuals and was the first to report concordance of papillary ridge patterns among relatives. This opened the field as a useful tool in anthropology.[18]

Sir Edward Richard Henry, then Inspector General of Police of Lower Bengal, with the help of Khan Bahadur Azizul Haque and Hemchandra Bose, developed a system of classification, and in January 1893, he included it in the record card of criminals.[19]

Wilder (1864 – 1928) studied Morphology, comparative aspects, inheritance and racial differences in ridges. Inez Whipple (1871 – 1929) has done important work by carrying out comparative dermatoglyphic surveys. Poll H. (1877 – 1939) studied new methods, racial differences, geographic variation and symmetry in dermatoglyphics.[15]

Fingerprints are not restricted in study of criminology. Dermatoglyphic studies (The non criminal study of fingerprints) cover wide range of spectrum including Anthropology, Genetics, Medicine, an oddly enough the Art, so the areas for research are considerable.

The second quarter of the twentieth century, the field was dominated by Harold Cummins, sometime professor of Microscopic Anatomy at Tulane University. In 1926 he coined the word dermatoglyphics and used it at the annual meeting of the American Association of Anatomists. It appears in the same year in a paper written with his collaborator Charles Midlo.[20] That term, dermatoglyphics, is used to this date in describing the scientific fields of study of the palmer and plantar ridges of the

hands and feet. In 1929, he together with others, including Midlo and the Wilders, published one of the most widely referenced papers on dermatoglyphic methodology to date.[21] Over the years he, alone and with collaborators, published numerous studies in the field as well as his now famous 1943 book, Finger Prints, Palms and Soles, a bible in the field of dermatoglyphics, which he dedicated to the pioneer Harris Hawthorne Wilder.[15]

Thus in nineteenth century dermatoglyphics has played an important role in medical disorders and still is offering a wide scope for research in various disorders.

Sr.No	Date	Person	Historical events[18]
1	1685	Gouard Bidloo	First book with detailed drawings of fingerprints
2	1686	Marcello Malpighi	First observations of fingerprints under microscope
3	1788	J.C.A. Mayer	First to write out basic tenets of fingerprint analysis.
4	1823	John E. Purkinje	First classification system of dermatoglyphics based on nine print categories.
5	1833	Sir Charles Bell	Anatomist: studied structure and functions of hand
6	1858	Sir William Herschel	British Chief Administration officer, Bengal, India.
5	1880	Dr. Henry Faulds	Suggests picking up fingerprints at crime scene
6	1883	Mark Twain	Life on the Mississippi: Dramatic fingerprints identification was introduced
7	1892	Sir Francis Galton	Anthropologist, Cousin of Charles Darwin, First practical method of fingerprints identification; was responsible for basic nomenclature (arch, whorl, loop); Scientifically demonstrated permance of fingerprints.

8	1897	Harris Hawthorne Wilder	First American to study dermatoglyphics; Named A, B, C, D points. Invented the Main Line index; Studied Thenar& hypothenar eminences, zones II, III, IV.
9	1904	Inez Whipple	First serious study of non-human prints.
10	1923	Kristine Bonnevie	First extensive genetic studies.

EMBRYOGENESIS AND DEVELOPMENT OF THE EPIDERMAL RIDGES: (Fig-1)

In the embryology of epidermal ridges volar pads call the first attention[15]. Pads that serve as cushion in walking develop on the underside of the extremities. Hair are absent on the pads. The pads are ordinarily devoid of ridges. This ridged skin develops on the palmar and plantar surface, on the tips of finger and toes as a structural specialization.[1]

Dermal ridges are formed early in fetal development. The resulting ridge configurations are genetically determined and are modified by environmental factors. Ridges develop in relation to volar pads. The volar pads are seen at about the 6th week of gestation and reach maximum size by the 12th to the 13th week of intra-uterine life.[4]

Fetal volar pads are mound-shaped elevation of mesenchymal tissue. These pads are situated above the distal end of the metacarpal bones in each interdigital area, in the thenar – hypothenar area of the palm and sole and also in the calcar area of the sole.[22]

Blanka Schaumann and Milton Alter considered process of the ridge formation takes place from 3rd month to the 6th prenatal month.[9]

According to Bonnevie, the presence of volar pads is responsible for the development of finger prints pattern. This view is still widely accepted.[22]

Several hypotheses have been formulated concerning the forces that are responsible for the development of specific ridge patterns. Environmental factors such as external pressure on the fetal pads and perhaps embryonic movements. Particularly finger movement can influence ridge formation.[9]

Galton and Wilder are the first to have studied the hereditary basis of dermal patterns. Past research has demonstrated that the epidermal ridge patterns are under genetic influence.[9]

Mulvihill and Smith described stages in the Morphogenesis of dermal ridges as follows[23]:

1. Fetal pad appears during 6th and 7th week of gestation, just after the hand loses its webbed appearance.
2. Fetal pads begin to regress in its size during the 12th and 13th weeks and the ridges begin to develop at the dermal – epidermal junction and are called primary dermal ridges.
3. These primary dermal ridges subdivided to form more parallel ridges during the 17th week.
4. These underlying patterns become reflected by identical configuration on the skin surface at the 20th week.

Mulvihill and Smith[23] considered it to be completed at about 19th week of gestation.

Sr. No.	Crown Rump Length of The Fetus	Gestational Week	Microscopic findings of the skin
1	4 cm long	9 weeks	The skin is smooth, thick layered; outer surface

			of the skin is irregular.
2	8 cm long	12 weeks	The most superficial layer of skin is increased in thickness. The outermost cells tend to desquamate. Undulation in basal layer of epidermis is seen.
3	13 cm long	16 weeks	Periodic down growth from the basal layer called as epidermal folds are seen. The papillae develop on epidermal folds. The tip of papillae becomes sweat glands. Deep in the epidermis the papillae elongate and form the ducts of sweat glands.
4	20 cm long	23 weeks	The outer layer of the epidermis becomes keratinized. Shallow furrow are seen on the surface between the sweat glands. Below the furrow appear secondary outgrowths which are known as furrow folds.

HEREDITY AND DERMATOGLYPHICS:

Heredity plays an important role in the formation of dermatoglyphics patterns. The inheritance of dermatoglyphic traits was initially studied by Galton in 1892, Wilder in 1902, Penrose in 1954 and Holt in 1968[9]. Studies of inheritance of pattern sizes, direction and shape often give contradictory conclusions. Individual dermatoglyphic traits have been claimed to be inherited as dominant, recessive, and a single gene or polygenic with complete or in-complete penetrance and variable expression of genes.

Holt studied total ridge count of fingers and inheritance. She stated that this trait was determined almost entirely by one or more additive or co-dominant genes.[24]

There are also normal variations which represent hereditary differences between ethnic groups and even within the same family.[25]

At present, there is wide agreement that the heredity of most dermatoglyphic features confirm to polygenic system. Modern cytogenetic methods allow precise identification of chromosomes and thus help in studying the correlation between individual chromosome observations and dermatoglyphics features.[9]

On the basis of current knowledge it can be said that the total ridge has greater clarity in terms of heritability, followed by 'atd' angle and the patterns on the fingers and the palms in that order.[26]

TECHNIQUE OF OBTAINING PRINTS:

A number of techniques have been recorded for the printing of dermal ridge configurations. Dermatoglyphics prints can be directly inspected by means of simple magnifying lens. For permanent record and for the detailed study such as quantitative analysis permanent prints are needed.

To obtain good quantity of dermatoglyphic prints following care should be taken.

1. Hands of person should be washed with soap and water to remove oil, sweat and dirt from the skin.
2. The ridges areas should be printed completely, fingers should be rolled to obtain a print of the whole pattern.
3. Palm print must include the area from the distal crease of the wrist to the Metacarpo-Phalangeal creases.
4. Palm should be printed completely to get printings of both ulnar and radial side.

For qualitative and quantitative study of permanent print, a magnifying lens of four to five powers is helpful for inspecting ridge details as well as in counting ridges. A low power binocular Microscope [Eyepiece 6x and objective 0.7] with a large field (25mm) has been recommended for study of the ridge detail for quantitative analysis the ridges can be counted by using needle or other object with a sharp point.[9]

The 'atd' angle can be marked with lead pencil and measured by using transparent protractor of the variety which is contracted of a semicircle of plastic material.[27]

A) Standard Methods:

1) Ink Method
2) Chemical Method
3) Transport adhesive type Method
4) Photographic Method
5) Special Methods

Ink Method:-

This method, described by Purvis-Smith[28], is widely used and gives good results. Simple material such as printer's ink, a rubber roller, glass or metal inking slab, a sponge rubber pad and good quality paper with a slightly glazed surface is needed.

A small amount of ink is placed on the slab and spread with the roller in to a thin even film. The area to be printed is pressed against the slab, taking care that the whole area to be printed is covered with the ink.

A firm surface is used under the sheet of paper on which the inked finger is pressed. To ensure complete print and also to print the hollow of the palm it is advisable to place a sponge rubber pad under the paper on which the prints are made.

The rubber pad gets moulded into concave portions of the hand and complete palm print is ensured.[9]

Ordinary ink stamp pad can also be used instead of slab and printer's ink. The rubber stamping pads are made moist with ink and glycerin.

Advantages of Ink Method are-

a) It is very easy to use.
b) It is rapid and inexpensive.
c) Prints are permanent and can be inspected qualitatively and quantitatively.

B) Special methods:

These methods are not widely used and they are-

1) Hygrophotography
2) Radiodermatography
3) Plastic Moulds

DERMATOGLYPHIC PATTERNS IN NORMAL INDIVIDUALS:

The terminologies for dermatoglyphic pattern configurations put forth by Cummins and Midlo and by Penrose are widely in use[29]. Variability of patterns is sufficiently great so that no two individuals have identical ridge patterns. Although highly variable, the patterns may be classified into various groups and can be studied qualitatively as well as quantitatively.

I) Qualitative analysis of Dermatoglyphic Pattern Configuration.

Specific group of epidermal ridges embracing any arrangement is called as configuration. The definite configuration which includes sharply curved lines of either loop or whorl from is called as patterns. It loosely includes arch form also.[23]

A) Fingertip pattern configurations

Galton divided the ridge patterns on the distal phalanges of the finger tip into three groups.

i) Arch –

It is the simplest pattern to be found on the fingertips. It is again classified into.

a) The simple or plain Arch (fig.2)

b) The tented Arch. (fig.3)

ii) Loop –

It is the most common pattern on the finger tips. In this configuration, a series of ridges enter the pattern are on one side of the digit, recurves, and leaves the pattern area on the same side.

If the ridge opens on the ulnar margin the resulting loop is termed as ulnar loop. If he ridge opens towards the radial margin the resulting loop is termed as radial loop. A loop has single triradius. The tri-radius is usually located laterally on the finger tip and is always on the side where the loop is closed **(**fig.4**)**.

iii) Whorl –

According to Galton's classification a whorl is ridge configuration with two or more tri-radius. One tri-radius is on the radial and the other on the ulnar side of the pattern. Whorls are classified as follows.

a) Simple Spiral Whorl **(**fig.5**)**.

b) Simple Concentric Whorl.

c) Double Loop Whorl **(**fig.6**)**.

d) Central Pocket Whorl.

e) Accidentals.

Henry limited the designation of whorl to those configuration having ridges that actually encircle a core. He called more complex patterns as "Composites".

The Hindu formula concerns three types of prints: the *Shankh* which resembles the ulnar and radial loop; the *Chakra* or whorl; and the *Shakti* resembling the composite. These are the ridge patterns recognized in the Hindu school of palmistry according to Dr. M. Katakkar, one of the leading contemporary authorities on that school of palmistry.[30]

B) Dermatoglyphic Landmarks

The three basic dermatoglyphic landmarks found on the finger tip pattern are.

1) The tri-radius
2) Core
3) The radiants

1) The Tri-radius:-

A triradius is formed by the confluence of three ridge systems. The geometric centre of the tri-radius is designated as a triradial point **(**Fig.7**).**

Ideally, the tri-radius is the meeting point of three ridges that form angles of approximately 120^{o} with one another. If the three ridges fail to meet, the triradial point can be represented by a very short, dot like ridge called an island; or by a ridge ending, or it may lie on a ridge at the point nearest to the centre of the divergence of the three innermost ridges. The tri-radial point forms one end of the line along which the ridges are counted.

2) The core:-

The core is an approximate centre of the pattern. The core may be of different shapes.

In a loop pattern, the core is represented by a straight rod like ridge or a series of two or more such parallel ridges over which recurving ridges pass. If a straight ridge is absent in the centre of a loop. The innermost recurving ridge is designated as a core. In a whorl, the core can appear as dot or short ridge or it can appear as a circle or an ellipse in the centre of the pattern.

3) The Radiants:-

They are also called as type lines. The radiants are ridges that start from the triradius & enclose the pattern area. These ridges constitute the 'skeletal' framework of the pattern area. In schematic drawings type line alone are used to represent the pattern.

C) Pattern of Middle & Proximal Phalanges

The presence of definite patterns on middle & proximal phalanges was reported by Whipple & Pinkus.[9] Ploetz[31] classified these patterns into four basic & eight composite types of configurations. The clinical value of these patterns has not been well studied.

However, they may be useful for following two purposes.

a. In discriminating between monozygotic & dizygotic
b. In personal Identification.

D) Palmar Pattern Configuration

The palm has been divided into several anatomically defined areas to carry out dermatoglyphic analysis. The areas approximate the sites of embryonic volar pads. The palm is divided into the thenar area. Four interdigital areas & the Hypothenar areas as shown in Fig.8.

- **Thenar & First Interdigital areas (Th / I $_1$)**

  Anatomically these two areas are closely related. In dermatoglyphic analysis these two areas are considered as one area & it is labeled 'thenar / first Interdigital area (Th / I_1) (Fig.8.).

  Usually, pattern is absent internal this area. But sometimes 'a vestige' or 'a true 'pattern can be present in either thenar or the I_1 area or in each of the areas at the same time.[7]

  A vestige is a pattern configuration, which occurs when the simple flow of ridges is disturbed by an area of abruptly disarranged ridges.

  Commonly patterns showing loops are present in 'Thenar/first Interdigital' area, but sometimes whorls also occur in this area.

- **Second, third & fourth Interdigital areas:**

  These areas are located in the distal palm in the region of the heads of the metacarpal bones. Each Interdigital area is bordered laterally by digital triradii. The digital triradii are almost always located proximal to the base of digits II, III, IV, V. digital tri-radii are labeled as 'a', 'b', 'c' & 'd' starting from the tri-radius located at the base of digit II (Index finger) moving towards the tri radius associated with digit V (little finger) as shown in Fig.8.

Thus, the second Interdigital area (I_2) lies between triradii 'a' & 'b' the third interdigital area (I_3) lies between triradii 'b' and 'c' and the fourth Interdigital area (I_4) lies between tri-radii 'c' & 'd'.

If a digital tri-radius is absent, the midpoint of the base of the corresponding digit can be used to separate the interdigital area.

In these Interdigital areas the commonly found pattern configurations are loops, whorls, and vestige & open fields. Loops are most commonly found patterns in the distal palm. Whorls are very rare in the interdigital areas, while vestiges are relatively common open fields are the most common ridge configuration found in the distal palm. Truly speaking, openfields are patternless areas formed by almost parallel ridges. Occasionally, two ridge configurations can be present in the same interdigital area. True pattern are relatively rare in the I_2 area but are commonly present in both I_3 & I_4 areas.

- **Hypothenar Areas**

True patterns are commonly present in hypothenar area. The patterns usually found in this area are whorls, loops & tented arches. Sometimes simple arches, open fields, vestiges & ridge multiplication also occur. Whorls in the hypothenar area have three triradii.

- **The axial tri-radius (t)** (Fig.7, 8 & 9.).

The tri-radius close to the palmar axis is termed as axial tri-radius. It is present normally near the proximal margin of palm and separates the thenar and hypothenar eminences.[32]

It is denoted as 't' and is usually not more than 10% of the distance between the distal crease of the wrist and proximal crease of the middle

finger. This triradial point gets displaced in number of conditions such as Mongolism, the D_1 syndrome, the broad thumb and great toe syndrome, Turner's syndrome and congenital heart defect.[32]

Sometimes more than one axial triradius may be present. The following criteria as detailed by Cummins and Midlo[15], and Penrose, Kumar et al[33] have been used to indicate the position of axial triradius.

- ✦ The axial triradius is indicated as 't' when it is near the wrist crease.
- ✦ It is indicated as 't" ', when it is near the centre of the palm.
- ✦ It is indicated as't' ', when it lies intermediate near a line transecting the base of the thumb.

While, Penrose suggested the position of axial triradius depending upon 'atd' angle as follows[34]:

- ❖ The axial triradius is indicated as 't' when 'atd' angle is less than 45^0.
- ❖ It is indicated as t', when 'atd' angle is in between 45^0 and 56^0.
- ❖ While it is indicated as t", when 'atd' angle is more than 56^0.

If more than one axial triradius is present, the most distal axial triradius is used for analysis.

II) Quantitative analysis of Dermatoglyphics:-

Many dermatoglyphic characteristics can be expressed quantitatively which are useful in normal as well as in medical disorders. The commonly used quantitative measures are as follows.

A) Finger ridge count.

B) 'a-b' ridge count.

C) 'atd' angle.

D) 't-d' ridge count.

E) Breadth ratio

A) Finger ridge count (Fig.12 & 13):-

It is done to indicate the pattern size. Ridges are counted along a straight line connecting the triradial point to the point of core. In whorls where there are two triradii, larger one is taken into count. A total finger ridge count (TFRC) represents the sum of the ridge count of all ten fingers.

B) 'a-b' ridge count:-

Ridges on palms are often counted between two interdigital triradii. The ridge count most frequently obtained is in between triradii 'a' and 'b' which is denoted as 'a-b' ridge count.

The 'b-c' and 'c-d' ridge counts are seldom used in dermatoglyphic analysis for medical purpose.

Sometimes, very large patterns may extend beyond the limit of ridged skin areas and triradii can be absent. Such triradii are called "extra-limital". The site of an extra-limital triradius can be approximated from the direction of ridge flow.

C) 'atd' angle (Fig:9 & 14**) :-**

Basically, 'atd' angle is used in interpreting the position of't' triradius.' Atd' angle is formed by lines drawn from the digital triradius 'a' and 'd' to the axial triradius 't'. In palms with more than one axial triradius, the 'atd' angle drawn from each axial triradius should be measured. If the axial triradius (t) is more distal, the 'atd' angle is larger.

There are some disadvantages in using the 'atd' angle as dermatoglyphic parameters they are as follows.

- Penrose thought that the ‘atd’ angle tends to decrease with age because the palm grows much more in length than breadth. This problem can be partially overcome by introducing the age correction.[34]
- The size of the angle is affected by the amount of spreading of the fingers when the patterns are printed.
- The pressure exerted while the palm is printed can affect the ‘atd’ angle.

Measuring the maximal ‘atd’ angle enabled Penrose to differentiate Down’s syndrome from phenotypically normal individuals.[9]

D) ‘t-d’ ridge count :-

Ridge counting between the triradii ‘d’ and ‘t’ has been proposed as yet another method of describing the position of axial triradius. ‘t-d’ ridge count can also be used as a promising parameter in the study of chromosomal aberrations and other diseases.

E) Breadth ratio:-

Breadth ratio is also one of the methods occasionally used to determine the position of axial triradius ‘t’. It is based on the measurement of the perpendicular distance from ‘t’ to a line drawn between ‘a’ and ‘d’ triradii[9].

The position of axial triradius has been considered to be of great importance since it has been used as a valuable dermatoglyphic trait in individuals with various medical disorders.[9]

CONGENITAL MALFORMATIONS OF HUMAN DERMATOGLYPHICS:

Malformations of the ridged skin are sometimes seen on the volar aspects of human hands and feet. The study of congenital malformations as physical signs in pediatric practice is very important.

Classification of congenital malformation of Dermatoglyphics:

i) Ridge Aplasia :-

This is a rare malformation. In this epidermal ridges over the entire palmar and plantar surface are absent. The palmar and interphalangeal flexion creases remain normal. The palmar and plantar surfaces do not sweat. Terry R and Richard L S reported the absence of fingerprints in five consecutive generations.[35]

ii) Ridge hypoplasia:-

In ridge hypoplasia, ridges are present but they are reduced in height. This condition is inherited as an autosomal dominant trait. The epidermal ridge atrophy is partly reversible change found in extreme old age and in some people with mental sub-normality and 90 to 95% of adults with coeliac disease.

Study of fingerprints of 73 patients with coeliac disease by David T.J., showed changes varying between moderate epidermal ridge atrophy and actual loss of fingerprint patterns.[36]

iii) Ridge dissociation:-

In ridge dissociation, the ridges instead of running in more or less parallel lines, are broken up into disorganized short ridges and are often dot like.

It is a heterogeneous condition which can be inherited as an autosomal dominant trait or it can be sporadic. It is present in 18% schizophrenics. Ridge dissociation occurs, with increased frequency in individuals suffering from various medical disorders.[9]

iv) Ridge-off-the-end:-

The fingertip ridges in this condition run vertically of the end of fingertips. It is unassociated with any disease but the hair pattern on the head is abnormal in some cases.

Flexion Creases:-

Flexion creases represent the location of firm attachment of the skin to underlying structures. Flexion creases are formed during early intrauterine life and therefore they can be influenced by factors causing aberrant development of the embryo.[9]

A) Palmar Flexion Creases:-

These are included in routine dermatoglyphic study because their alterations may be of diagnostic value in a variety of medical disorders. There is a close association of palmar creases with schizophrenia, leprosy and tuberculosis[37].

Loeffler divided the palmar creases into three groups.[9]

i) Major creases

ii) Minor creases

iii) Secondary creases

i) Major Creases:-

There are three major creases on palm

a) The axial longitudinal creases [Thenar crease]

b) The proximal transverse crease

c) The distal transverse crease

Variations in the course and appearance of the major palmar flexion crease in a normal population were described by Alter as follows.

- **Simian Crease or line (**Fig.10)

Sometimes the proximal and distal transverse flexion creases are replaced by one single crease. This single crease transverses the whole palm and is known as a simian crease about 4 % of normal individuals have a simian crease.[38]

The simian line was reported by Turpin, Bernyer and Teissier to be present in 58.50% of mongoloid patients.

- **Sydney crease or line (**Fig:11**):–**

Proximal transverse crease may sometimes extend beyond the hypothenar eminence to ulnar margin of the palm. This transverse crease is called as Sydney line. About 6% of normal individuals have a Sydney line.[39]

In the Sydney line configuration, the distal palmar crease is present on the palm, separate from the lengthened proximal crease.

ii) Minor Creases

In addition to major creases several minor creases are also present on the palm. There prominence, length & shape are variable to great extent than those of the major creases.[9]

- Three longitudinal creases running from the central part of the wrist towards the 3rd, 4th, 5th digits.
- 'E'line located at distal ulnar edge of palm between the origin of distal transverse crease and Metacarpo-Phalangeal creases of 5th finger.

iii) Secondary Creases

The secondary creases are the visible creases present on the palm other than major & minor creases. Secondary creases vary in number, length, depth & direction in different individuals. They also vary with age & sex.

B) Phalangial Flexion Creases

The thumb normally has a single Phalangial Flexion Crease, while all other fingers have proximal & distal flexion creases

According to Penrose, a single Phalangial Crease of the fifth finger happens to be characteristic features of Down's syndrome.

A single Phalangial Crease of fifth finger is also reported in Trisomy – 13, Trisomy –18 & in other medical disorders.[9]

C) White lines

Sometimes on the fingertips variable number of shallow grooves of different length, width and direction can be observed. There grooves are called as White lines as they appear white on dermatoglyphic prints. The White lines are probably caused by skin buckling rather than skin flexion.

White lines are not permanent features of the skin. Existing white lines can disappear partially or completely and new ones can appear. So, they do not play important role either in identification or serve any medical purpose.

QUANTITATIVE ANALYSIS (Fig:12 & 13**) :-**

The quantitative study includes total finger ridge count (TFRC), absolute finger ridge count (AFRC), mean 'atd' angle.

A) Ridge Count:-

The characteristics of dermatoglyphics can be described quantatively i.e. by counting the number of ridges within a pattern and measuring angles or distances between specified points of triradii.

The counting was done along a straight line connecting the triradii point to the point of core. Ridge counts were recorded in order, beginning with thumb to little finger of both right hand and left hand.

B) The Total Finger Ridge Count (TFRC):-

Was derived by adding the ridge counts on all ten fingers. In a loop, there is one triradius and so one ridge count in a whorl with two triradii, there are two counts and the higher is used. Only larger count was used in those digits with

more than one ridge count. For an arch, the score is zero. For double loop whorls, the ridge numbers between the two scores was added to the conventional count.

C) Absolute Finger Ridge Count (AFRC):-

Was derived by adding the ridge counts of all the fingers. The TFRC and AFRC are the same if no whorls are present.

D)'atd' Angle (Fig:14**):-**

It was recorded by drawing lines from the digital triradius 'a' to the axial triradius 't' and from this to digital triradius 'd'. In palms with more than one triradius, the 'atd' angle originating from each axial triradius was measured.

QUALITATIVE ANALYSIS:-

The qualitative study includes finger print patterns (whorls, radial loops, ulnar loops and arches) and palmar pattern (simian line and Sydney line).

DERMATOGLYPHIC TRAITS IN VARIOUS MEDICAL DISORDERS:

Dermatoglyphic traits play an important role in medical disorders & act as a diagnostic tool because;

1. Dermatoglyphic traits are genetically inherited &
2. They are highly influenced by insult during the Intra Uterine life.

I) Dermatoglyphic traits in congenital heart diseases

Fried and Neel commented on the higher frequency of wide atd angles and distal axial triradii in patients with CHD.[40]

Of 15 patients with CHD studied by Christensen and Nelson, 11 (73%) had distal or multiple axial triradii whereas only six of 25 (24%) with acquired heart disease had this dermatoglyphic stigma.[41]

In one study done by Alter M, Schulenberg R, a higher frequency of wide 'atd' angles was observed in the patients than in the controls.[42]

II) Dermatoglyphic traits in 'ABO' Blood groups:-

Otto and Bozotil studied digital dermatoglyphics and blood group in 300 white individuals belonging to both sexes. They found an increase of whorls and decrease of loop in the people with 'O' blood group type and the difference was statistically significant.[43]

III) Dermatoglyphics traits in Rubella syndrome:-

Typically rubella embryopathy may include cataracts, congenital heart disease, deafness and failure to thrive. Various studies have confirmed the association of unusual dermatoglyphics and rubella embryopathy.

Alter and Schulenberg studied dermatoglyphics in 28 rubella affected individuals. They found higher frequency of whorl pattern, a reduced 'a-b' ridge count and wider 'atd' angle. They also observed a tendency towards more patterns on the palm and higher frequency of transitional and simian lines than in normal individuals.[9]

Achs et al reported on increased incidence of simian lines and bilateral axial triradii in 39 rubella exposed infants. They also found an increased incidence of radial loops on other than the second digit.[2]

IV) Dermatoglyphics traits in Down's syndrome:-

Mongolism i.e. Trisomy-21 i.e. Down's syndrome is the result of an extra 21 chromosome in the individual. A mongol resembles another mongol more than his own parents. Dermatoglyphics traits in mongolism were first described by Cummins H. The common dermatoglyphic features found in mongolism are an increased frequency of ulnar loops on the fingers & radial loops on fourth and fifth finger, increased incidence of a second and third interdigital pattern & a hypothenar pattern. The average 'atd'angle in. Down's syndrome is about 80^0 compared with 45^0

in normal. A simian line, a single crease on the fifth finger is also more common than normal individuals[2, 4]. A combination of the above in a given individual is of considerable aid in the diagnosis of mongolism.

Saksena et al studied dermatoglyphics traits in 35 cases of mongolism. They observed that the ulnar loops are prominent in all the digits except on the fifth as well as prominence of loops and vestiges on both the palms. They found presence of simian line in 51.40% of cases, high axial triradius and 'atd' angle more than 56^0 in Mongol children. They also observed single transverse crease on fifth finger of Mongol children with frequency of 11.40% on the right side while 5.60% on the left side.[45]

V) Sex – chromosomal Disorders:-

The dermatoglyphic anomalies associated with abnormal sex chromosomes are less striking than those found on autosomal trisomies.

a) Turner's syndrome:-

Turner's syndrome is most often associated with 45-XO chromosome constitutions. Occasionally it is also caused by rare aberration of the X-chromosome. On the fingers, large patterns, both loops and whorls are common, while arches are rare. The total finger ridge count (TFRC) is, therefore, much higher than in normal females or even males-169 compared with 127.The average value of the maximal 'atd' angle is 10^0 larger.[2]

Saksena and Kumar studied dermatoglyphics in 4 cases of Turner's syndrome and their families. They found increased frequency of true patterns in the hypothenar area and increased frequency of distally placed triradii. They also found increase in whorls in most of the digits, increased ridge count and a complete or partial simian line on the palm.[46]

b) Kleinfelter's syndrome :-

Penrose and Forbes observed a low total ridge count and an increase in arches on the finger tips.[2]

Uchida et al reported seven patients with an XXYY variant of Kleinfelter's syndrome in which he described dermatoglyphic abnormalities. They found on ulnar displaced axial triradius associated with arch (radial), loop radial and loop carpal hypothenar patterns in five out of the seven cases.[47]

In general pattern is similar to females may be because of an extra X chromosome.

VI) Pulmonary Tuberculosis

It is one of the oldest diseases known to affect humans caused by Mycobacterium tuberculosis (M. tuberculosis) complex. The disease usually affects the lungs, although others can be affected. If properly treated, tuberculosis caused by drug susceptible strains is cured in virtually all cases. If untreated, the disease may be fatal within 5 years in more than half cases. Transmission usually takes places through the air-borne route by droplet nuclei produced by patients with infectious pulmonary tuberculosis[13].More than 3.8 million new cases of tuberculosis (all forms – pulmonary and extra pulmonary tuberculosis), 90% of them from developing countries, were reported to the WHO in 2001[13]. Interestingly, not all individuals exposed to

M. tuberculosis become infected. Moreover, progression toward clinical tuberculosis is far from an inevitable consequence of infection with M. tuberculosis, since only approximately 10% of the vast number of infected individuals actually develops clinical disease.[48] Both M. tuberculosis infection and clinical tuberculosis result from complex interactions between the infectious agent, environmental factors, and the host.

The involvement of human genes in tuberculosis has been suggested by numerous epidemiological observations. Twin studies have also demonstrated the importance of host genes, by showing higher concordance rates for clinical tuberculosis among monozygotic than among diazygotic pairs. Recent population-based studies have reported associations between some candidate genes and clinical tuberculosis. Genes were selected on the basis of their known or suspected role in innate or adaptive antimycobacterial immunity. Association of tuberculosis with some HLA class II alleles has been reported in populations from Cambodia and India. In the Gambian population, an association was also reported with polymorphisms in the vitamin D–receptor gene.[48] Finally, polymorphisms in the genes encoding the cytokine interleukin (IL)-1 beta and its receptor antagonist IL-1Ra were found to be associated with tuberculosis in patients of Gujarati origin who were living in England. The predisposing alleles reported in these studies have only moderate effects, and their functional relevance needs to be established before their role can be validated. Thus, the molecular basis of the genetic control of clinical tuberculosis in large populations remains largely elusive. More specifically, the authors analyzed a large aboriginal Canadian pedigree after an epidemic of tuberculosis and found, for the first time, convincing evidence of the existence of a major locus of susceptibility to clinical tuberculosis. This locus maps to chromosome 2q35 (two-point LOD score 3.8; three-point LOD score 4.2), which includes the NRAMP1 gene. This view of tuberculosis genetics has major implications for future studies. This research has major biological implications for an understanding of the genetic control of antimycobacterial immunity. It is now urgent that we find new ways to combat tuberculosis, one of the most fatal infectious diseases worldwide.[48]

Hereditary factors influence susceptibility to TB and other lung diseases. Recent immunogenetic studies have confirmed the genetic predisposition in different populations. Precise knowledge of genetic aspects of disease susceptibility is important for improvement of public health.[49]

Comprehensive clinical, genetic, epidemiological and immunogenetic studies have established that TB is a multifactorial disease whose development and natural history are due to the interaction of environmental factors, primarily to infection and hereditary predisposition.[50]

Comprehensive study of genetic markers allows one to make a prompt assessment of the nature of TB process to define its prognosis and to correct treatment.[50]

Genetic predisposition is an important factor in Pulmonary TB. The pattern of dermatoglyphic indicators is thought a reliable marker of such predisposition, selective character of the disease emergence is related with an unfavorable combination of genetic and extra genetic risk factors in an individual. A Comprehensive assessment of the above factors may contribute to a reliable prediction of a high risk to develop TB.[51]

The specimen tested is the sputum. Sputum is best collected in the morning before any meal. Sputum (collection) sampling on 3 days increases the chances of detection.[52]

Microscopy:-

Direct / concentration smears of sputum are examined. Smears are prepared from thick purulent sputum. under the oil immersion field, acid fast bacilli are seen as bright red rods.

At least 10,000 acid fast bacilli should be present per ml of sputum to be seen in direct smears.

A negative report should not be given till at least 100 fields have been examined, taking about 10 minutes.

A positive report can be given only if 2 or more typical bacilli have been seen[52].

Smears are graded depending on the number of bacilli seen;

1+ When 3-9 bacilli are seen in the entire Smear.

2+ When 10 or more bacilli are seen in the entire Smear.

3+ When 10 or more bacilli are seen in the most oil immersion fields.

In 2005 in national laboratory of genetic engineering, institute of genetics, Shanghai, China, a study was conducted to know the association of variants of NRAMP1 with severe forms of Pulmonary Tuberculosis. To test this possibility, NRAMP1 variants at INT4 and D543N loci were examined as well as there association with severe forms of Pulmonary Tuberculosis, in 127 patients with active Pulmonary Tuberculosis and in 91 ethnically matched healthy subjects in areas of china where Tuberculosis is endemic. It was found that NRAMP1 polymorphisms at these 2 loci were significantly associated with 2 severe forms of Pulmonary Tuberculosis; sputum Smear positive and cavitatory tuberculosis. The findings of this study support the hypothesis that genetic variants of NRAMP1may have an effect on bacilli growth and on outcomes of Pulmonary Tuberculosis.[53]

The 96 families were studied and split into two subsamples according to the affected/unaffected status of the parents. They found significant heterogeneity of linkage with the 8q12-q13 region between the two subsamples. The effect of the

susceptibility locus was stronger in families with at least one affected parent than in the whole sample. These results provide strong evidence for the existence of an autosomal dominant allele of a major susceptibility gene controlling pulmonary tuberculosis in these Moroccan families, particularly in those families including pulmonary tuberculosis cases in multiple generations.[54]

According to the study conducted in Tuvinian children, to know the association of various genetic markers with TB, in 1996, it was demonstrated that in Tuvinian children with TB, the frequencies of HLA-DR2 and HLA-DRW53 antigens are increased in comparison with healthy persons. So HLA complex genetic factors influence susceptibility to TB and other lung diseases in Tuvinian children.[49]

A study conducted in 1977 in Roman, the palmar flexion creases of fully diagnosed patients of TB (n=80).have been compared with a control group (n=150) of the same stock. The palmar flexion creases of TB patients were significantly different from those of the control population.[55]

A study conducted in 1995 in Russia, showed association between TB and various HLA loci B antigens as well as HLA locus D-DR2 antigen different populations.[50]

In a study conducted in 1993 in Russia, to know the correlation of dermatoglyphic and cellular immunity parameters in children with early stage of Pulmonary TB, immunological status and dermatoglyphic characteristics were compared in 55 children aged 4-14 with a turn in tuberculin reactions. A correlation was established between genetic and immunological factors, thus pointing to the fact that dermatoglyphics is a component of genotype, indicative of natural resistance of children to TB. The findings supported the hypothesis on an evolutional role of M.

tuberculosis as natural selection factors as well as setting up genetically determined mechanisms of natural resistance to TB. [56]

A study on dermatoglyphics of 100 tuberculosis patients (41 females and 59 males) when compared with controls showed 606 whorls, 364 loops and 30 arches which account for 60.6% whorls, 36.4%loops and 3% arches, while in control study there were 32.4% whorls, 59.4% loops and 8.2% arches. On considering the occurrence of patterns in different fingers of right hand 87% of pattern in ring finger were whorls.[57]

A study on dermatoglyphics of 100 patients of sputum positive pulmonary tuberculosis was compared with controls and it was observed that whorls pattern (56.6%) was predominant with decrease in loops pattern (32.1%). The difference in mean absolute finger ridge count of controls and of patients of tuberculosis was found to be statistically significant ($p<0.05$). The 'atd' angle had narrowed in the study group when compared with controls.[58]

A study of finger ball pattern of dermatoglyphic of 200 patients of pulmonary tuberculosis and 200 normal persons was done, no statistically significant difference was observed in these groups except for various subtypes in index finger of both hands and little finger of right hand and pleotropic hands.[59]

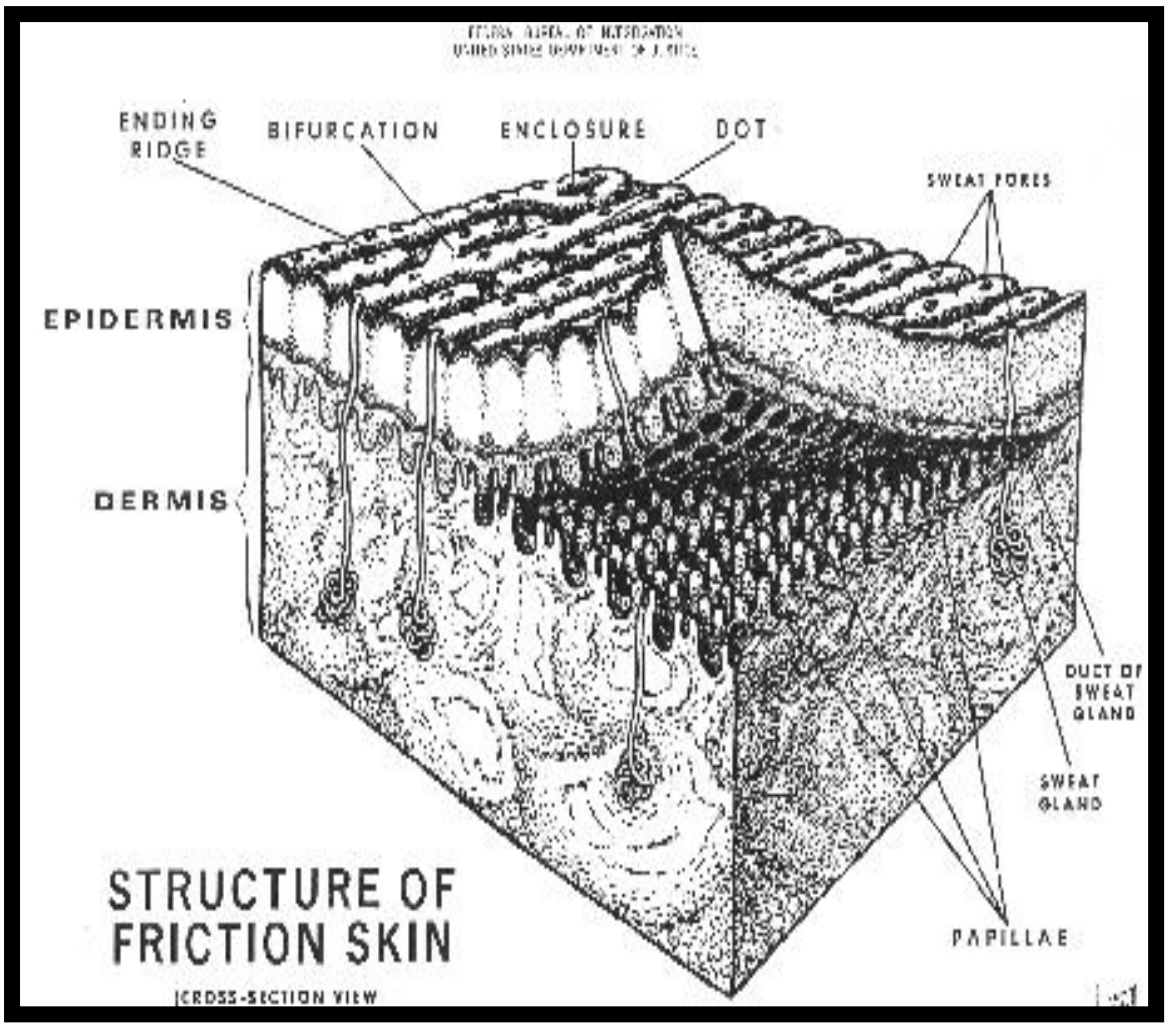


Fig. 1.Structure of skin

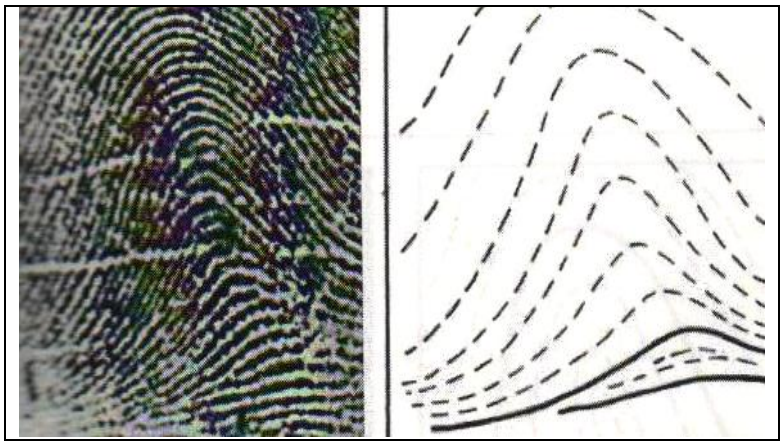


Fig. 2. Fingertip pattern-simple arch

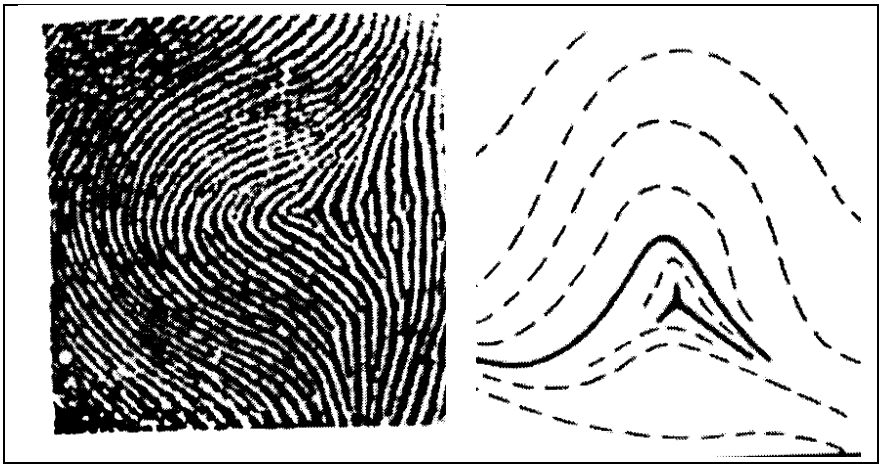


Fig. 3. Fingertip pattern- tented arch

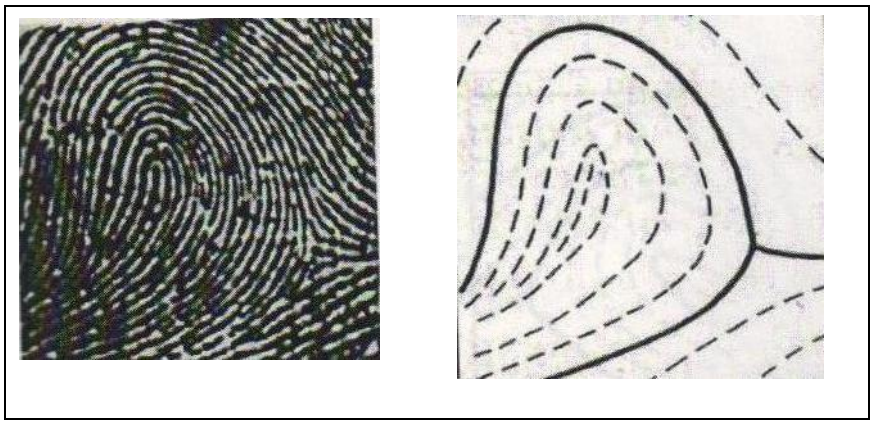


Fig. 4. Fingertip pattern- ulnar loop/radial loop

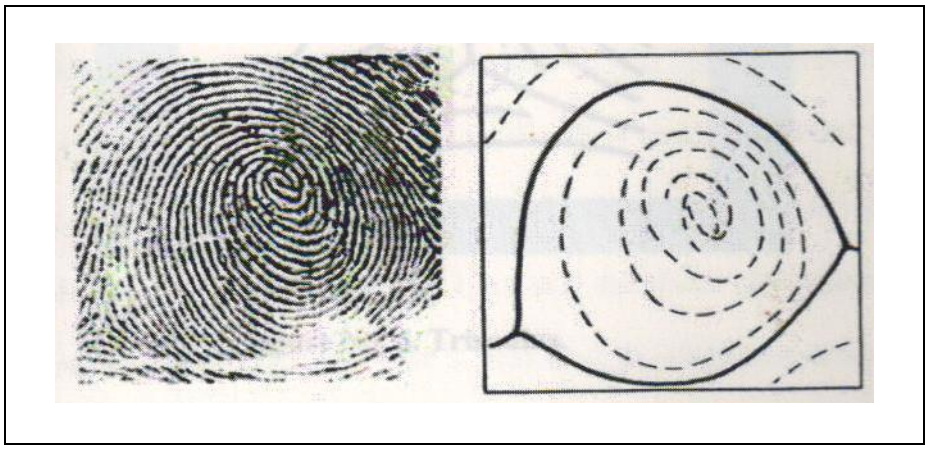


Fig. 5. Fingertip pattern-simple whorl

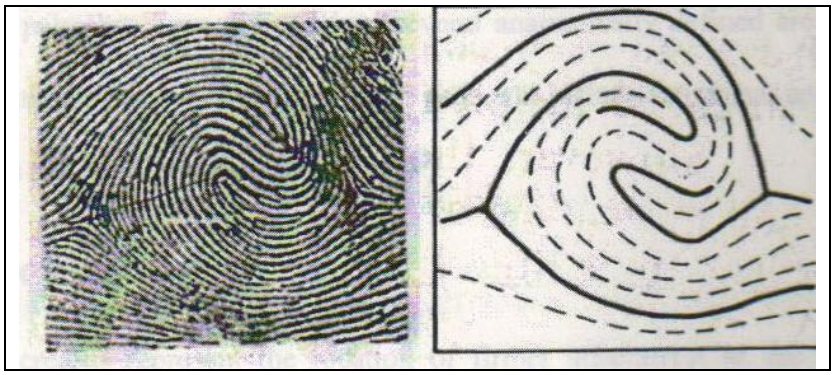


Fig. 6.Fingertip pattern-double pocket whorl

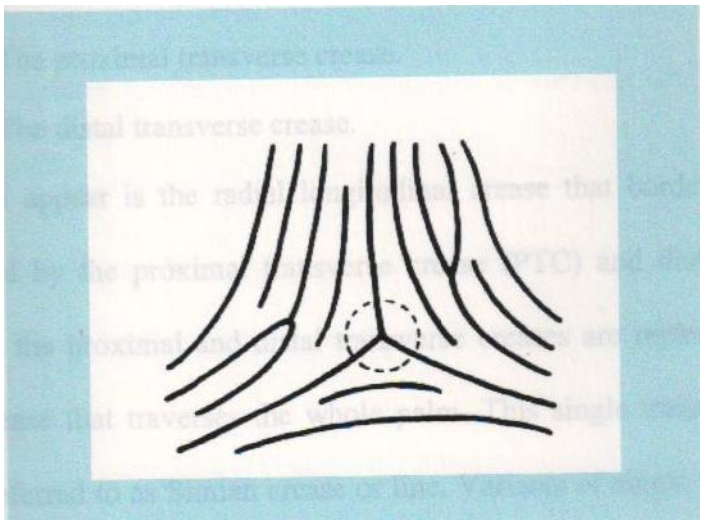


Fig. 7. Tri-radius

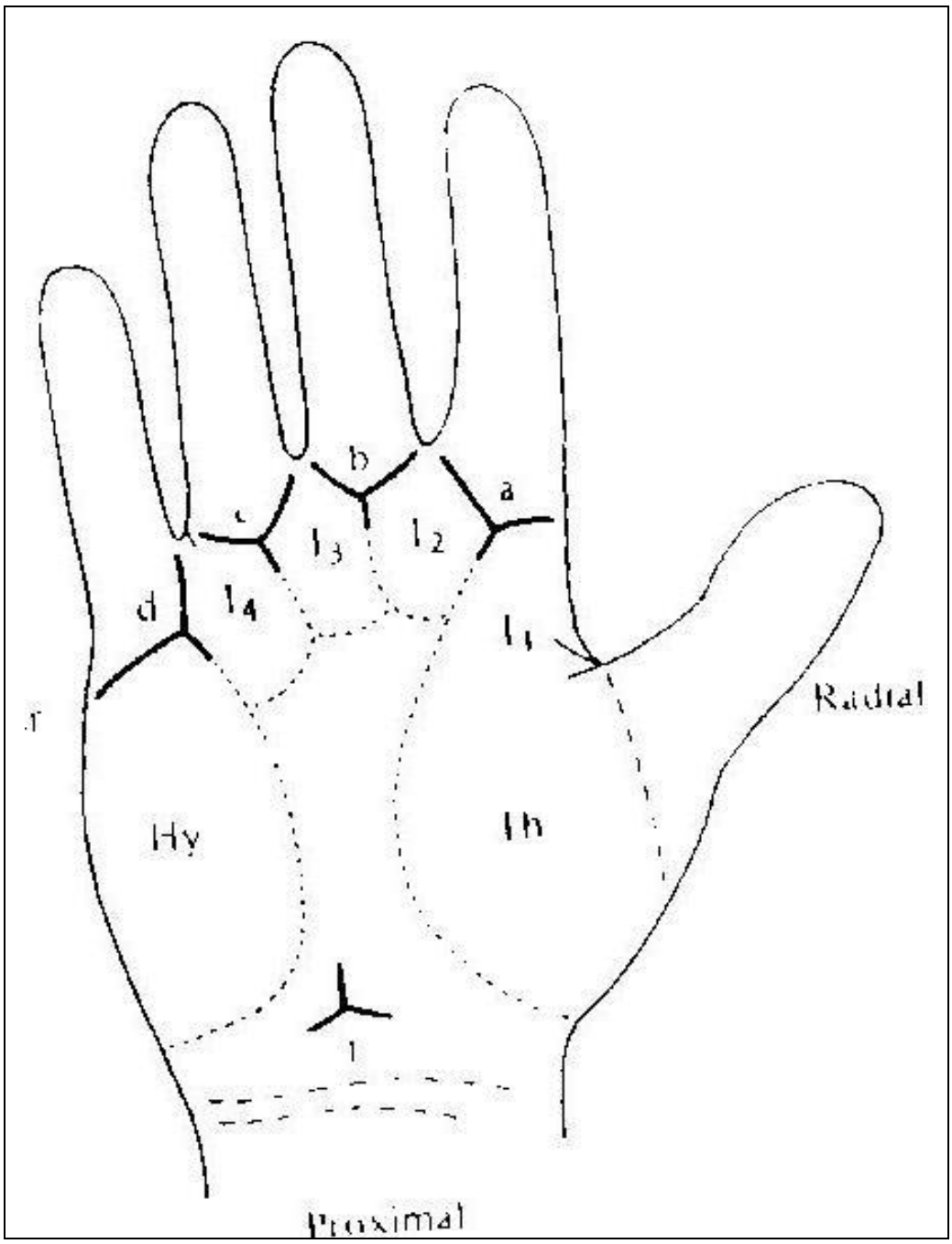


Fig. 8. Palmar dermatoglyphic patterns

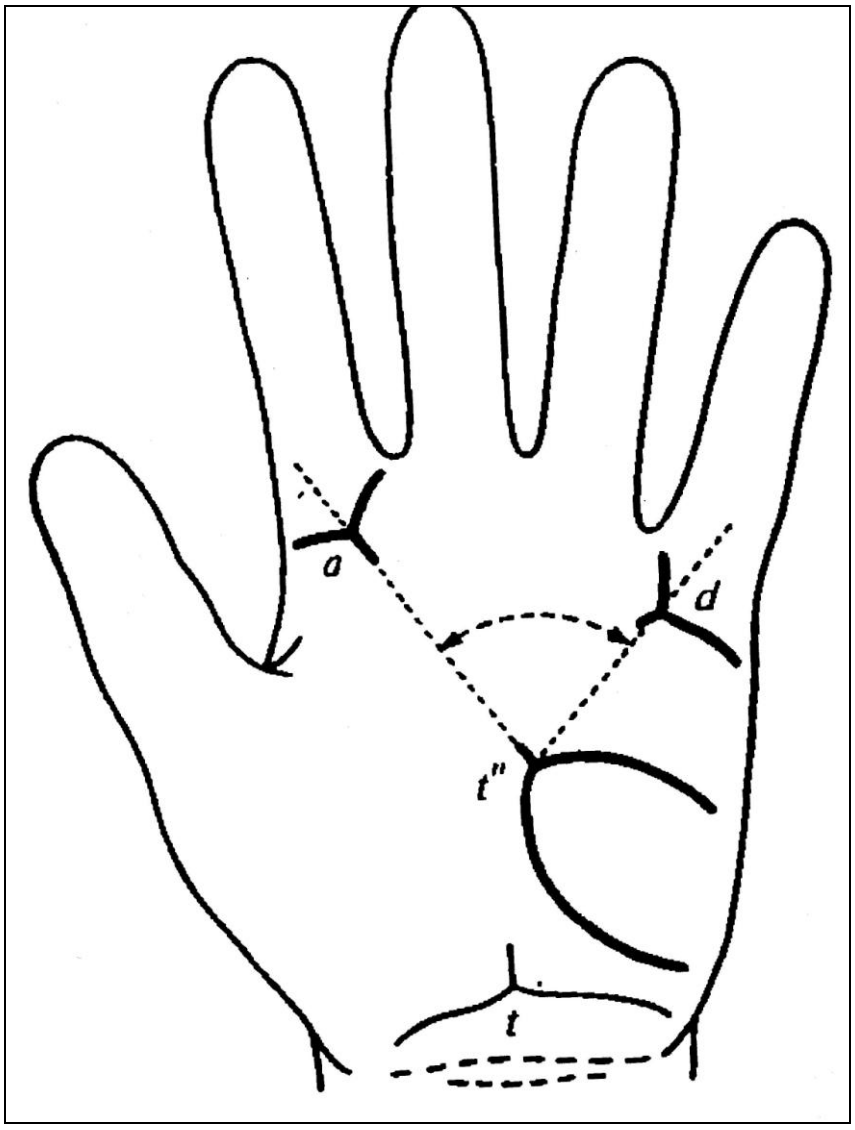


Fig. 9 ‘at”d’ Angle

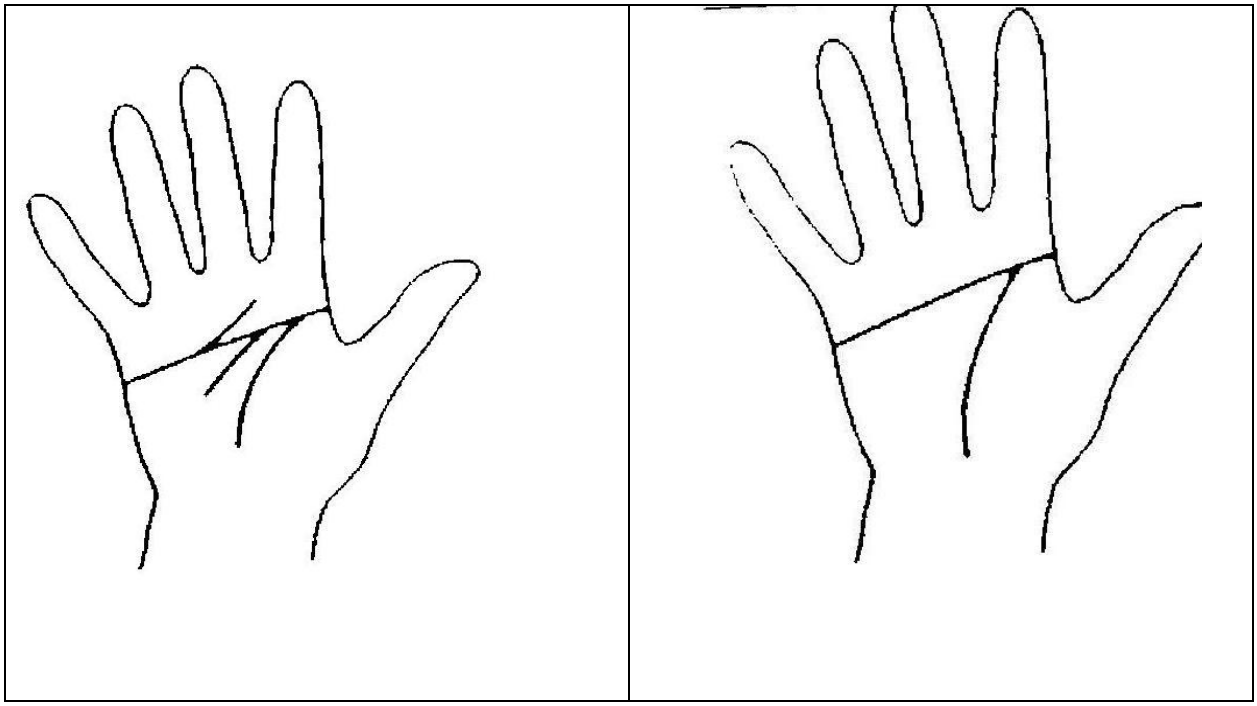


Fig.10.Simian crease or line

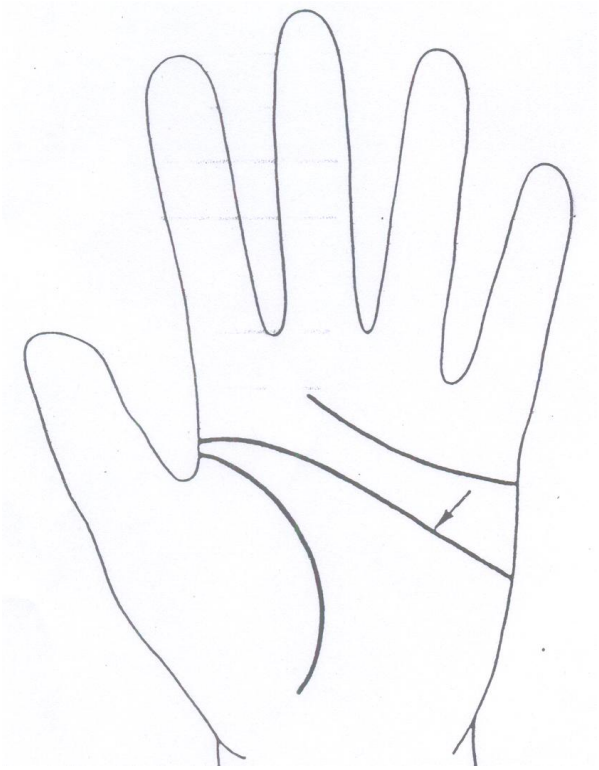


Fig. 11.Sydney crease or line

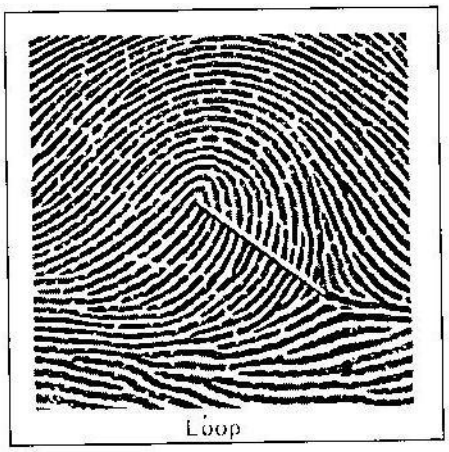
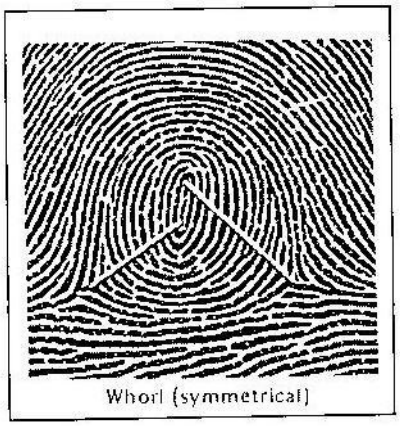


Fig. 12. Method of ridge counting in loop.



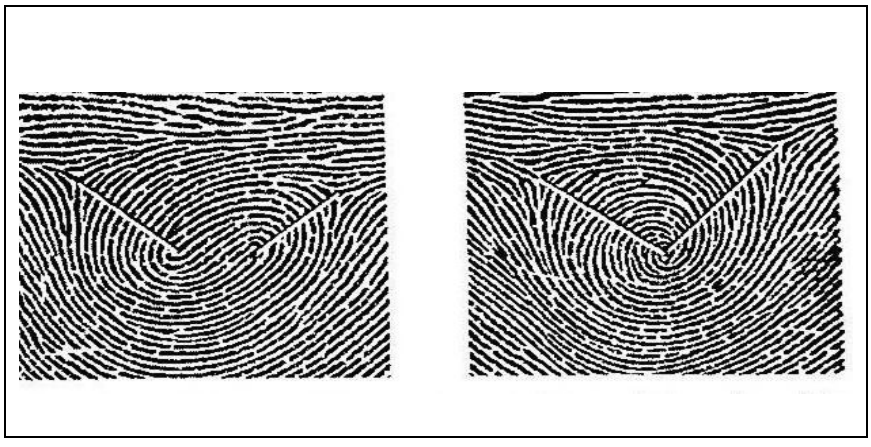


Fig. 13. Method of ridge counting in Whorl

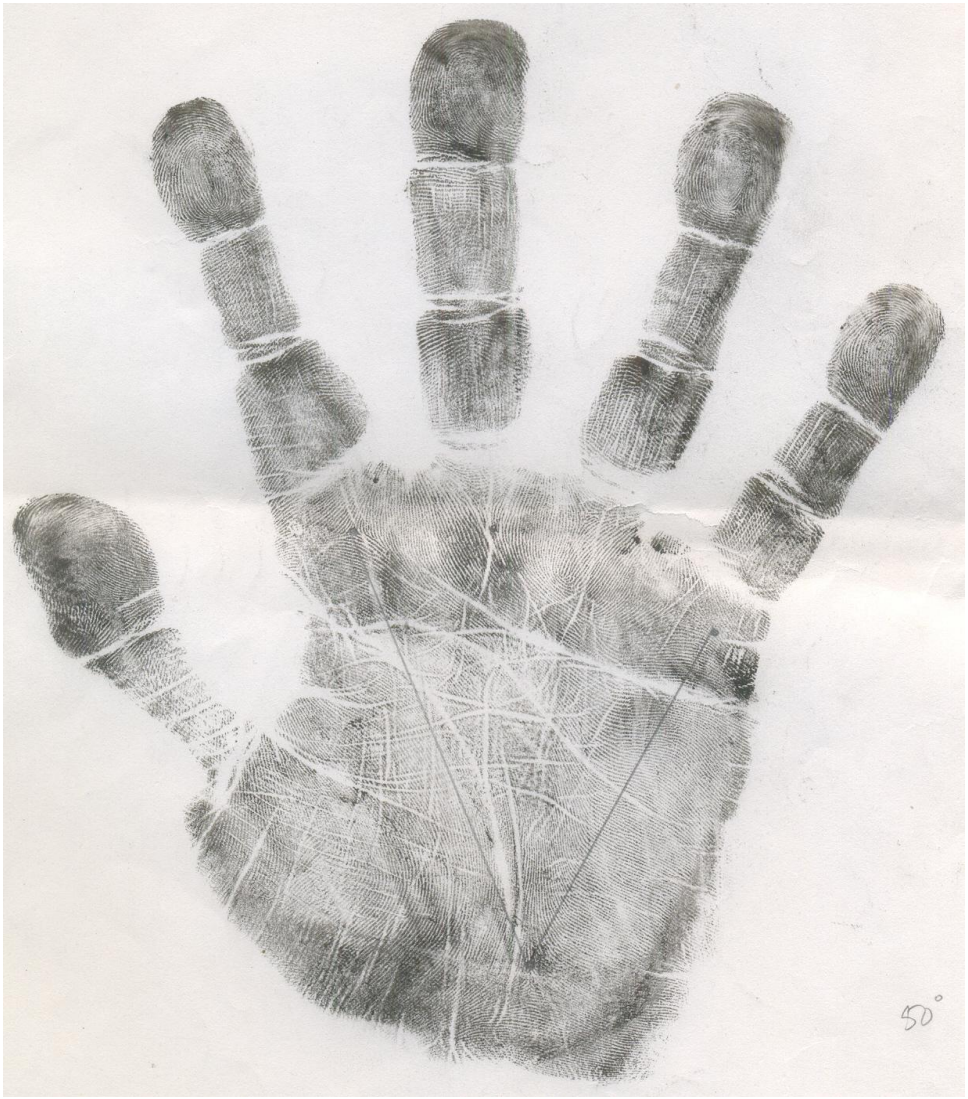


Fig- 14. Hand print of ‘atd’angle.

MATERIAL AND METHODS

Material used:-

1. Wooden table of suitable height.
2. 'Kores' duplicating ink.
3. Roller.
4. White crystal bond paper.
5. Soap, water and towel
6. Magnifying lens
7. Needle, Scale

Method:-

The materials to be used are stamp pad, bond paper and roller. The modified Purvis Smith method will be applied. Patients will be asked to wash both their hands with soap and water so as to remove any oil or dirt. Black duplicating ink (Kores, Bombay) will be smeared on both hands one by one and prints will be taken by rolling the hands from wrist creases to finger tips on the roller covered with bond paper.

Fingerprints:-

The distal phalanges of person's right hand were inked over the tile by firm pressure on the dorsum, starting from little finger. The distal phalanges of left hand were similarly inked.

While crystal bond paper, applied firmly over a wooden pad, was used for recording the inked epidermal ridge patterns. Rolled finger prints were recorded after applying uniform pressure on white bond paper as following order. [Ulnar to radial side]

Right Hand

Thumb → (R_1) Index Finger → (R_2) Middle Finger → (R_3) Ring finger → (R_4)

Little Finger (R_5)

Left Hand

Thumb → (L_1) Index Finger → (L_2) Middle Finger → (L_3) Ring finger → (L_4)

Little Finger (L_5)

Palm Print:-

Palm prints of both hands were obtained after inking them with help of rubber roller. A white crystal bond paper was wrapped around a wooden rod placed on the table. The hand was horizontally placed against it and the rod was gradually rolled on the table. Complete palm impression, including the hollow or the palm was obtained over paper. Thus one set of finger prints and palm prints was obtained.

The prints obtained were immediately examined with hand-lens and care was taken to include all essential details. Dermatoglyphics of sole and toes were not recorded.

Collection of Data:-

With the help of above method, finger and palm prints of 100 sputum positive pulmonary tuberculosis patients in the age group of 20-60 years. were obtained from:

1. BLDEA'S B.M. PATIL Medical college, Hospital and Research Centre, Bijapur
2. District Tuberculosis Centre, Bijapur

Finger and palm prints of 100 normal people for control of same age group were obtained from

1. Staff of BLDEA'S B.M. PATIL Medical college, Hospital and Research Centre , Bijapur
2. Post Graduate residential doctors of BLDEA'S B.M. PATIL Medical college, Hospital and Research Centre , Bijapur

All the data was analyzed qualitatively and quantitatively. Findings of each case were recorded in separate forms.

Method of Data Collection

Sample Size:

With prevalence rate of sputum positive cases of tuberculosis 4 per 1000 population [60] or 0.4% and 10% margin of error, the calculated sample size is 92.2 cases. The statistical formula used is-

$$n = \frac{(1.96)^2 P (1-P)}{d^2}$$

n = Sample size

P = Prevalence rate

d = Margin of error

The study is carried for a period of 1 ½ years from November 2007 to April 2009 with maximum sample of 100 patients of pulmonary tuberculosis confirmed by clinical history, examination, and sputum for acid fast bacilli in the age group of

20-60 years of either sex and equal number of normal healthy subjects of identical age and either sex will serve as control.

Type of Study:

The quantitative study includes total finger ridge count (TFRC), absolute finger ridge count (AFRC), mean 'atd' angle.

The quantitative study includes finger print patterns (whorls, radial loops, ulnar loops and arches) and palmar pattern (simian line and Sydney line).

Statistical analysis for quantitative analysis, the arithmetic mean and standard deviation will be calculated, 'Z' test will applied. For qualitative analysis, the 'Chi' square test will applied whenever necessary.

Inclusion Criteria:

Diagnosis of pulmonary tuberculosis is based on the finding of acid fast-bacilli on microscopic examination under the oil immersion objective of expectorated three sputum specimens stained with Ziehl-Neelsen basic fuschin dyes, showing two or more typical bacilli. A negative report should not be given till at least 100 fields have been examined, taking about 10 minutes[52].

Definition of smear positive tuberculosis – At least two initial sputum smears positive for acid fast bacilli or one acid fast bacilli positive smear and one positive culture.[10]

Exclusion Criteria:

Patients with deformed fingers and palms, infections and injuries like burns of fingers and palms, scars of burns of fingers and palms of both hands will be excluded from the study.

Definition of smear negative tuberculosis–At least three negative smears, but tuberculosis suggestive symptoms and X-ray abnormalities or positive culture.[10]

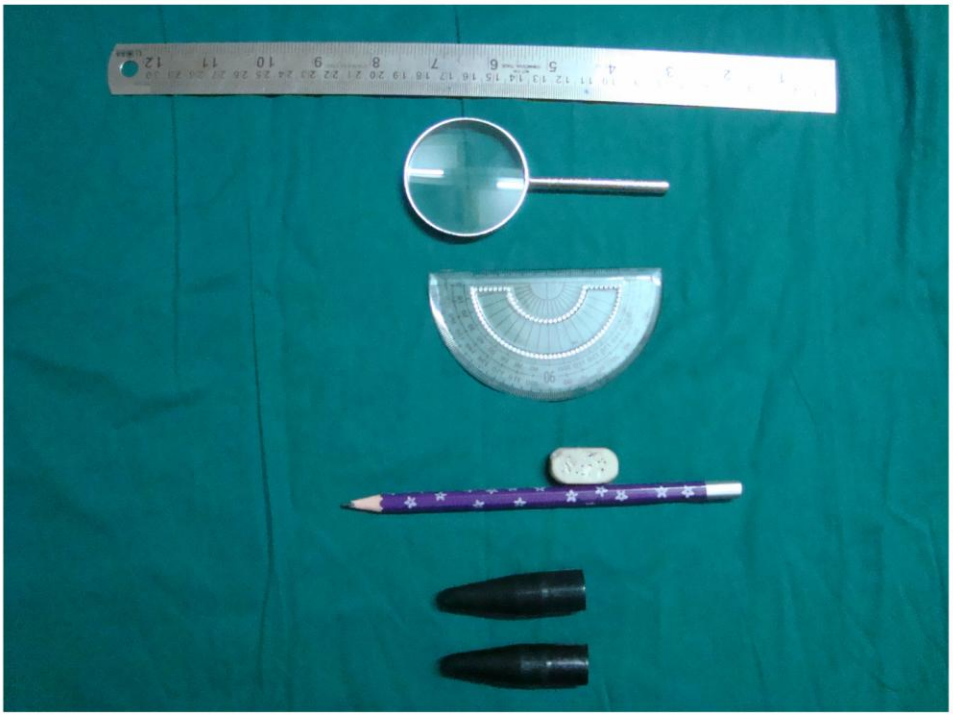
To analyze finger pattern frequency, the fingertip pattern configurations were classified as arches (A), loops (L), whorls W). The arches were further recorded as simple (A), or tented (A^t) arches depending upon the presence or absence of a triradius. For statistical purpose, both were grouped together as arches only.

Loops (L) were recorded as ulnar or radial depending upon the side on which it opened and whorls were recorded as DLWs and whorls. But for quantitative analysis, they were grouped together and were called as loops and whorls.

'P' value is probability rate at 0.05 level of significance for the corresponding degree of freedom.

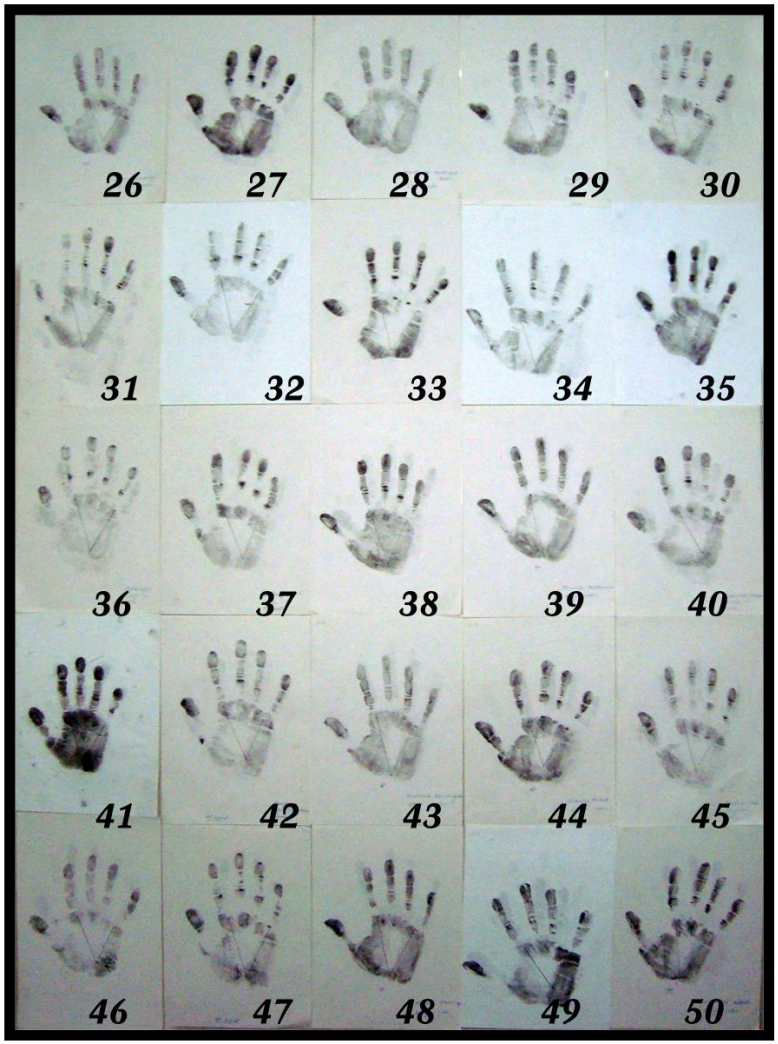
$P<0.05$ is significant.

$P>0.05$ is non-significant

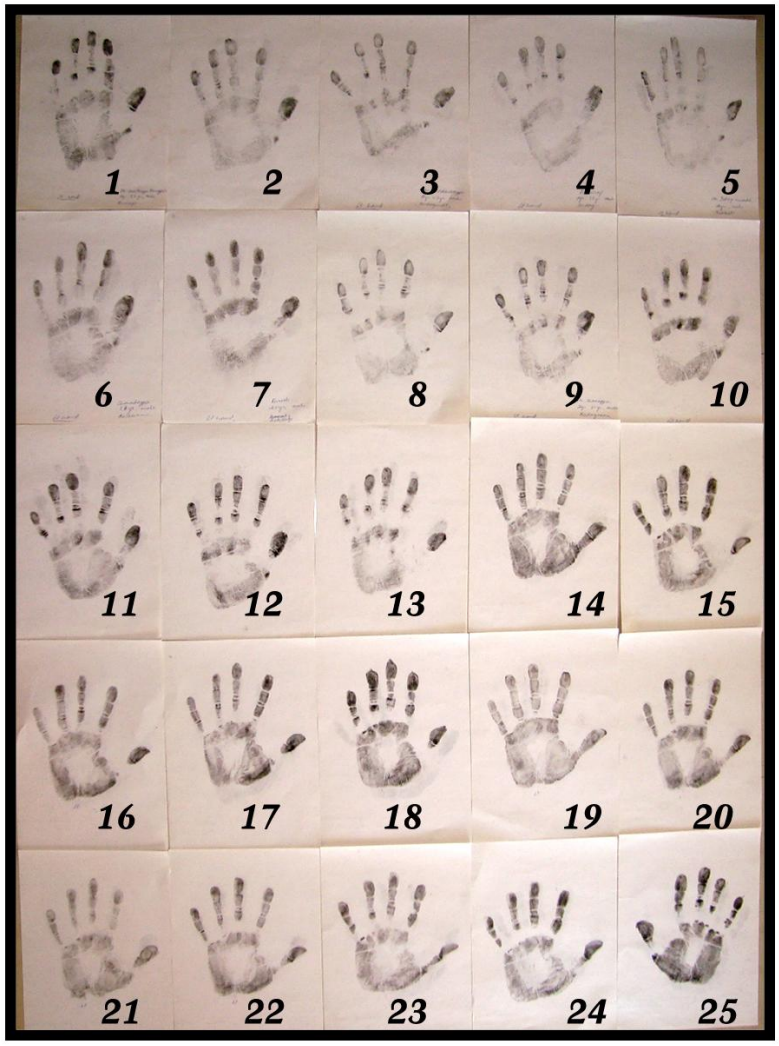


MATERIALS USED TO RECORD
FINGER AND PALM PRINTS

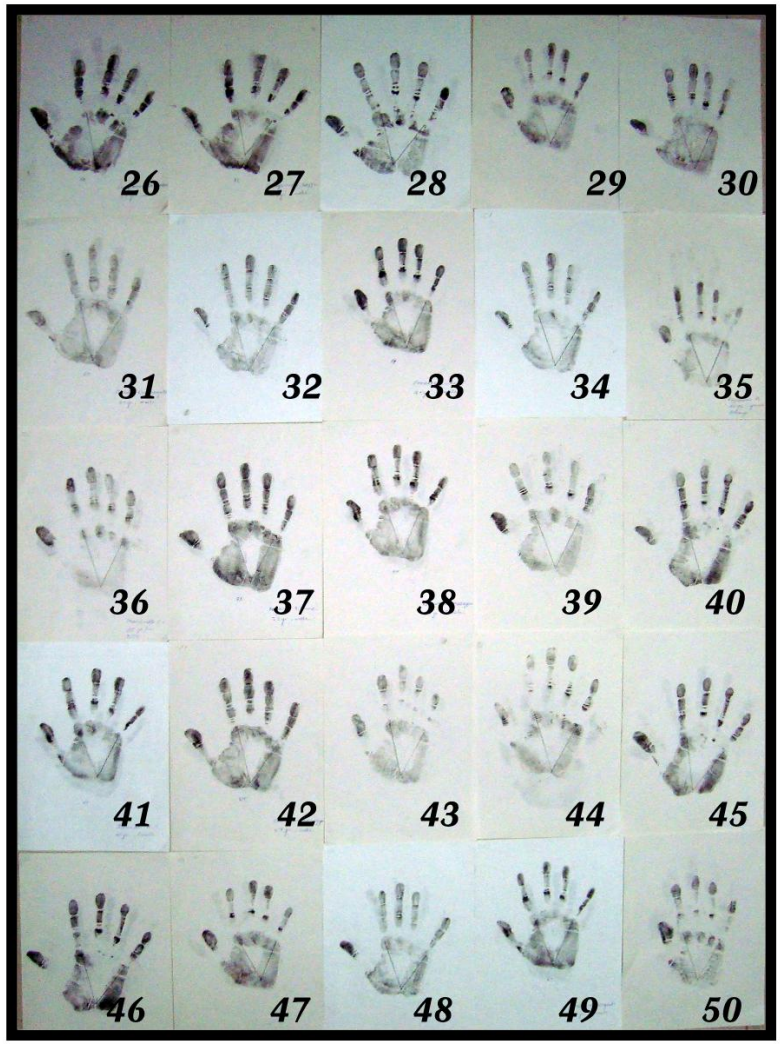
PROCEDURE FOR TAKING FINGER AND PALM PRINTS



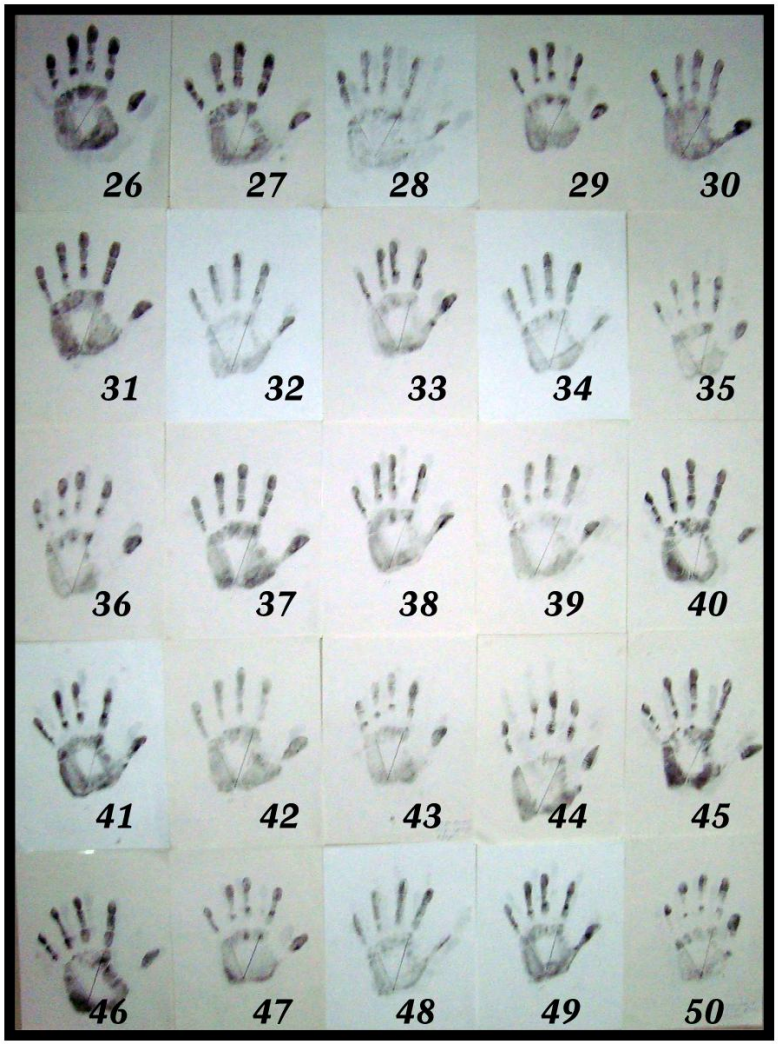
MALE PATIENT RIGHT HAND



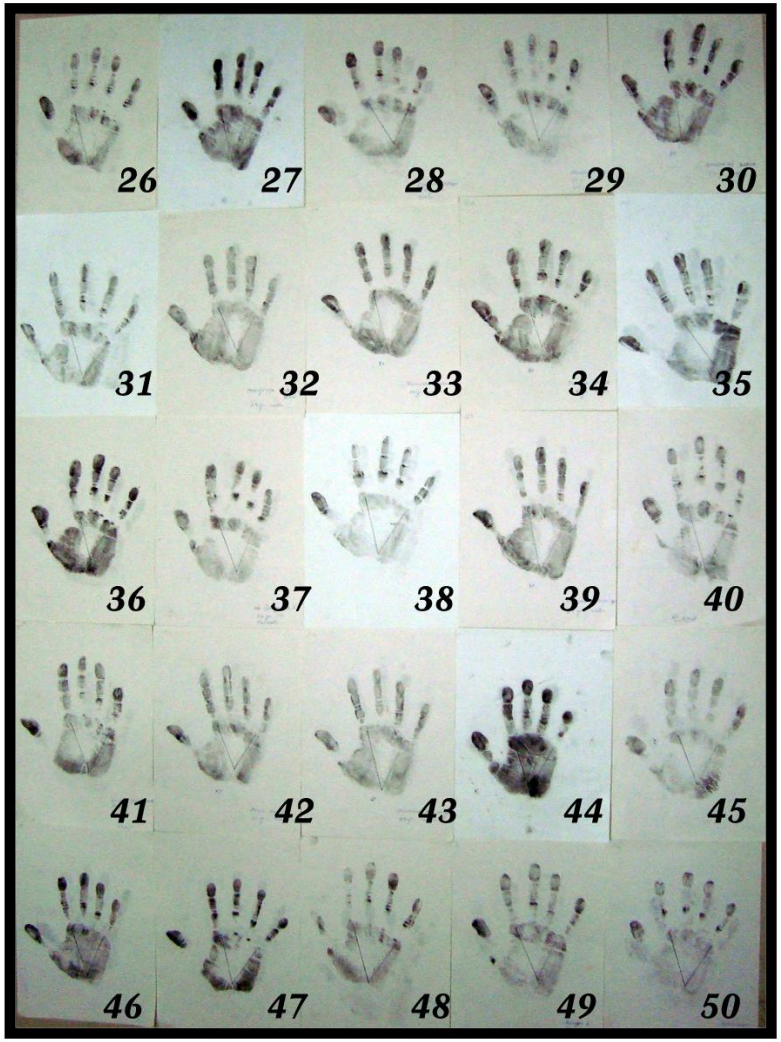
MALE PATIENT LEFT HAND



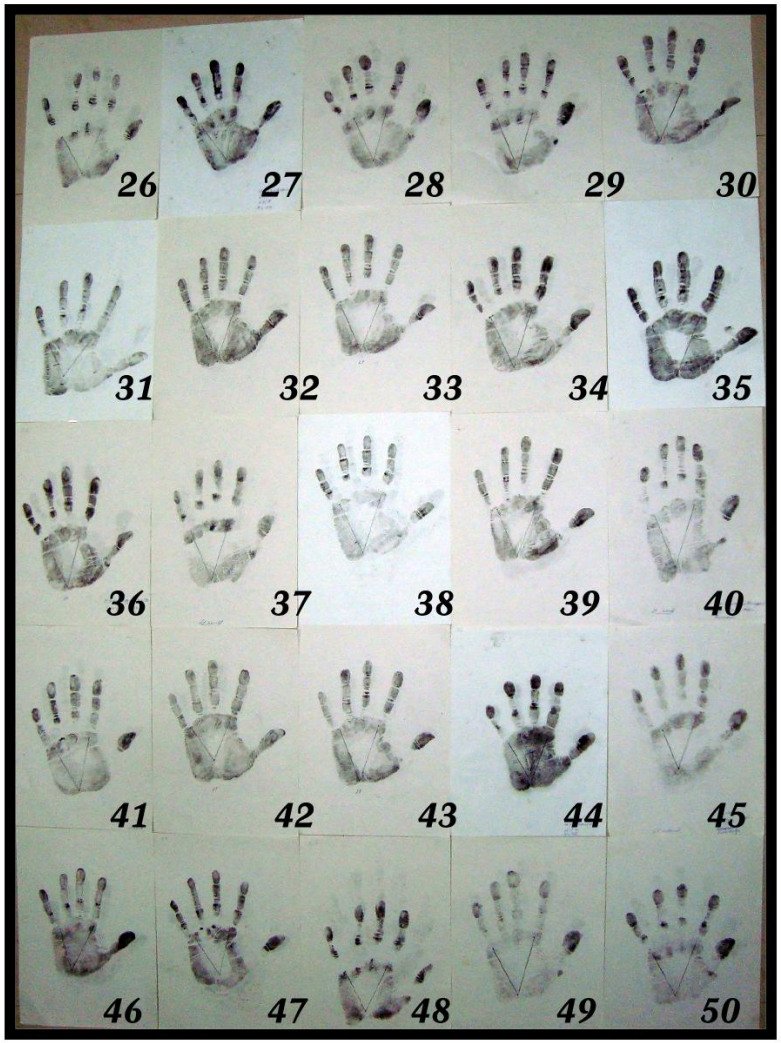
FEMALE PATIENT RIGHT HAND



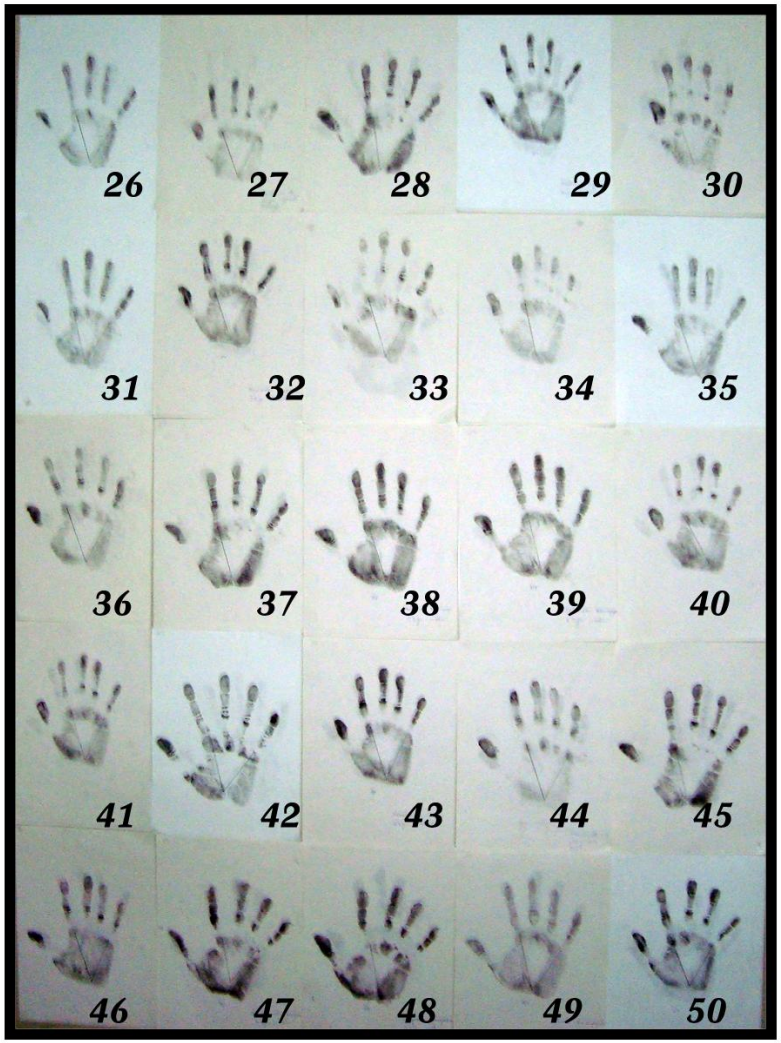
FEMALE PATIENT LEFT HAND



MALE CONTROL RIGHT HAND



MALE CONTROL LEFT HAND



FEMALE CONTROL RIGHT HAND

FEMALE CONTROL LEFT HAND

OBSERVATIONS

Tuberculosis remains a worldwide public health problem. Tuberculosis is not a hereditary disease however twin studies indicate that susceptibility is an important risk factor[1].Infection with TB depends on various factors. One amongst them is heredity. Development of dermatoglyphic pattern is under genetic control. Hence qualitative and quantitative study of dermatoglyphic traits may give us a clue to the susceptibility of pulmonary TB.

In present study, 100 sputum positive Pulmonary TB patients (50 males and 50 females) in the age group of 20-60 years were studied. For such traits observations were compared with normal control group of people of identical age group and number (50 males and 50 females).

The Quantitative Analysis includes:

- The Total Finger Ridge Count (TFRC)
- Absolute Finger Ridge Count (AFRC)
- 'atd' Angle

The Qualitative Analysis includes

- Analysis fingertip patterns of
  - Right hand and left hand separately
  - Right hand and left hand combined
- Abnormal palmar creases Sydney line (Sy line) and simian line(Sm line).

The arithmetic mean and standard deviation were calculated and Z- test was applied.

Fingertip patterns:-

Fingertip patterns were studied in both groups for arches (A), ulnar loops (L_u) and radial loops (L_r) and whorls (W).

TABLE NO.1

DIGIT WISE FREQUENCY OF PATTERN IN MALE STUDY GROUPS.

Digit	Arches (A)	Radial Loops (L_r)	Ulnar Loops (L_u)	Whorls (W).
R_1	01	04	22	23
R_2	04	04	17	25
R_3	02	02	15	31
R_4	02	03	27	18
R_5	02	01	18	29
L_1	01	03	18	28
L_2	04	02	17	27
L_3	02	01	14	33
L_4	00	01	26	23
L_5	02	01	15	32

TABLE NO.2

DIGIT WISE FREQUENCY OF PATTERN IN MALE CONTROL

Digit	Arches (A)	Radial Loops (L_r)	Ulnar Loops (L_u)	Whorls (W).
R_1	01	02	12	35
R_2	03	03	11	33
R_3	04	03	23	20
R_4	01	02	21	26
R_5	01	02	16	31
L_1	0 1	02	15	32
L_2	00	04	12	34
L_3	00	01	19	30
L_4	0 2	03	23	22
L_5	03	02	26	19

Table no. 1 and 2 shows:

R_1 - There is decrease in whorls and increase in radial and ulnar loops in Tuberculosis patients as compared to controls.

R_2 - There is decrease in whorls and increase in arches, ulnar loops and radial loops in Tuberculosis patients as compared to controls.

R_3 - There is decrease in arches, radial loops, ulnar loops and increase in whorls in Tuberculosis patients as compared to controls.

R_4 There is decrease in whorls and increase in arches, radial loops, and ulnar loops in Tuberculosis patients as compared to controls.

R_5 - There is decrease in radial loops and whorls and increase in arches and ulnar loops in Tuberculosis patients as compared to controls.

L_1 - There is decrease in whorls and increase in radial loops and ulnar loops in Tuberculosis patients as compared to controls.

L_2 - There is decrease in radial loops and whorls and increase in ulnar loops and arches in Tuberculosis patients as compared to controls.

L_3 - There is decrease in ulnar loops and increase in whorls in Tuberculosis patients as compared to controls.

L_4 - There is decrease in radial loops and arches and increase in ulnar loops and Whorls in Tuberculosis patients as compared to controls.

L_5 - There is decrease in radial loops, arches and ulnar loops and increase in whorls in Tuberculosis patients as compared to controls.

TABLE NO.3

DIGIT WISE FREQUENCY OF PATTERN IN FEMALE STUDY GROUPS.

Digit	Arches (A)	Radial Loops (L_r)	Ulnar Loops (L_u)	Whorls (W).
R_1	0 1	02	22	25
R_2	0 3	03	20	24
R_3	00	02	22	26
R_4	00	03	29	18
R_5	03	04	19	24
L_1	00	01	26	23
L_2	04	04	18	24
L_3	03	02	24	21
L_4	00	03	21	26
L_5	02	00	17	31

TABLE NO.4

DIGIT WISE FREQUENCY OF PATTERN IN FEMALE CONTROLS.

Digit	Arches(A)	Radial Loops (L_r)	Ulnar Loops (L_u)	Whorls (W).
R_1	02	01	22	25
R_2	03	03	18	26
R_3	01	02	31	16
R_4	00	03	23	24
R_5	03	02	27	18
L_1	01	01	26	22
L_2	02	02	25	21
L_3	03	03	21	23
L_4	04	00	24	22
L_5	02	01	28	19

Table no. 3 and 4 shows :

R_1 - There is decrease in arches and increase in radial loops Tuberculosis patients as compared to controls.

R_2 - There is decrease in whorls and increase in ulnar loops in Tuberculosis patients as compared to controls.

R_3 - There is decrease in arches and ulnar loops and increase in whorls in Tuberculosis patients as compared to controls.

R_4 - There is decrease in whorls and increase in ulnar loops in Tuberculosis patients as compared to controls.

R_5 - There is decrease in ulnar loops and increase in radial loops and whorls in Tuberculosis patients as compared to controls.

L_1- There is decrease in arches and increase in whorls in Tuberculosis patients as compared to controls.

L_2 - There is decrease in ulnar loops and increase in radial loops, arches and whorls in Tuberculosis patients as compared to controls.

L_3 - There is decrease in radial loops and whorls and increase in ulnar loops in Tuberculosis patients as compared to controls.

L_4 - There is decrease in arches and ulnar loops and increase in whorls and radial loops in Tuberculosis patients as compared to controls.

L_5 - There is decrease in ulnar loops and radial loops and increase in whorls in Tuberculosis patients as compared to controls.

TABLE NO.5

FREQUENCY OF PATTERNS IN MALE STUDY GROUPS AND CONTROLS (RIGHT HAND)

Pattern	Study groups		Controls		Z – test	P-Value	Inference
	No.	%	No.	%			
Arch (A)	11	4.4	10	4	0.22	0.8236	Not Significant
Radial Loop (L_r)	14	5.6	12	4.8	0.40	0.6871	
Ulnar Loop (L_u)	99	39.6	83	33.2	1.48	0.1370	
Whorl (W)	126	50.4	145	58	1.70	0.0881	

Table no. 5 Shows whorls were predominant pattern seen in 50.4% of the patients as compared to 58% in controls. While Arches were the least common pattern (4.4%) in patients. Combined Radial and Ulnar loops constituted 45.2% in study group as compared to 38% in controls. Thus even when combined whorls were predominant pattern, but this difference is not statistically significant (P>0.05).

FREQUENCY OF PATTERNS IN MALE STUDY GROUPS AND CONTROLS

(RIGHT HAND)

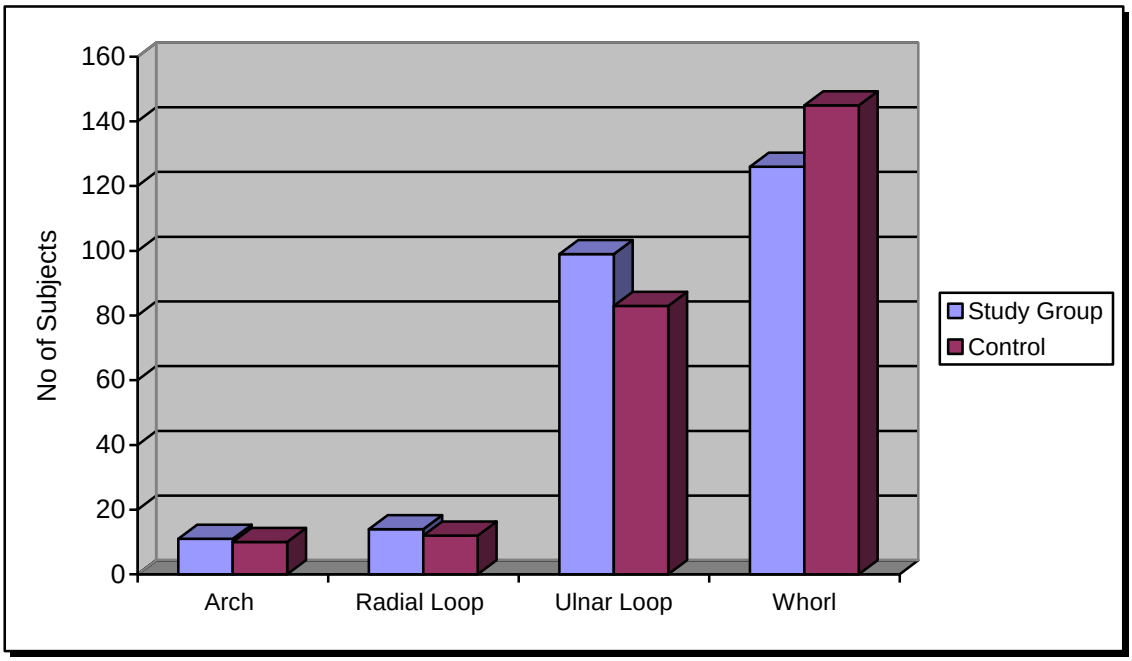


TABLE NO.6

FREQUENCY OF PATTERNS IN MALE STUDY GROUPS AND CONTROLS (LEFT HAND)

Pattern	Study groups		Controls		Z - test	P-Value	Inference
	No.	%	No.	%			
Arch (A)	09	3.6	06	2.4	0.78	0.43	Not Significant
Radial Loop (L_r)	08	3.2	12	4.8	0.91	0.36	
Ulnar Loop (L_u)	90	36	95	38	0.46	0.64	
Whorl (W)	143	57.2	137	54.8	0.54	0.58	

Table no. 6 shows whorls were predominant pattern seen in 57.2% of the patients as compared to 54.8% in controls. While Radial loops were the least common pattern (3.2%) in patients. Combined Radial and Ulnar loops constituted 39.2% in study group as compared to 46.4% in controls. Thus even when combined whorls were predominant pattern, but this difference is not statistically significant (P>0.05).

FREQUENCY OF PATTERNS IN MALE STUDY GROUPS AND CONTROLS (LEFT HAND)

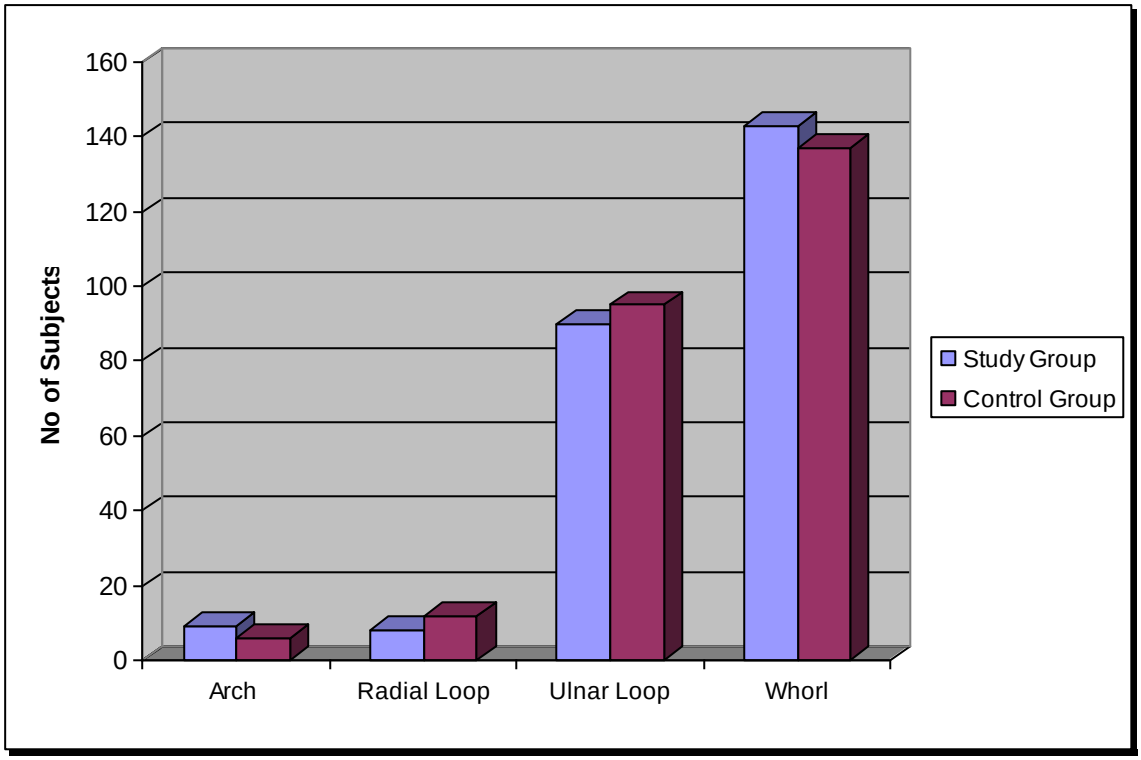


TABLE NO.7

FREQUENCY OF PATTERNS IN MALE STUDY GROUPS AND CONTROLS (BOTH HANDS)

Pattern	Study groups		Controls		Z - test	P-Value	Inference
	No.	%	No.	%			
Arch (A)	20	4	16	3.2	0.67	0.4971	Not Significant
Radial Loop (L_r)	22	4.4	24	4.8	0.30	0.7642	
Ulnar Loop (L_u)	189	37.8	178	35.6	0.72	0.4715	
Whorl (W)	269	53.8	282	56.4	0.82	0.4122	

Table no.7 shows whorls were predominant pattern seen in 53.8% of the patients as compared to 56.4% in controls. While Arches were the least common pattern (4%) in patients. Combined Radial and Ulnar loops constituted 42.2% in study group as compared to 42.2% in controls. Thus even when combined whorls were predominant pattern, but this difference is not statistically significant (P>0.05).

FREQUENCY OF PATTERNS IN MALE STUDY GROUPS AND CONTROLS

(BOTH HANDS)

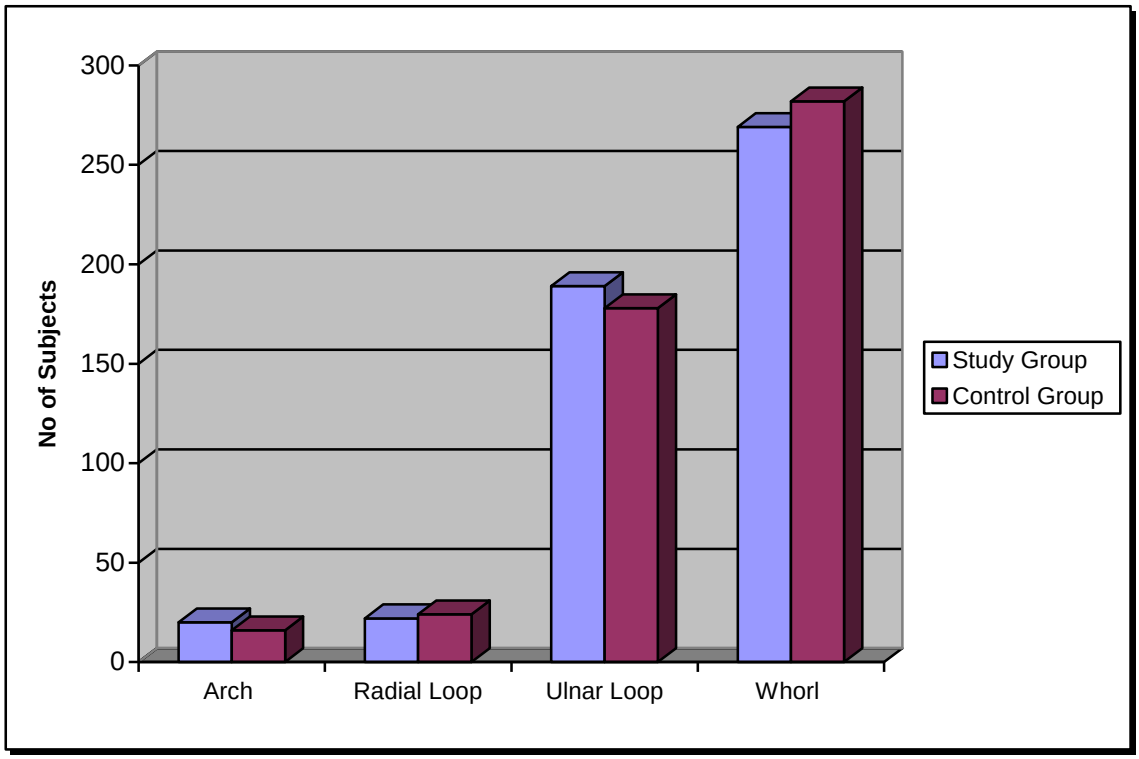


TABLE NO.8

FREQUENCY OF PATTERNS IN FEMALE STUDY GROUPS AND CONTROLS (RIGHT HAND).

Pattern	Study groups		Controls		Z-test	P-Value	Inference
	No.	%	No.	%			
Arch (A)	07	2.8	09	3.6	0.50	0.6113	Not Significant
Radial Loop (L_r)	14	5.6	11	4.4	0.61	0.5382	
Ulnar Loop (L_u)	112	44.8	121	48.4	0.80	0.4198	
Whorl (W)	117	46.8	109	43.6	0.71	0.4722	

Table no.8 shows whorls were predominant pattern seen in 46.8% of the patients as compared to 43.6% in controls. While Arches were the least common pattern (2.8%) in patients. Combined Radial and Ulnar loops constituted 50.4% in study group as compared to 52.8% in controls. When combined Radial and Ulnar loops were predominant pattern, but this difference is not statistically significant (P>0.05).

FREQUENCY OF PATTERNS IN FEMALE STUDY GROUPS AND CONTROLS (RIGHT HAND).

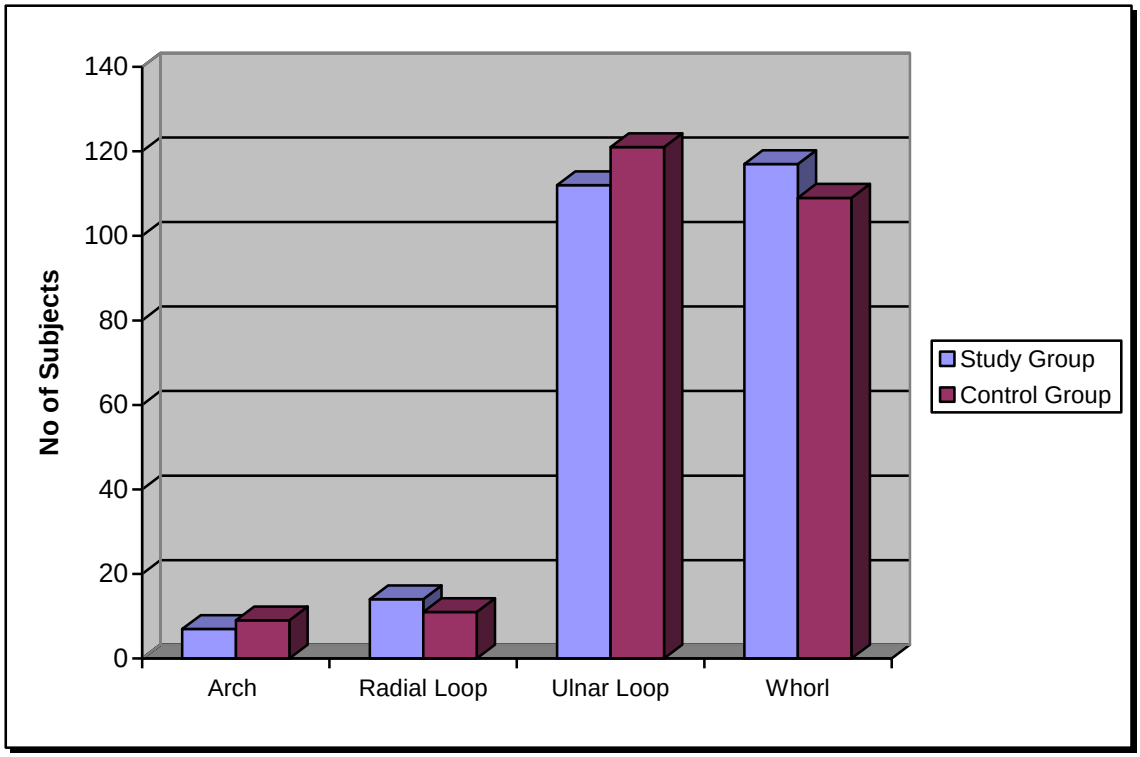


TABLE NO.9

FREQUENCY OF PATTERNS IN FEMALE STUDY GROUPS AND CONTROLS (LEFT HAND)

Pattern	Study groups		Controls		Z – test	P-Value	Inference
	No.	%	No.	%			
Arch (A)	09	3.6	12	4.8	0.66	0.50	Not Significant
Radial Loop (L_r)	10	4.0	07	2.8	0.74	0.45	
Ulnar Loop (L_u)	106	42.4	124	49.6	1.61	0.10	
Whorl (W)	125	50	107	42.8	1.61	0.10	

Table no.9. shows whorls were predominant pattern seen in 50% of the patients as compared to 42.8% in controls. While Arches were the least common pattern (3.6%) in patients. Combined Radial and Ulnar loops constituted 46.4% in study group as compared to 52.4% in controls. Thus even when combined whorls were predominant pattern, but this difference is not statistically significant (P>0.05).

FREQUENCY OF PATTERNS IN FEMALE STUDY GROUPS AND CONTROLS (LEFT HAND)

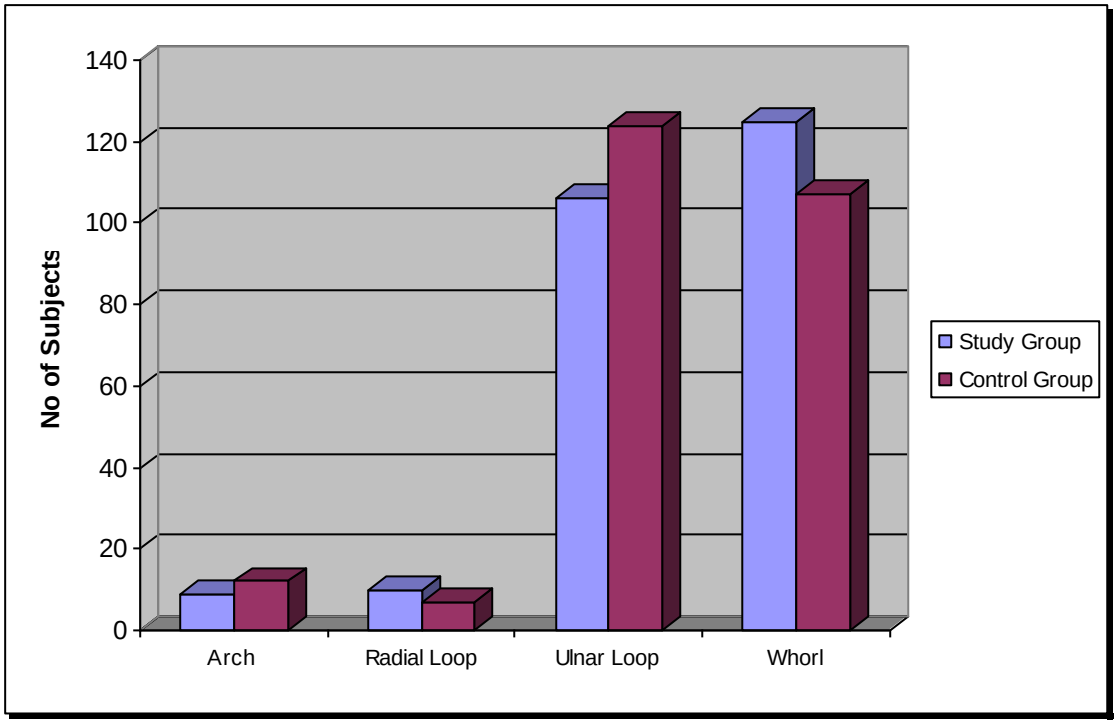


TABLE NO. 10

FREQUENCY OF PATTERNS IN FEMALE STUDY GROUPS AND CONTROLS (BOTH HAND)

Pattern	Study groups		Controls		Z – test	P-Value	Inference
	No.	%	No.	%			
Arch (A)	16	3.2	21	4.2	0.83	0.40	Not Significant
Radial Loop (L_r)	24	4.8	18	3.6	0.94	0.34	
Ulnar Loop (L_u)	218	43.6	245	49	1.71	0.08	
Whorl (W)	242	48.4	216	43.2	1.65	0.09	

Table no.10. shows whorls were predominant pattern seen in 48.4% of the patients as compared to 43.2% in controls. While Arches were the least common pattern (3.2%) in patients. Combined Radial and Ulnar loops constituted 48.4% in study group as compared to 52.6% in controls, but this difference is not statistically significant (P>0.05).

FREQUENCY OF PATTERNS IN FEMALE STUDY GROUPS AND CONTROLS (BOTH HAND)

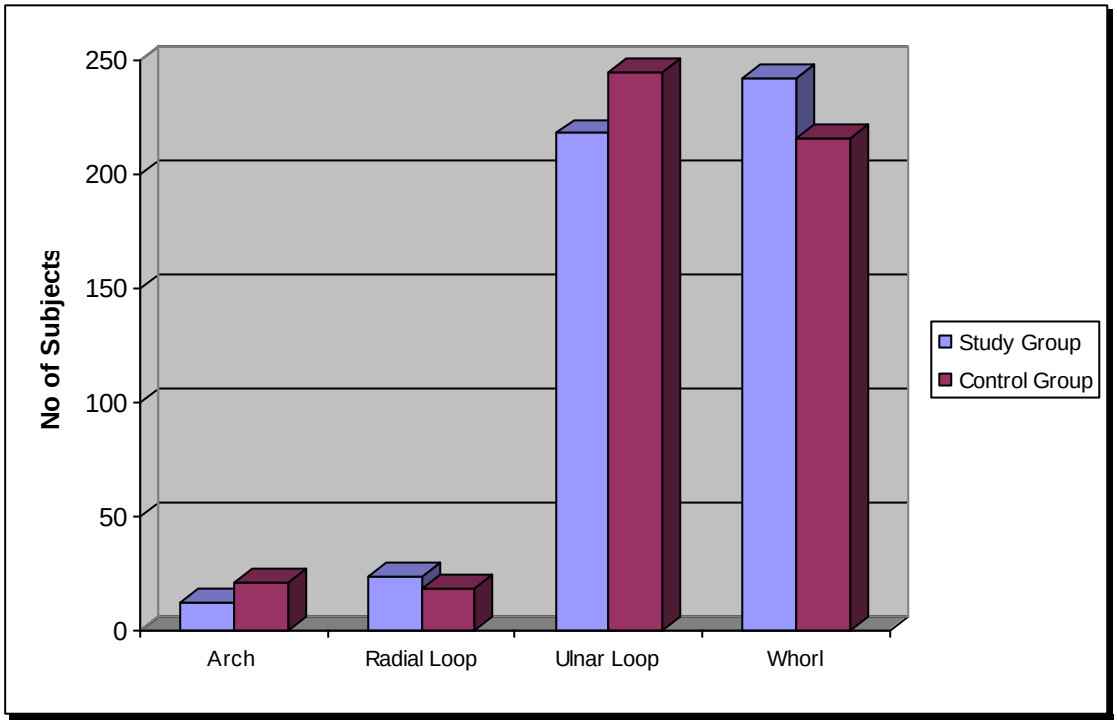


TABLE NO. 11

FREQUENCY OF PATTERNS IN MALE & FEMALE STUDY GROUPS AND CONTROLS (BOTH HAND)

Pattern	Study groups		Controls		Z – test	P-Value	Inference
	No.	%	No.	%			
Arch (A)	36	3.6	37	3.7	0.11	0.91	Not Significant
Radial Loop (L_r)	46	4.6	42	4.2	0.43	0.66	
Ulnar Loop (L_u)	407	40.7	423	42.3	0.72	0.47	
Whorl (W)	511	51.1	498	49.8	0.58	0.56	

Table no.11 shows whorls were predominant pattern seen in 51.1% of the patients as compared to 49.8% in controls. While Arches were the least common pattern (3.6%) in patients. Combined Radial and Ulnar loops constituted 45.3% in study group as compared to 46.5% in controls. Thus even when combined, whorls were predominant pattern (51.1% in patients against 45.4 in controls), but this difference is not statistically significant (P>0.05).

FREQUENCY OF PATTERNS IN MALE & FEMALE STUDY GROUPS AND CONTROLS (BOTH HAND)

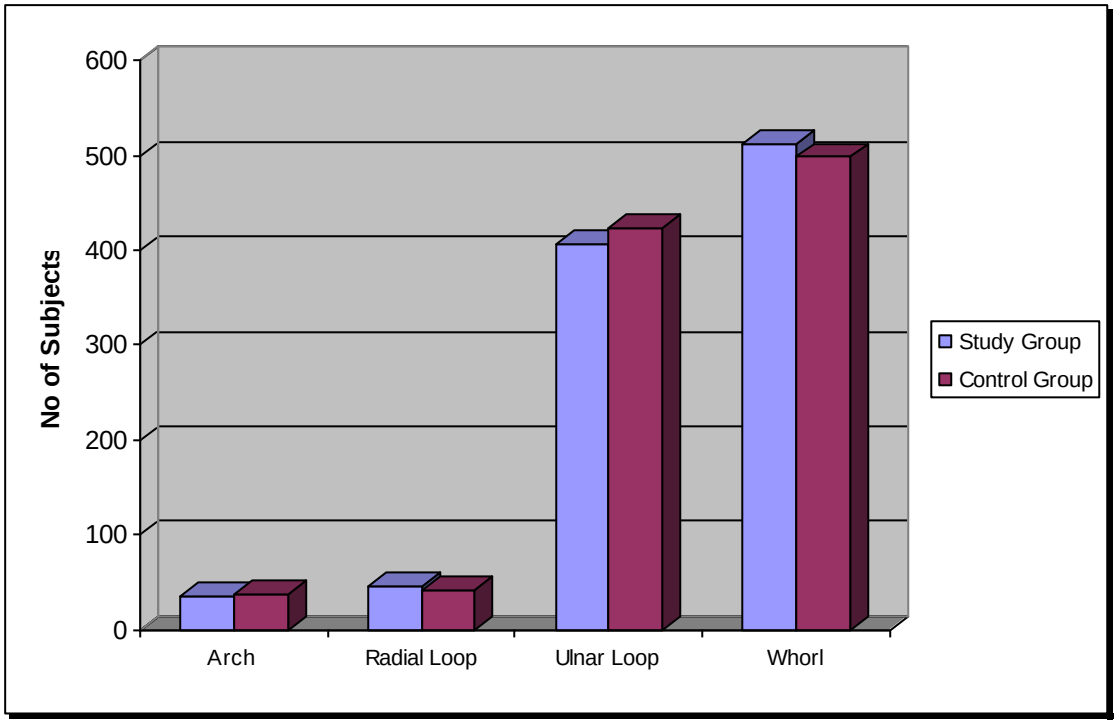


TABLE NO.12

PRESENCE OF SYDNEY LINE IN MALES

Hands	Study Groups (%)	Controls (%)	Z – test	P-Value	Inference
Right	00	00	00	-	Not Significant
Left	01 (2%)	00	1.00	0.31	

Table no.12 shows that the Sydney crease is very rare. Only 1 patient had it, While in controls it was not present in any subject (P>0.05).

TABLE NO.13

PRESENCE OF SYDNEY LINE IN FEMALES

Hands	Study groups (%)	Controls (%)	Z – test	Inference
Right	00	00	00	Not Significant
Left	00	00	00	

Table no.13 shows that the Sydney crease is very rare. It was not seen in any female patients or controls (P>0.05).

TABLE NO.14

PRESENCE OF SIMIAN LINE IN MALES

Hands	Study Group (%)	Control (%)	Z – test	Inference
Right	00	00	-	P <0.05 (Not Significant)
Left	02 (4%)	00	1.42	

Table no.14 shows that the Simian line is also very rare. On right side, simian line was not seen in any subject. On left side, 2 patients (4%) had simian line, while no control subject had it. . This difference was not statistically significant (P>0.05).

TABLE NO.15

PRESENCE OF SIMIAN LINE IN FEMALES

Hands	Study Group (%)	Control (%)	Z – test	Inference
Right	00	00	00	P <0.05 (Not Significant)
Left	00	00	00	

Table no.15 shows that the Simian line is also very rare. simian line was not seen in any female subjects on left as well as on right side . This difference was not statistically significant (P>0.05).

TABLE NO.16

MEAN TOTAL FINGER RIDGE COUNT (TFRC) IN MALES

Study group Mean (SD)	Control Mean (SD)	Z – test	P-Value	Inference
129.9 (36.25)	126.4 (30.06)	6.86	0.0001	P< 0.001 Highly Significant

Table no.16 shows that the Mean Total Finger Ridge Count (TFRC) in Male patients was higher 129.9 with S.D. of 36.25 as compared to male control group which had TFRC 126.4 with S.D. of 30.06. This difference was highly statistically significant (Z – test = 6.86 and P <0.001).

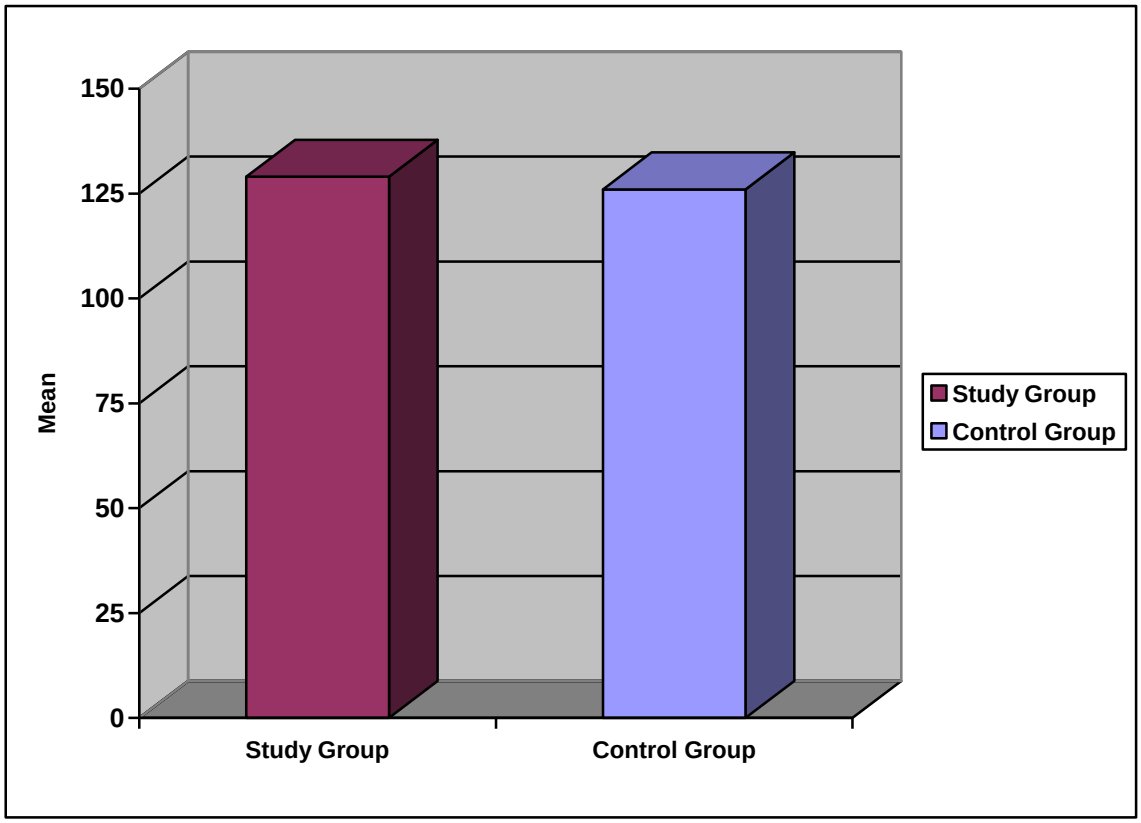


TABLE NO.17

MEAN TOTAL FINGER RIDGE COUNT (TFRC) IN FEMALES

Study Group Mean (SD)	Control Mean (SD)	Z – test	P-Value	Inference
132.96 (49.93)	128.52 (22.41)	8.70	0.0001	P< 0.001 Highly Significant

Table no.17 shows that the Mean Total Finger Ridge Count (TFRC) in female patients was higher 132.96 with S.D. of 49.93 as compared to male control group which had TFRC 128.52 with S.D. of 22.41. This difference was statistically significant (Z- test = 8.70 and P <0.001).

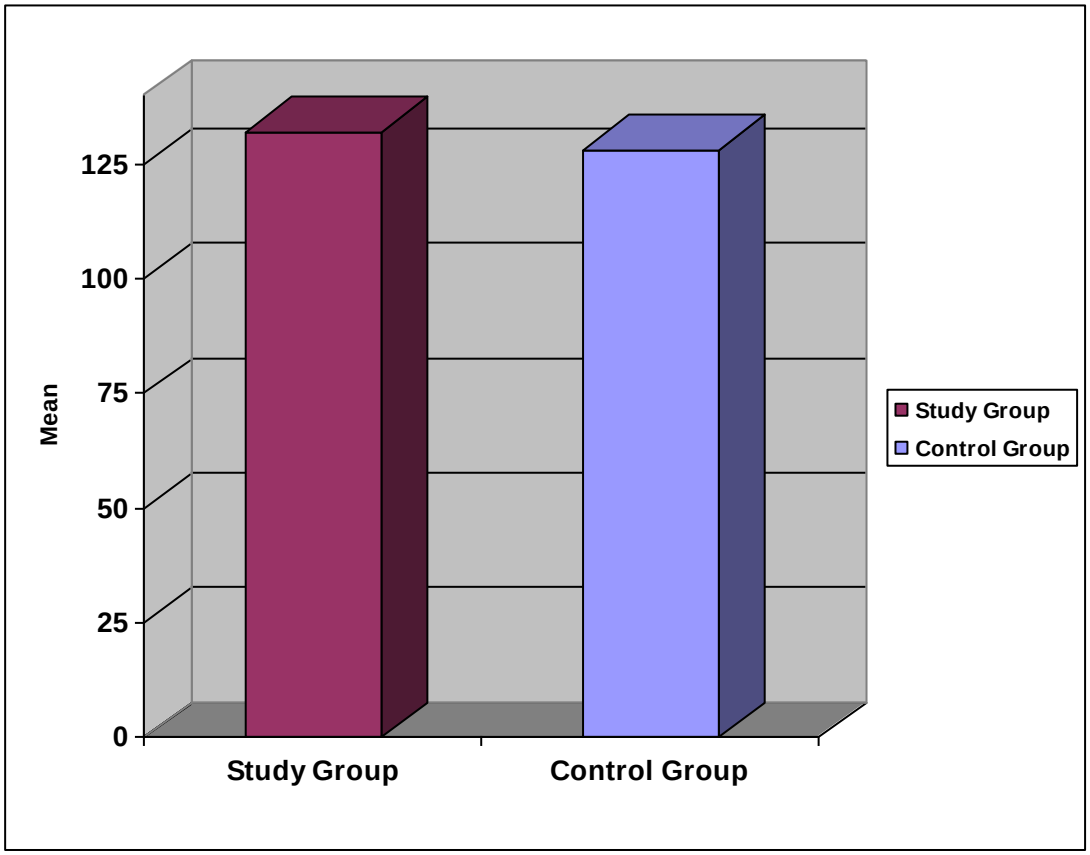


TABLE NO.18

MEAN TOTAL FINGER RIDGE COUNT (TFRC) IN STUDY GROUP

Study Groups Mean (SD)	Controls Mean (SD)	Z – Test	Inference
131.43 (43.44)	127.46 (26.40)	11.01	P< 0.001 Highly Significant

Table no.18 shows that the Mean Total Finger Ridge Count (TFRC) in study group was higher i.e. 131.43 with S.D .of 43.44 as compared to control group which had TFRC of 127.46 with S.D. of 26.40. This difference was highly statistically significant (Z- test 11.01and P <0.001).

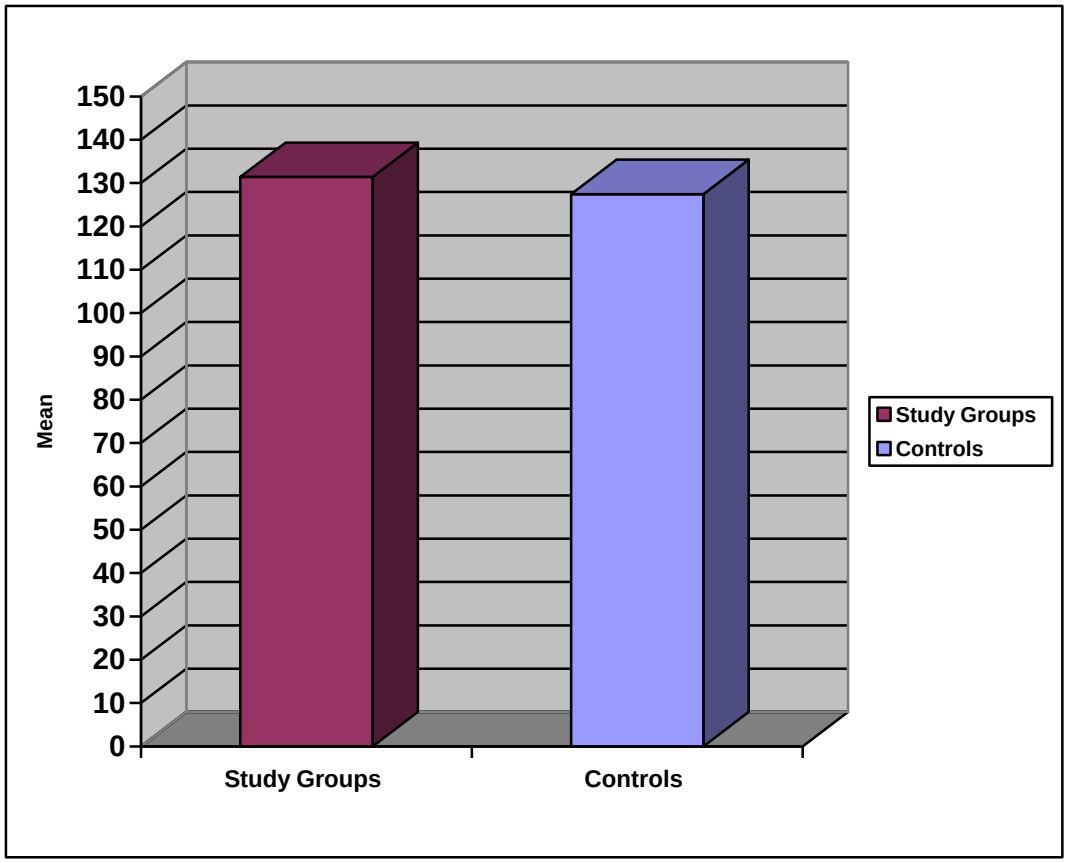


TABLE NO.19

MEAN ABSOLUTE FINGER RIDGE COUNT (AFRC) IN MALES

Study Groups Mean (SD)	Controls Mean (SD)	Z – test	P-Value	Inference
166.5 **(**50.55)	158.16 **(**23.70)	16.43	0.0001	P< 0.001 Highly Significant

Table no.19 shows that the Mean Absolute Finger Ridge Count (AFRC) in Male patients was higher 166.54 with S.D. of 50.55 as compared to male control group which had AFRC 158.16 with S.D. of 23.700. This difference was statistically significant (Z- test= 16.43 and P = <0.001).

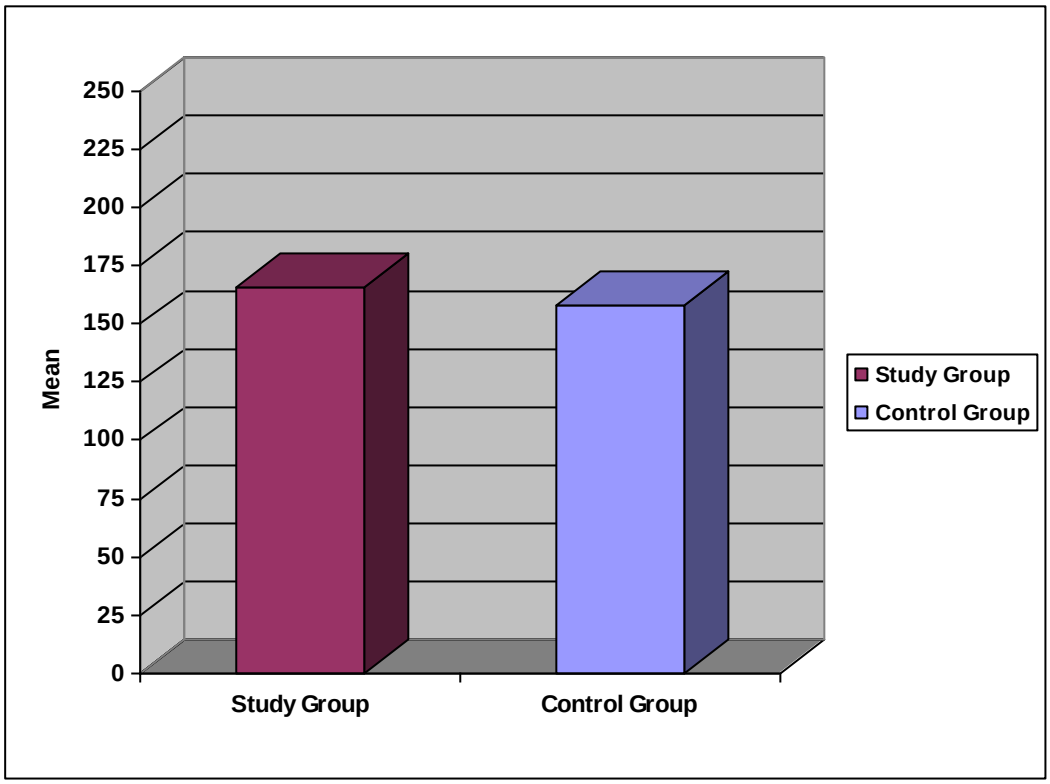


TABLE NO.20

MEAN ABSOLUTE FINGER RIDGE COUNT (AFRC) IN FEMALES

Study Groups Mean (SD)	Controls Mean (SD)	Z – Test	P-Value	Inference
169.84 (43.57)	164.58 **(**24.31)	10.31	0.0001	P< 0.001 Highly Significant

Table no.20 shows that the Mean Absolute Finger Ridge Count (AFRC) in Male patients was higher 169.84 with S.D. of 43.57 as compared to male control group which had AFRC 164.58 with S.D. of 24.31. This difference was statistically significant (Z- test= 10.31 and P <0.001).

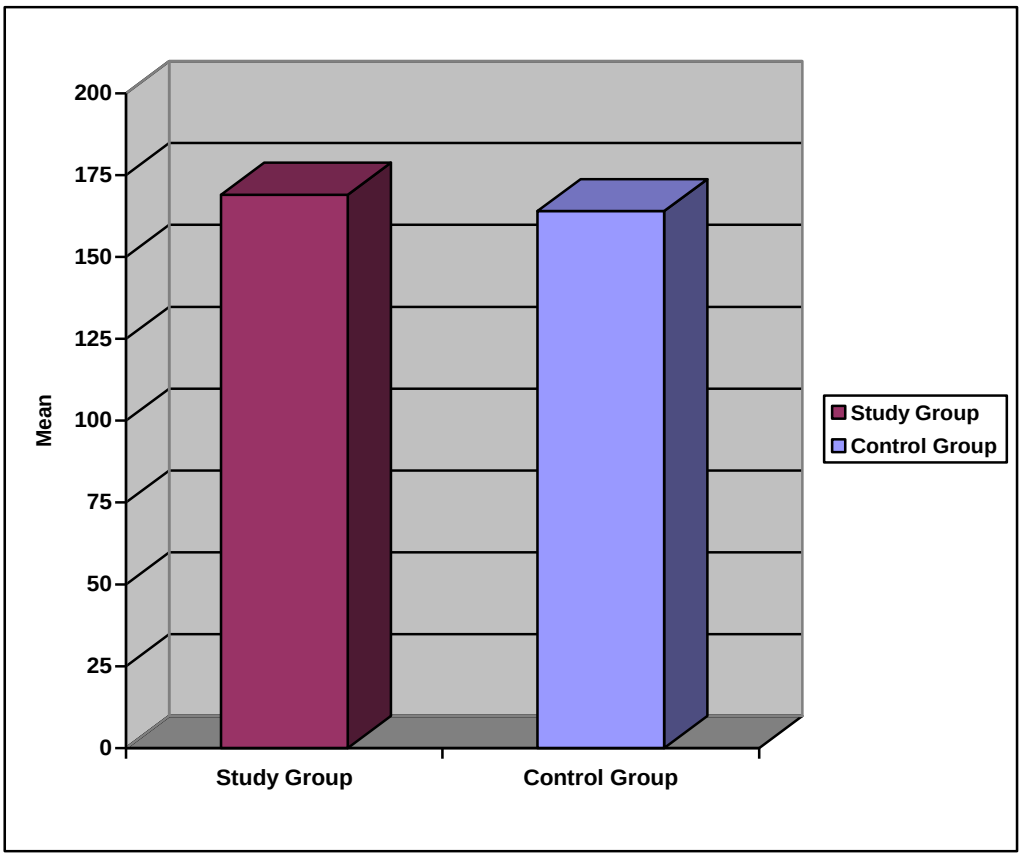


TABLE NO.21

MEAN ABSOLUTE FINGER RIDGE COUNT (AFRC) IN STUDY GROUP

Study Groups Mean (SD)	Controls Mean (SD)	Z – test	Inference
168.15 (46.98)	161.37 (24.10)	18.80	P< 0.001 Highly Significant

Table no.21 shows that the Mean Absolute Finger Ridge Count (AFRC) in study group was higher 168.15 with S.D. of 46.98 as compared to control group which had AFRC 161.37 with S.D .of 24.31. This difference was highly statistically significant (Z- test= 18.80 and P < 0.001).

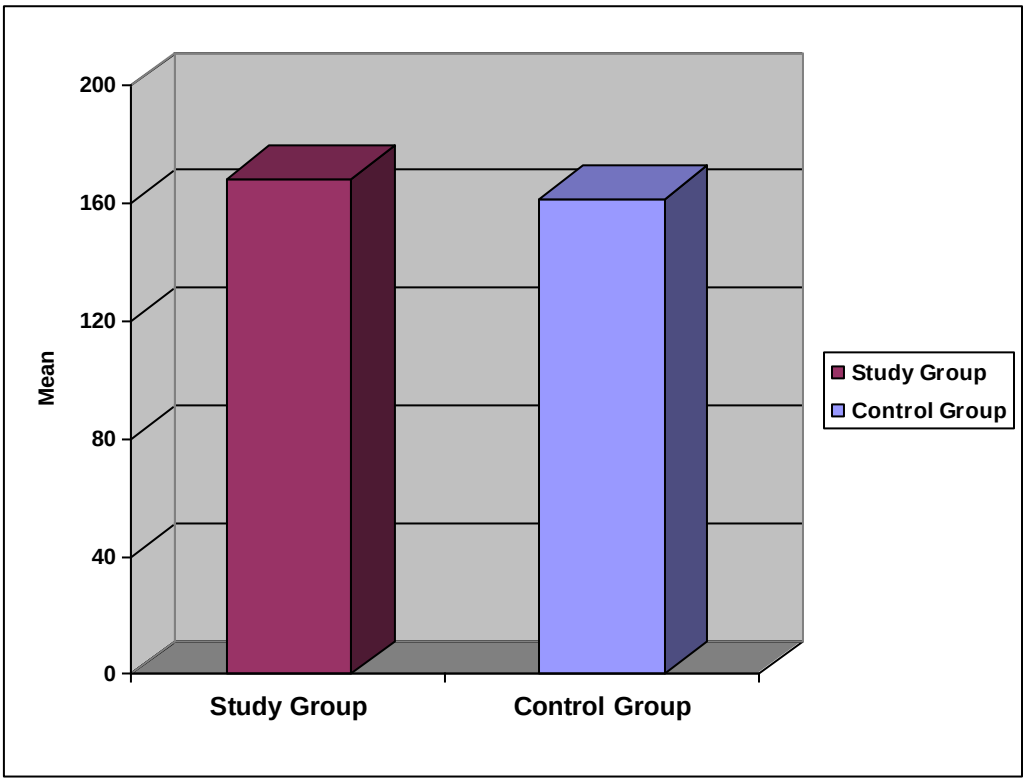


TABLE NO.22

MEAN 'atd' ANGLE IN MALES

Hands	Study Groups Mean (SD)	Controls Mean (SD)	Z – test	Inference
Right	40.58 **(**5.66)	42.68 **(**6.51)	4.11	P< 0.001 Highly Significant
Left	41.08 **(**5.23)	43.84 (6.76)	5.39	

Table no.22 shows that the Mean 'atd' angle in right hand of male patients (40.58^0) was lesser than that of controls (42.68^0). Similarly it was less in left hand of patients (41.08^0) than that of controls (43.84^0).This difference was statistically significant (P<0.001). This indicates that the triradius was displaced proximally in patients than in controls.

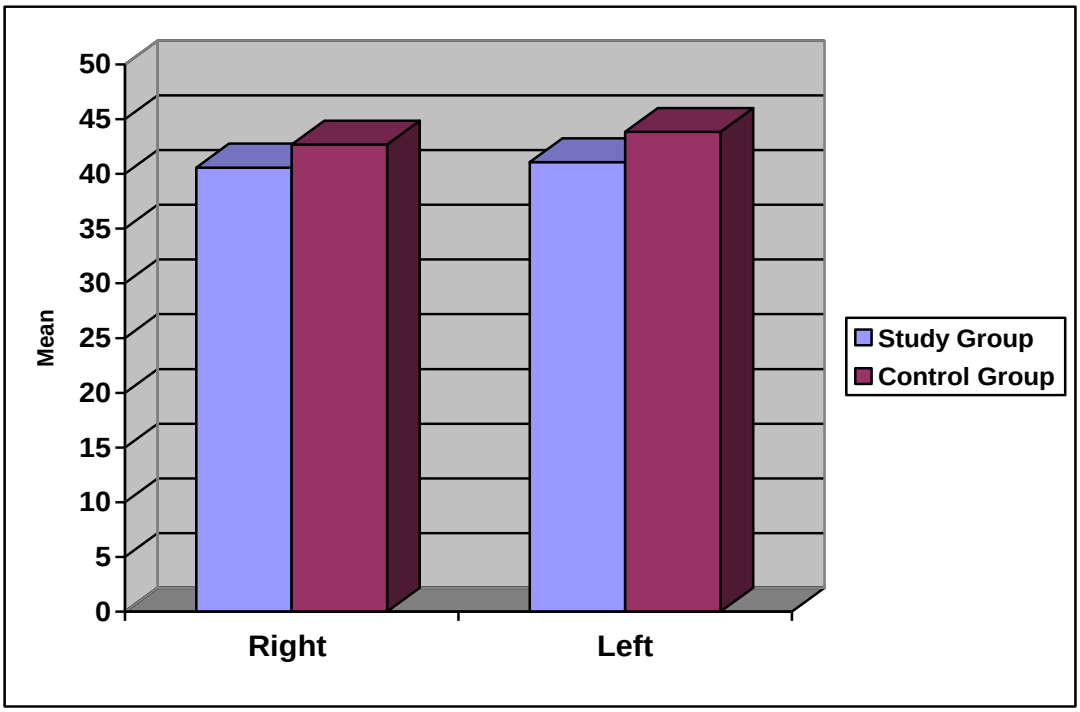


TABLE NO.23

MEAN 'ATD' ANGLE IN FEMALES

Hands	Study Groups Mean (SD)	Controls Mean (SD)	Z – test	Inference
Right	39.58 (5.11)	43.20 (6.55)	7.09	P< 0.001 (Highly Significant)
Left	42.14 **(**8.60)	44.36 (7.08)	4.35	

Table no.23 shows that the Mean 'atd' angle in right hand of female patients (39.58^0) was lesser than that of controls ($43.20^{0)}$. Similarly it was less in left hand of patients (42.14^0) than that of controls (44.36^0). This difference was statistically significant (P<0.001). This indicates that the triradius was displaced distally in patients than in controls.

DISCUSSION

Tuberculosis is not a hereditary disease however many studies have indicated that susceptibility plays an important role in the causation of disease.[10] Susceptibility to pulmonary tuberculosis in India has been linked to Mannose binding protein gene[11].Also significant association has been found between IL-1 gene clusters and host susceptibility to tuberculosis.[12]

Several observations suggest that genetic factors play a key role in innate non-immune resistance to infection with Mycobacterium tuberculosis. In mice a gene called Nramp1 has a regulatory role in resistance/susceptibility to Mycobacterium tuberculosis. The human homologue NRAMP1, cloned to chromosome 2q, may have a role in determining susceptibility to tuberculosis as is suggested by a study among West Africans.[13] Heredity plays an important role in the formation of dermatoglyphics patterns.

Considering the high mortality and morbidity due to tuberculosis in our country and studies showed that tuberculosis and genetics are linked, this study is done in order to observe the difference in dermatoglyphic pattern between sputum positive pulmonary tuberculosis patients and normal subjects between 20-60 years age group and to determine the usefulness of dermatoglyphics in studying the genetic susceptibility to pulmonary tuberculosis. Thus the study can be used to predict the susceptibility to pulmonary tuberculosis. The relevance of dermatoglyphics is not to diagnose, but to prevent by predicting a disease; not for defining an existing disease, but to identify people with genetic predisposition to develop certain diseases.[14]

In present study, we tried to determine significant palmar dermatoglyphic parameters in case of sputum positive pulmonary tuberculosis in age group between

20-60 years and whether the parameters can be used for screening purpose i.e. early detection of sputum positive pulmonary tuberculosis.

The study consists of 100 cases (50 males and 50 females) of sputum positive pulmonary tuberculosis and 100 controls (50 males and 50 females) in age group between 20-60 years.

The parameters observed among the study group and controls were

I) Qualitative Analysis:

Arches: Frequency of arches found in right hand of male study group is 4.4% and in left hand is 3.6% while in right and left hand of controls is 4% and 2.4% respectively. In female study group, the frequency of arches in right hand and left hand are 2.8% and 3.6% respectively while in control group, the frequency of arches in right hand and left hand are 3.6 % and 4.8 % respectively. Furthermore the right hand and left hand of the male study group showed more number of arches than controls while in females control group showed more number of arches in both hand.

Krishnan M et al studied dermatoglyphics of tuberculosis patients and found arches as the least common pattern i. e. in 3 % of the patients while in controls it was 8.2%.[57]

Babu SS et al studied dermatoglyphics of tuberculosis patients and found that arches were very much reduced in the study group (3.3%) while in controls found to be 11.3%.But these differences were not statistically significant.[58]

Radial loops: Frequency of Radial loops found in right hand of male study group is 5.6% and in left hand is 3.2% while in right hand and left hand of controls is 4.8 % and 4.8 % respectively. In female study group, the frequency of Radial loops in right hand and left hand are 5.6% and 4% respectively while in control group, the frequency of Radial loops in right hand and left hand are 4.4% and 2.8 % respectively.

Furthermore the right hand and left hand of the female study group showed more number of Radial loops than controls while in males control group showed more number of Radial loops in right hand but control group had more number of Radial loops in left hand of males than study group.

Krishnan M et al found loops as second common pattern i.e. in 36.4 % of the patients while in controls it was 59.4%.[57]

Babu SS et al found that loops were reduced in the study group (32.1%) while in controls found to be 73.3 %. The differences were highly significant (P<0.01). [58]

Ulnar loops: Frequency of Ulnar loops found in right hand of male study group is 39.6% and in left hand is 36% while in right hand and left hand of controls is 33.2 % and 38 % respectively. In female study group, the frequency of Ulnar loops in right hand and left hand are 44.8% and 42.4% respectively while in control group, the frequency of Ulnar loops in right hand and left hand are 48.4 % and 49.6 % respectively. Furthermore the right hand and left hand of the female controls showed more number of Ulnar loops than study group while in males, control group showed more number of Ulnar loops in left hand and right hand had less number of ulnar loops in study group.

Krishnan M et al found loops as second common pattern i.e. in 36.4 % of the patients while in controls it was 59.4%.[57]

Babu SS et al found that loops were reduced in the study group (32.1%) while in controls found to be 73.3 %. The differences were highly significant (P<0.01) [58].

Whorls: Frequency of Whorls found in right hand of male study group is 50.4% and in left hand is 57.2 % while in right hand and left hand of controls is 58 % and 54.8 % respectively. In female study group, the frequency of Whorls in right hand and left hand are 46.8% and 50 % respectively while in control group, the frequency of

Whorls in right hand and left hand are 43.6 % and 42.8 % respectively. Furthermore the right hand and left hand of the female study group showed more number of Whorls than controls while in males, control group showed more number of Whorls in right hand and less number of Whorls in left hand as compared to study group.

Krishnan M et al found whorls as most common pattern i.e. in 60.6 % of the patients while in controls it was 32.4%. From this it is clear that the number of whorls in TB patients is almost double as compared to controls. Whorl pattern is the closely related to tuberculosis. Thus the most common pattern in tuberculosis patients is whorls in the right ring finger.[57]

Babu SS et al found that whorls were predominant (56.6%) in the study group when compared to controls (23.8%) which found to be highly significant ($P< 0.01$). Thus whorls are the most common pattern in pulmonary tuberculosis.[58]

Frequency of fingertip patterns in right and left hand separately:

In right hand of male study group, there is increase in arches, radial loops, and ulnar loops while there is decrease in whorls as compared to controls. This difference is not statistically significant.

In left hand of male study group, there is increase in arches and whorls while there is decrease in ulnar loops and radial loops as compared to controls. This difference is also not statistically significant.

In right hand of female study group, there is increase in radial loops and whorls while there is decrease in ulnar loops and arches as compared to controls. This difference is not statistically significant.

In left hand of female study group, there is increase in radial loops and whorls while there is decrease in ulnar loops and arches as compared to controls. This difference is also not statistically significant.

Frequency of fingertip patterns in both hands combined :

In male study group, there is increase in ulnar loops and arches while there is decrease in radial loops and whorls as compared to controls. This difference is not statistically significant.

In male study group, there is increase in radial loops and whorls while there is decrease in ulnar loops and arches as compared to controls. This difference is not statistically significant.

In study group (both male and female), radial loops and whorls were more and ulnar loops and arches as compared to controls. This difference is not statistically significant.

Sydney Line: Only 1 (1%) Sydney line was present in both male and female study group. There was no Sydney line in controls. This presence of Sydney line is not statistically significant.

Simian Line: The Simian line was seen in 2 (4%) of male patients on left side only and controls did not show it on left side. Also patient group as well as control group did not show it on right side. This difference was not statistically significant.

II) Quantitative Analysis:

Mean The Total Finger Ridge Count (TFRC): The Mean the Total Finger Ridge Count (TFRC) in Male patients was higher 129.9 with S.D. of 36.25 as compared to male control group which had TFRC 126.4 with S.D. of 30.06. This difference was statistically highly significant ($P < 0.001$). The Mean the Total Finger Ridge Count (TFRC) in female patients was higher 132.96 with S.D. of 49.93 as compared to female control group which had TFRC 128.52 with S.D. of 22.41. This difference was statistically highly significant ($P<0.001$). The Mean Total Finger Ridge Count

(TFRC) in study group (both male and female patients) was higher i.e. 131.43 with S.D. of 43.44 as compared to control group which had TFRC of 127.46 with S.D. of 26.40. This difference was highly statistically significant (P<0.001).

According to study by Babu SS et al, TFRC in the controls was 99.8 ± 6.18 and in patients it was 112 ± 7.36. The mean TFRC was higher in study group and this difference was statistically highly significant (P<0.02). [58]

Mean Absolute Finger Ridge Count (AFRC): The Mean Absolute Finger Ridge Count (AFRC) in Male patients was higher 166.54 with S.D. of 50.55 as compared to male control group which had AFRC 158.16 with S.D. of 23.70. This difference was statistically significant (P<0.001). The Mean Absolute Finger Ridge Count (AFRC) in female patients was higher 169.84 with S.D. of 43.57 as compared to female control group which had AFRC 164.58 with S.D. of 24.31. This difference was statistically significant (P<0.001**).** The Mean Absolute Finger Ridge Count (AFRC) in study group (both male and female patients) was higher 168.15 with S.D .of 46.98 as compared to control group which had AFRC 161.37 with S.D .of 24.10. This difference was highly statistically significant (P<0.001).

According to study by Babu SS et al, AFRC in the controls was 122 ± 18.9 and in patients it was 180 ± 50.6. The mean TFRC was higher in study group and this difference was statistically highly significant (P<0.05).[58]

Mean 'atd' Angle: The Mean 'atd' angle in right hand of male patients (40.58^0) was lesser than that of controls (42.68^0). Similarly it was less in left hand of patients (41.08^0) than that of controls (43.84^0).This difference was statistically significant (P<0.001). This indicates that the triradius was placed proximally in patients than in controls. The Mean 'atd' angle in right hand of female patients (39.58^0) was lesser

than that of controls (43.20^0). Similarly it was less in left hand of patients (42.14^0) than that of controls (44.36^0). This difference was statistically significant ($P<0.001$). This indicates that the triradius was placed proximally in patients than in controls.

According to study by Babu SS et al, 'atd' angle in the controls was 43.6 ± 5.56 and in patients it was 38 ± 3.77. The mean 'atd' angle was lower in study group and this difference was statistically highly significant ($P<0.02$).[58]

CONCLUSIONS

In ancient India, palmistry, an art of fortune telling by reading the pattern of friction ridges and palmar lines dates from about 2000 B.C.[5]

Dermatoglyphics has been studied extensively in chromosomal disorders, single gene disorders and those disorders whose genetic basis is not clear. Dermatoglyphic studies have proved quite useful at least in three fields medico-legal, anthropological and clinical.

Dermatoglyphics is a growing discipline and its easy and ready applicability renders it as a useful tool to the clinician. The relevance of dermatoglyphics is not to diagnose, but to prevent by predicting a disease; not for defining an existing disease, but to identify people with genetic predisposition to develop certain diseases.[14]

Heredity plays an important role in the formation of dermatoglyphics patterns. The inheritance of dermatoglyphic traits was initially studied by Galton in 1892, Wilder in 1902, Penrose in 1954 and Holt in 1968.[9]

Tuberculosis is not a hereditary disease however twin studies indicate that susceptibility is an important risk factor[10]. Susceptibility to pulmonary tuberculosis in India has been related to Mannose binding protein gene and IL-1 gene clusters. [11, 12]

In present study, we tried to determine significant palmar dermatoglyphic parameters in case of sputum positive pulmonary tuberculosis in age group between 20-60 years and whether these parameters can be used for screening purpose i.e. to identify people with genetic predisposition to develop to pulmonary tuberculosis.

The study consists of 100 cases (50 males and 50 females) of sputum positive Pul. TB and 100 controls (50 males and 50 females) in age group between 20-60 years.

The analysis revealed the following findings:

Significant findings in qualitative and quantitative analysis of both sexes of sputum positive pulmonary tuberculosis in age group between 20-60 years were:

1. The mean ‘atd’ angle was lower in study group (both male and females). This means the tri-radius was more proximal in patients as compared to controls.
2. The Mean Absolute Finger Ridge Count (AFRC) in study group (both male and females) was higher as compared to control group.
3. The Mean Total Finger Ridge Count (TFRC) in study group (both male and females) was higher as compared to control group.

No Significant difference was noted in following parameters:

1. Whorls were the predominant pattern in study group as compared to controls.
2. No Significant difference was noted in Sydney line
3. No Significant difference was noted in Simian line

The present study indicates that there are some genetic factors which are involved in the causation of pulmonary tuberculosis and it is possible to certain extent to predict from dermatoglyphics individual’s chance of acquiring pulmonary tuberculosis. Like clinical history, examination and investigations, the dermatoglyphics will play an important role revealing the genetic susceptibility to pulmonary tuberculosis. It will also be contributory in the assessment of contacts of pulmonary tuberculosis; So that they are diagnosed and treated early.

At present there are very few studies on palmar dermatoglyphics in pulmonary tuberculosis. The findings of previous studies are many ways similar to our present

study. But still the number of studies is limited. Since this is an interesting subject, more number of studies are expected. This was a small study consisting of 100 patients (50 male and 50 females). Hence its findings can't be generalized. So further large case controls are needed to establish the exact relation between pulmonary tuberculosis and dermatoglyphics and utility of dermatoglyphics in prediction of susceptibility to tuberculosis.

SUMMARY

In present study, we tried to determine significant palmar dermatoglyphic parameters in case of sputum positive pulmonary tuberculosis in age group between 20-60 years and whether these parameters can be used for screening purpose i.e. to identify people with genetic predisposition to develop to pulmonary tuberculosis.

The study consists of 100 cases (50 males and 50 females) of sputum positive Pul. TB and 100 controls (50 males and 50 females) in age group between 20-60 years.

The following significant parameters have been found in the present study of palmar dermatoglyphics in patients with sputum positive tuberculosis in the age group between 20-60 years:

In both males and females:

1. Lower mean ‘atd’ angle in study group.
2. Higher Mean Absolute Finger Ridge Count (AFRC).
3. Higher Mean Total Finger Ridge Count (TFRC)

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PROFORMA

FOR QUALITATIVE AND QUANTITIVE ANALYSIS OF PALM AND FINGER PRINTS

NAME: **ADDRESS:**
AGE and SEX:
OCCUPATION:
OPD NO: **SPUTUM FOR AFB** **1st :**
2nd :
3rd :

II FINGER PRINT PATTERN :

		R1	R2	R3	R4	R5	L1	L2	L3	L4	L5
1	Arch										
2	RadialLoop										
3	Ulnar Loop										
4	Whorl										
	TOTAL	Right Hand					Left Hand				

PALM PRINT PATTERN:

		Right Hand	Left Hand
5	'atd' angle		
6	Simian line		
7	Sydney line		

FINGER RIDGE COUNT OF BOTH HANDS:

		Number	Total Ridge
1	Arch		
2	Radial Loop		
3	Ulnar Loop		
4	Whorl		
5	TFRC AFRC		

Signature of Subject **Signature of P.G.** **Signature of Guide**

ANNUXURES

PROFORMA

Associated Diseases;-

Indicate if the following disease(s) are present with Yes (Y)/ No (N)/; Indicate if family history is present and specify the relationship.

1. Deaf mutism Y/N
2. Coeliac disease Y/N
3. Ulcerative colitis Y/N
4. Crohn's disease Y/N
5. Autism Y/N
6. Kleinfelter's syndrome Y/N
7. Turner's syndrome Y/N
8. Primary sterility Y/N
9. Stein leventhal's syndrome Y/N
10. Down's Syndrome Y/N
11. Leprosy Y/N
12. Epilepsy Y/N
13. Asthma Y/N
14. Blindness/ Color blindness Y/N
15. Retinitis pigmentosa Y/N
16. Psoriasis Y/N
17. Maniac depressive psychosis Y/N
18. Schizophrenia Y/N
19. Rheumatic heart disease Y/N
20. Systemic lupus erythmatosus Y/N

21. Vitiligo Y/N

22. Huntington's chorea Y/N

23. Hashimoto's disease Y/N

24. Cooley's anemia Y/N

25. Ca breast Y/N

26. Ca cervix Y/N

27. Ca stomach Y/N

28. Parkinson's disease Y/N

29. Albinism Y/N

If there is any other congenital abnormality

Specify……

History of Koch in the family

……

History of consanguinity in the parents- Y/N

If yes, what degree?

Family pedigree chart.

TABLE SHOWING DERMATOGLYPHIC PARAMETERS IN MALE PATIENTS (n = 25)

Sr. No.	Name	Age	Ridge Pattern										TFRC	AFRC	'atd'Angle		Sm.line		Sy.line	
			R1	R2	R3	R4	R5	L1	L2	L3	L 4	L5			Rt. hand	Lt. hand	Rt. hand	Lt. hand	Rt. hand	Lt. hand
1	BS	25	L_u	W	W	W	L_u	L_u	W	W	L_u	W	67	142	34	35	N	N	N	N
2	LD	45	L_u	W	W	W	A	L_u	W	W	L_u	W	108	138	35	40	N	N	N	N
3	SS	58	L_u	W	L_u	W	W	W	A	W	L_u	W	181	200	34	46	N	N	N	N
4	BSP	42	L_u	L_u	L_u	L_r	W	W	W	W	L_u	L_u	113	113	44	34	N	N	N	N
5	MSP	50	L_u	L_u	L_u	W	L_u	W	W	L_u	L_u	W	115	142	38	42	N	N	N	N
6	SB	26	W	A	L_u	W	W	L_r	W	W	W	W	163	238	30	45	N	N	N	N
7	SMM	25	W	W	L_u	A	L_u	L_u	W	W	L_u	L_u	52	154	43	34	N	N	N	N
8	VBT	40	L_r	W	L_u	L_u	W	W	W	W	L_u	L_u	128	153	39	40	N	N	N	Y
9	SVB	45	W	W	W	L_u	W	L_u	L_u	W	L_u	L_r	111	140	33	40	N	N	N	N
10	SSB	22	W	W	A	L_u	L_u	W	W	L_u	L_u	W	141	141	30	45	N	N	N	N
11	MM	59	A	L_r	W	L_u	L_u	W	L_u	W	L_u	L_u	149	357	40	35	N	N	N	N
12	SP	35	W	W	L_u	L_u	L_u	W	W	W	L_u	W	120	170	38	42	N	N	N	N
13	AS	21	W	W	W	L_u	L_r	W	W	A	L_u	W	116	180	32	35	N	N	N	N
14	S	45	L_r	A	L_u	W	W	W	L_u	W	L_u	L_u	164	164	43	50	N	Y	N	N
15	SL	35	L_u	W	W	L_u	L_u	W	W	L_u	W	W	194	214	33	45	N	N	N	N
16	TR	28	L_r	W	W	L_r	W	W	L_u	W	W	W	191	199	40	44	N	N	N	N
17	RA	20	L_u	L_r	A	W	L_u	W	W	W	L_u	W	128	165	35	45	N	N	N	N
18	MK	50	L_u	W	W	L_u	W	W	L_u	W	L_u	L_u	211	231	50	45	N	N	N	N
19	H	55	L_u	L_u	L_u	A	L_u	W	W	L_u	L_r	W	141	173	33	48	N	N	N	N
20	BG	41	L_u	L_u	W	W	W	L_u	L_u	W	L_u	W	147	189	42	44	N	Y	N	Y
21	VR	55	L_r	L_u	L_u	L_u	L_u	W	A	W	W	W	152	198	44	35	N	N	N	N
22	BS	30	W	L_u	W	L_u	W	L_r	W	L_u	L_u	L_u	149	157	63	40	N	N	N	N
23	S	25	W	L_u	W	L_u	W	W	L_u	A	W	W	120	153	45	33	N	N	N	N
24	RB	35	W	L_u	L_u	L_u	W	A	A	W	L_u	W	98	141	44	44	N	N	N	N
25	C	46	W	L_u	W	L_u	L_u	W	W	L_u	W	L_u	132	197	40	45	N	N	N	N

Sr. No.	Name	Age	Ridge Pattern										TFRC	AFRC	'atd' Angle		Sm.line		Sy.line	
			R1	R2	R3	R4	R5	L1	L2	L3	L4	L5			Rt. hand	Lt. hand	Rt. hand	Lt. hand	Rt. hand	Lt. hand
26	S	48	L_u	L_u	W	W	W	L_u	W	W	L_u	L_u	97	97	30	44	N	N	N	N
27	S	59	L_u	L_u	W	W	W	L_u	W	W	L_u	W	129	159	35	40	N	N	N	N
28	RB	22	W	L_u	W	L_u	W	W	L_u	W	L_u	W	139	180	45	30	N	N	N	N
29	P	45	W	A	W	L_u	L_u	L_u	W	L_u	L_u	W	163	213	30	35	N	N	N	N
30	Y	29	W	W	W	L_u	W	L_u	W	W	W	L_u	72	72	44	40	N	N	N	N
31	M	52	L_u	L_r	L_r	W	L_u	W	W	L_u	L_u	W	144	189	37	45	N	N	N	N
32	V	44	W	W	W	L_u	W	L_u	W	W	W	W	144	189	35	34	N	N	N	N
33	HB	39	W	W	W	L_u	A	L_u	L_u	W	W	W	175	210	40	35	N	Y	N	N
34	SY	53	L_u	W	L_u	W	W	W	A	L_u	W	L_u	170	220	39	49	N	N	N	N
35	PK	59	W	W	W	L_u	W	L_u	L_u	W	L_u	W	21	21	43	45	N	Y	N	N
36	S	50	L_u	W	W	L_u	W	L_r	W	W	W	A	140	196	45	35	N	N	N	N
37	C	25	W	W	W	L_u	L_u	W	L_u	L_r	L_u	W	80	84	40	44	N	N	N	N
38	B	59	L_u	A	W	L_u	W	L_u	W	L_u	L_u	W	127	178	48	45	N	N	N	N
39	GM	35	W	L_u	W	L_r	L_u	W	W	W	W	L_u	101	101	42	50	N	N	N	N
40	MK	58	L_u	L_u	L_u	W	W	W	W	W	L_u	W	134	181	40	44	N	N	N	N
41	H	45	W	L_r	W	L_u	W	L_u	L_r	W	L_u	W	136	143	45	40	N	N	N	N
42	D	48	W	L_u	W	L_u	W	W	L_u	L_u	L_u	W	130	179	50	44	N	N	N	N
43	GR	22	W	L_u	W	W	L_u	L_u	W	W	W	L_u	125	164	40	33	N	N	N	N
44	BS	26	L_u	W	L_r	W	W	W	L_u	W	L_u	W	110	165	45	40	N	N	N	N
45	S	38	L_u	W	W	L_u	L_u	L_u	W	L_u	L_u	W	69	79	45	37	N	Y	N	Y
46	RB	54	L_u	W	L_u	W	W	W	L_u	W	W	L_u	141	181	44	47	N	N	N	N
47	C	41	L_u	W	W	L_u	W	L_u	L_r	W	L_u	W	115	152	53	38	N	N	N	N
48	S	40	L_u	L_u	W	W	L_u	W	L_u	L_u	L_u	W	152	185	45	35	N	N	N	N
49	S	42	W	L_u	L_u	W	W	W	L_u	W	L_u	L_u	154	154	40	49	N	N	N	N
50	RB	30	W	L_u	W	L_u	W	W	L_u	L_u	W	A	136	186	47	45	N	N	N	N

TABLE SHOWING DERMATOGLYPHIC PARAMETERS IN FEMALE PATIENTS (n = 25)

Sr. No.	Name	Age	Ridge Pattern										TFRC	AFRC	'atd' Angle		Sm.line		Sy.line	
			R1	R2	R3	R4	R5	L1	L2	L3	L4	L5			Rt. hand	Lt. hand	Rt. hand	Lt. hand	Rt. hand	Lt. hand
1	.NK	56	L_u	W	L_u	L_u	W	L_u	W	L_u	L_r	W	69	134	35	44	N	N	N	N
2	UHA	22	L_u	A	W	L_u	L_u	W	L_u	W	L_u	W	117	125	40	38	N	N	N	N
3	SB	36	L_u	W	L_u	L_u	A	L_u	W	L_u	W	L_u	156	184	36	40	N	N	N	N
4	SSB	22	L_u	W	W	W	L_u	L_u	A	L_u	W	L_u	179	189	38	30	N	N	N	N
5	KV	35	W	W	L_r	W	L_u	L_u	W	A	L_u	W	84	112	40	45	N	N	N	N
6	LN	59	A	W	L_u	W	L_u	L_u	W	W	L_u	W	99	132	32	54	N	N	N	N
7	R	25	W	W	W	L_u	L_u	L_r	W	L_u	W	L_u	69	121	35	38	N	N	N	N
8	SL	35	L_u	L_r	L_u	L_u	W	W	L_u	L_u	W	L_u	117	149	45	40	N	N	N	N
9	B	55	W	L_u	W	L_u	W	W	W	L_u	W	L_u	156	184	44	34	N	N	N	N
10	M	26	L_r	L_u	L_u	W	L_u	L_u	L_r	L_u	W	L_u	112	149	42	50	N	N	N	N
11	G	30	W	L_u	W	W	L_u	L_u	W	W	L_u	A	104	136	30	34	N	N	N	N
12	KV	35	L_u	L_u	L_u	W	W	L_u	W	W	L_u	W	105	141	43	40	N	N	N	N
13	LB	59	L_u	L_u	W	L_r	L_u	L_u	W	W	L_u	W	112	165	41	55	N	N	N	N
14	B	35	L_u	L_u	L_u	L_u	W	W	L_u	W	L_u	W	104	141	43	49	N	N	N	N
15	RM	39	L_u	W	L_u	L_u	W	W	L_u	A	L_u	W	140	186	35	44	N	N	N	N
16	MH	41	L_u	W	L_u	W	L_r	W	W	W	L_u	W	197	214	40	55	N	N	N	N
17	AK	49	L_u	W	L_u	L_r	W	L_u	A	L_u	W	L_u	179	204	39	50	N	N	N	N
18	LN	43	W	L_u	W	L_u	L_u	L_u	W	L_u	W	L_u	161	198	49	45	N	N	N	N
19	SJ	38	W	L_u	W	L_u	W	L_u	L_u	L_u	W	W	123	139	44	35	N	N	N	N
20	RM	26	W	L_u	W	W	L_r	L_u	W	L_u	W	A	85	110	40	54	N	N	Y	Y
21	RS	27	L_u	L_u	W	L_u	W	L_u	W	L_u	W	W	202	264	45	50	N	N	N	N
22	AH	35	L_u	L_r	L_u	L_u	W	L_u	A	L_u	W	W	141	188	38	36	N	N	N	N
23	AH	25	W	W	L_u	L_u	L_u	L_u	W	L_u	W	W	137	189	40	40	N	N	N	N
24	L	45	L_u	W	L_u	L_u	L_u	W	L_u	W	L_u	W	172	190	40	54	N	N	N	N
25	S	36	W	W	W	L_u	L_u	W	L_u	W	L_u	W	95	147	44	44	N	N	N	N

Sr. No.	Name	Age	Ridge Pattern										TFRC	AFRC	'atd'Angle		Sm.line		Sy.line	
			R1	R2	R3	R4	R5	L1	L2	L3	L4	L5			Rt. hand	Lt. hand	Rt. hand	Lt. hand	Rt. hand	Lt. hand
26	RMK	25	W	W	L_u	L_u	L_u	L_u	L_u	W	W	W	40	110	30	30	N	N	N	N
27	KR	27	W	W	L_u	L_u	L_r	L_u	W	W	W	W	249	249	44	34	N	N	N	N
28	SB	37	W	L_u	L_u	W	W	L_u	W	L_u	L_r	L_u	271	285	34	45	N	N	N	N
29	RS	39	L_u	L_u	L_u	W	W	L_u	W	L_u	W	W	192	234	40	45	N	N	N	N
30	ZH	21	L_u	L_u	W	W	L_r	W	L_u	L_u	W	W	84	124	43	34	N	N	N	N
31	GV	51	L_u	A	W	L_u	W	W	A	L_u	W	W	219	229	40	50	N	N	N	N
32	BGK	59	L_u	W	L_u	W	W	L_u	W	W	L_u	L_u	117	148	44	45	N	N	N	N
33	BH	31	W	W	L_u	W	W	W	L_u	W	L_u	W	106	130	48	34	N	N	N	N
34	KR	53	W	L_r	L_u	W	W	L_u	W	W	L_u	W	154	199	34	30	N	N	N	N
35	E	46	W	W	W	W	L_u	L_u	W	L_r	W	W	106	150	42	40	N	N	N	N
36	KM	44	L_r	W	W	L_u	W	L_u	W	W	L_u	W	106	151	30	35	N	N	N	N
37	VR	57	W	W	L_r	L_u	W	W	L_u	W	L_u	W	159	178	35	40	N	N	N	N
38	SKU	33	W	L_u	W	L_u	L_u	L_u	W	W	L_u	W	119	119	38	55	N	N	N	N
39	M	29	L_u	W	L_u	W	L_u	W	L_r	A	W	L_u	145	189	48	40	N	N	N	N
40	BBK	58	L_u	W	W	W	L_u	L_u	W	L_u	W	L_u	149	199	40	43	N	N	N	N
41	SV	22	L_u	L_u	L_u	W	W	W	L_u	L_u	W	L_u	123	151	44	34	N	N	N	N
42	JC	21	L_u	W	L_r	L_u	W	W	L_u	L_u	W	L_u	78	128	34	35	N	N	N	N
43	LB	35	W	W	W	L_u	A	W	L_r	W	L_u	W	152	180	33	35	N	N	N	N
44	B	41	W	L_u	L_u	L_u	W	W	L_u	W	L_u	W	154	179	40	50	N	N	N	N
45	G	47	W	A	W	W	L_u	W	L_u	L_u	W	W	205	269	40	34	N	N	Y	Y
46	RD	37	W	W	W	L_u	L_u	W	W	L_u	L_r	W	127	160	30	38	N	N	N	N
47	S	31	W	L_u	W	L_u	W	W	L_r	L_u	W	W	11	98	50	45	N	N	N	N
48	KS	26	W	L_u	W	L_u	W	W	L_u	W	L_u	L_u	158	198	45	43	N	N	N	N
49	RB	29	W	L_u	W	L_u	W	W	L_u	W	L_u	L_u	130	186	35	40	N	N	N	N
50	GC	40	W	L_u	W	L_u	A	W	L_u	L_r	W	L_u	79	158	40	55	N	N	N	N

TABLE SHOWING DERMATOGLYPHIC PARAMETERS IN MALE CONTROLS (n = 25)

Sr. No.	Name	Age	Ridge Pattern										TFRC	AFRC	'atd' Angle		Sm.line		Sy.line	
			R1	R2	R3	R4	R5	L1	L2	L3	L4	L5			Rt. hand	Lt. hand	Rt. hand	Lt. hand	Rt. hand	Lt. hand
1	GSC	21	L_u	L_r	W	W	L_u	w	w	L_u	L_u	A	153	188	34	40	N	N	N	N
2	SC	22	L_u	W	A	L_u	L_u	L_r	W	w	L_u	L_u	131	147	35	33	N	N	N	N
3	RH	55	L_u	W	W	L_u	L_u	W	L_r	W	L_u	L_u	126	145	45	43	N	N	N	N
4	UC	47	L_r	W	W	L_u	L_u	W	W	L_u	L_u	L_u	142	173	38	33	N	N	N	N
5	P	25	W	W	L_R	L_u	W	W	W	L_u	A	L_u	152	176	44	40	N	N	N	N
6	SD	36	W	L_u	W	W	W	L_u	W	W	W	L_u	126	165	40	48	N	N	N	N
7	R	38	A	L_u	W	W	W	L_u	W	W	w	L_u	133	156	45	40	N	N	N	N
8	IC	49	W	L_u	W	L_u	W	W	L_u	W	L_r	W	173	199	50	40	N	Y	N	N
9	AH	52	W	W	W	L_u	L_r	W	L_u	W	w	W	141	158	50	44	N	N	N	N
10	SH	24	W	W	A	L_u	L_u	W	L_u	W	w	L_u	116	159	45	30	N	N	N	N
11	CB	26	W	A	L_u	W	W	L_u	L_u	W	w	L_u	134	166	50	50	N	N	N	N
12	BB	25	W	L_r	L_u	W	W	L_u	L_u	W	w	W	151	171	40	44	N	N	N	N
13	NC	28	W	W	L_u	W	L_u	W	W	L_r	L_u	W	126	152	45	35	N	N	N	N
14	SC	29	W	W	L_u	W	W	L_u	W	W	L_u	W	143	167	50	54	N	N	N	N
15	VC	36	L_r	W	A	L_u	L_u	W	W	L_u	L_u	W	96	126	33	53	N	N	N	N
16	DC	38	W	A	L_u	L_u	W	W	W	L_u	L_u	W	125	153	40	40	N	N	N	N
17	SB	34	W	W	L_u	W	L_u	W	W	L_u	L_u	W	126	151	35	44	N	N	N	N
18	NS	47	W	L_u	A	L_u	W	W	W	L_u	w	L_u	70	115	30	35	N	N	N	N
19	SH	48	W	L_u	w	L_u	L_r	W	W	W	w	L_u	124	179	44	48	N	N	N	N
20	AM	54	L_u	W	L_u	L_u	W	W	W	L_u	w	L_u	128	166	43	54	N	Y	Y	Y
21	AS	25	L_u	W	L_u	W	W	L_u	W	W	L_r	w	96	123	46	40	N	N	N	N
22	VS	21	L_u	W	L_u	W	W	L_u	W	W	w	A	131	151	40	44	N	N	N	N
23	SG	26	L_u	W	L_u	W	W	L_u	W	W	L_r	L_u	91	136	38	45	N	N	N	N
24	DD	25	W	W	L_r	L_u	W	W	L_u	W	w	L_u	96	134	40	50	N	Y	N	N
25	DS	23	W	W	w	L_u	W	W	L_u	W	A	L_u	143	188	34	40	N	N	N	N

Sr. No.	Name	Age	Ridge Pattern										TFRC	AFRC	'atd' Angle		Sm.line		Sy.line	
			R1	R2	R3	R4	R5	L1	L2	L3	L4	L5			Rt. hand	Lt. hand	Rt. hand	Lt. hand	Rt. hand	Lt. hand
26	RN	21	W	W	L_u	L_u	w	A	W	L_u	L_u	W	132	158	30	42	N	N	N	N
27	NR	25	L_u	W	L_u	L_r	W	W	W	L_u	L_u	W	144	188	38	45	N	N	N	N
28	KF	56	W	W	L_u	W	L_u	W	L_r	W	L_u	W	126	166	44	48	N	N	N	N
29	MS	27	W	W	L_u	W	W	L_u	W	W	L_u	L_u	19	88	45	50	N	N	N	N
30	AS	28	W	A	L_u	L_u	W	W	W	L_u	L_u	W	144	177	40	45	N	N	N	N
31	SP	39	L_u	W	W	A	L_u	L_u	W	W	W	L_u	147	178	45	40	N	N	N	N
32	FK	49	W	L_u	W	W	L_u	L_r	W	W	L_u	W	157	181	49	50	N	N	N	N
33	DD	58	W	L_u	W	W	W	W	L_u	W	W	L_r	112	147	39	35	N	Y	N	N
34	JJ	45	L_u	W	W	L_u	W	W	L_u	W	W	L_u	76	121	45	44	N	N	N	N
35	BK	43	L_u	W	W	W	L_u	W	L_r	L_u	L_u	W	140	179	50	45	N	N	N	N
36	SG	41	L_u	W	W	L_u	W	L_u	W	L_u	W	L_u	139	159	60	65	N	N	N	N
37	MD	45	W	L_r	W	W	L_u	W	W	L_u	W	L_u	132	158	58	60	N	N	N	N
38	ST	42	W	L_u	W	L_u	A	W	L_u	W	L_u	W	153	176	45	51	N	N	N	N
39	YS	41	W	L_u	W	L_u	W	W	L_u	W	L_u	W	146	165	40	35	N	N	N	N
40	HS	34	W	L_u	W	W	W	L_u	W	W	L_u	W	19	86	50	40	N	N	N	N
41	JB	37	W	L_u	w	L_u	W	W	L_u	W	W	L_u	143	168	44	48	N	N	N	N
42	SK	41	W	W	L_u	W	W	W	L_u	W	W	L_u	138	154	40	36	N	N	N	N
43	SG	42	W	W	L_u	W	L_u	W	W	L_u	L_u	L_u	121	158	40	45	N	N	N	N
44	JR	21	W	W	L_u	W	W	W	W	L_u	W	L_u	156	176	39	40	N	N	N	N
45	RT	35	W	W	L_r	W	L_u	W	W	L_u	W	L_u	134	158	30	43	N	Y	Y	Y
46	DV	36	W	W	L_u	W	W	L_u	W	W	L_u	W	114	145	44	42	N	N	N	N
47	MH	45	W	W	L_u	W	L_u	W	W	L_u	L_u	L_r	149	198	45	45	N	N	N	N
48	RP	44	W	W	L_u	L_r	W	W	W	L_u	L_u	L_u	131	156	40	45	N	N	N	N
49	AF	41	W	W	L_u	W	W	L_u	W	W	W	L_u	131	154	50	42	N	N	N	N
50	KG	40	W	W	L_u	W	W	L_u	L_r	W	W	A	144	170	50	44	N	N	N	N

TABLE SHOWING DERMATOGLYPHIC PARAMETERS IN FEMALE CONTROLS (n = 25)

Sr. No.	Name	Age	Ridge Pattern										TFRC	AFRC	'atd' Angle		Sm.line		Sy.line	
			R1	R2	R3	R4	R5	L1	L2	L3	L4	L5			Rt. hand	Lt. hand	Rt. hand	Lt. hand	Rt. hand	Lt. hand
1	PC	24	L_u	W	W	W	L_u	W	L_u	W	A	L_u	125	159	44	40	N	N	N	N
2	AR	25	L_u	W	W	L_r	W	A	L_u	W	L_u	L_u	114	154	34	45	N	N	N	N
3	SA	26	L_u	W	W	L_u	L_u	L_u	L_u	W	L_u	L_u	96	138	33	34	N	N	N	N
4	SS	35	L_u	W	W	L_u	W	L_u	L_u	W	L_u	L_u	133	159	45	40	N	N	N	N
5	GH	36	A	W	W	L_u	W	L_u	L_u	W	L_u	L_u	141	174	45	45	N	N	N	N
6	AB	41	W	L_u	W	W	L_u	W	W	L_u	W	L_r	143	143	40	40	N	N	N	N
7	KK	40	W	L_u	L_r	W	L_u	W	W	L_u	W	L_u	137	169	42	54	N	N	N	N
8	PZ	45	W	L_u	L_u	L_u	W	W	W	L_r	W	L_u	91	134	40	46	N	N	N	N
9	SS	47	W	A	L_u	W	W	L_u	L_r	W	W	L_u	139	187	45	45	N	N	N	N
10	RR	47	W	W	L_u	W	L_u	W	W	L_u	W	L_u	85	95	53	33	N	N	N	N
11	RT	44	L_r	W	L_u	W	L_u	W	A	L_u	W	L_u	129	165	47	38	N	N	N	N
12	PP	41	W	L_u	L_u	W	L_u	L_u	L_u	W	L_u	W	141	159	44	40	N	N	N	N
13	GR	40	W	L_r	L_u	W	W	L_u	L_u	W	L_u	W	142	182	45	50	N	N	N	N
14	TH	42	W	L_u	A	L_u	L_u	W	L_u	W	L_u	W	144	164	45	40	N	N	N	N
15	MK	25	A	L_u	W	L_u	W	L_u	L_u	W	L_u	W	126	176	44	50	N	N	N	N
16	TS	21	L_u	L_r	W	L_u	W	L_u	L_u	W	A	L_u	131	166	40	50	N	N	N	N
17	AP	23	L_u	W	L_u	W	L_u	W	W	L_u	W	L_u	138	148	50	45	N	N	N	N
18	FK	20	L_u	L_u	L_u	L_u	W	L_u	L_u	W	L_u	W	140	145	45	55	N	N	N	N
19	SR	20	L_u	L_u	L_u	W	L_u	W	W	L_u	W	L_u	104	168	50	45	N	N	N	N
20	TG	22	W	L_u	L_u	L_r	W	L_u	W	L_u	W	L_u	135	176	36	42	N	N	Y	Y
21	SD	21	L_u	W	L_u	L_u	W	L_u	W	L_r	W	L_u	120	156	40	48	N	N	N	N
22	BD	22	L_u	W	L_u	L_u	L_r	L_u	W	L_u	L_u	W	91	133	50	55	N	N	N	N
23	BC	23	L_u	W	L_u	W	L_u	W	W	L_r	L_u	A	154	165	34	55	N	N	N	N
24	BH	29	L_u	W	L_u	L_r	L_u	L_u	W	L_u	L_u	W	142	187	44	40	N	N	N	N
25	KH	28	W	L_u	L_u	W	L_u	L_u	A	L_u	L_u	W	110	156	45	45	N	N	N	N

Sr. No.	Name	Age	Ridge Pattern										TFRC	AFRC	'atd'Angle		Sm.line		Sy.line	
			R1	R2	R3	R4	R5	L1	L2	L3	L4	L5			Rt. hand	Lt. hand	Rt. Hand	Lt. hand	Rt. hand	Lt. hand
26	GT	34	W	W	W	L_u	W	W	L_u	W	W	L_u	171	211	50	30	N	N	N	N
27	AG	44	W	A	L_u	W	L_u	W	L_u	W	W	L_u	117	181	40	45	N	N	N	N
28	GG	45	W	L_u	L_u	L_u	L_u	W	L_u	W	W	L_u	159	188	40	34	N	N	N	N
29	NK	46	W	L_u	W	L_u	L_u	W	L_u	W	A	L_u	141	165	40	40	N	N	N	N
30	FS	41	W	L_u	W	W	L_u	W	L_u	W	W	L_u	152	198	45	43	N	N	N	N
31	GD	40	W	W	W	L_u	W	L_u	W	L_u	W	L_u	93	115	45	50	N	N	N	N
32	AS	44	W	L_r	W	L_u	W	L_u	W	L_u	W	L_u	129	166	45	65	N	N	N	N
33	SD	44	W	W	L_u	W	A	L_u	L_u	W	L_u	W	123	179	45	54	N	N	N	N
34	VD	25	L_u	W	L_u	L_u	W	L_u	W	A	L_u	W	150	189	40	40	N	N	N	N
35	GC	25	L_u	W	L_u	W	L_u	W	L_u	W	L_u	W	144	145	65	50	N	N	N	N
36	CC	26	L_u	W	L_u	W	L_r	W	W	L_u	W	L_u	84	151	60	44	N	N	N	N
37	SC	24	L_u	W	L_u	W	A	L_u	L_u	W	L_u	W	112	125	34	40	N	N	N	N
38	NC	21	W	W	L_u	L_u	W	L_u	W	L_u	W	L_u	102	155	50	45	N	N	N	N
39	SC	20	L_u	W	L_u	W	L_u	W	W	L_u	W	L_u	114	178	50	46	N	N	N	N
40	PP	23	W	L_u	L_r	W	L_u	W	L_u	A	L_u	W	142	194	40	58	N	N	N	N
41	UP	28	W	L_u	W	L_u	W	L_u	W	L_u	L_u	W	86	125	35	34	N	N	N	N
42	VC	58	W	L_u	W	L_u	W	L_u	L_r	W	A	L_u	114	136	40	44	N	N	N	N
43	VP	58	W	L_u	W	L_u	W	L_u	W	L_u	L_u	W	158	165	44	51	N	N	N	N
44	SG	59	L_u	W	L_u	W	L_u	L_r	W	L_u	W	L_u	162	162	30	45	N	N	N	N
45	RG	46	L_u	W	L_u	L_u	A	L_u	W	L_u	W	L_u	147	201	44	34	N	N	Y	Y
46	UG	51	L_u	W	L_u	L_u	L_u	W	L_u	W	L_u	W	159	211	34	35	N	N	N	N
47	SS	52	W	W	L_u	L_u	L_u	W	L_u	W	L_u	W	158	198	44	40	N	N	N	N
48	BB	53	W	L_u	L_u	W	L_u	L_u	L_u	A	L_u	W	114	178	45	43	N	N	N	N
49	SD	55	L_u	W	L_u	W	L_u	L_u	L_u	L_u	W	A	120	187	35	43	N	N	N	N
50	LS	54	L_u	A	L_u	W	L_u	W	L_u	L_u	L_u	W	124	168	40	45	N	N	N	N