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Study of Palmar Dermatoglyphics in Cataract Associated with Diabetes Mellitus in Central India Region

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Abstract:

Objective: *to study finger and palmar dermatoglyphic patterns in diabetic cataract patients, to find out whether a specific dermatoglyphic trait exists & its significance, To compare dermatoglyphic configuration of diabetic cataract patients with normal population in central India region.* ***Material & methods:*** *The sample constituted 200 (100 men and 100 women) patients suffering from cataract associated with diabetes mellitus, all above 40 years of age group obtained from Ophthalmology wards, of a government medical college, in central India. The age matched control group of 200 (100 men and 100 women) were obtained from general population which were normal healthy individuals with no other obvious genetic disorders, all above 40 years of age group. Dermatoglyphic prints were taken by 'INK METHOD' described by Cummins (1936)[4] and Cummins and Midlo (1961) & were subjected for detail dermatoglyphic analysis with the help of magnifying hand lens. The prints obtained by ink method were studied in right and left hand separately. For statistical analysis of qualitative data 2 x 2 chi-square test and for quantitative data student's t-test were applied.* ***Observation & results:*** *Increase in total finger ridge count (TFRC) and absolute finger ridge count (AFRC) in cataract patients of both the sexes. Increase in frequency of loops in female cataracts, also male cataracts shows slight increase in loops. The increase in right hand is more prominent than that of left hand in both the sexes. Whorls pattern is decreased in right hand of female diabetics. The arch pattern found significantly higher in diabetic cataract males while it is lower in diabetic cataract females.* ***Conclusion:*** *Significant variations are observed in the various dermatoglyphic parameters among normal population and persons having cataract associated with diabetes mellitus. On the basis of results obtained, the study can be used for early detection of the predisposed persons from the normal population so that they can be subjected to preventive measures, to avoid the future burden of the disease on the community.*

Keywords: ***Dermatoglyphics, Cataract, Diabetes, Loop, Whorl***

1. Introduction

Dermatoglyphics is one of the branches of medical science where the dermal ridge patterns are studied and used in prediction of genetic disorders. Whenever there is abnormality in the genetic makeup of parents, it is inherited in children and is reflected in dermatoglyphic pattern. Hence, the study of dermatoglyphics proves to be very useful in predicting the hereditary diseases in patients. Abnormal dermatoglyphic patterns are known to occur with chromosomal abnormalities like Mongolism, Turner's syndrome, Klinefelter's syndrome, etc. (Harold Cummins, 1936; Penrose, 1963; Holf J Lindsten, 1964).[1],[2],[3]

Characteristic dermatoglyphic associations are also seen in many diseases with genetic predisposition e.g. cancers, mental retardation, schizophrenia as well as in cataract and diabetes.

In cataract as well as diabetes there are qualitative i.e. fingertip pattern, position of axial triradius etc. and quantitative like changes in total and absolute finger ridge counts in dermatoglyphic pattern are observed.

With the advancement in the field of dermatoglyphics it will be possible, to a large extent to predict whether an individual is suffering or will suffer in future from a particular disease.

Taking into consideration the genetic predisposition of cataract and diabetes, as there have been hardly any studies on the dermatoglyphic pattern in diabetic cataract patients in central India region. It was decided to study the dermatoglyphic patterns in diabetic cataract patients. The study was undertaken to find out correlation between them, so that it may prove helpful in early prediction and prevention of disease.

2. Objective

The present study was carried out with the following aims and objectives:-

- To study finger and palmar dermatoglyphic patterns in diabetic cataract patients.
- To find out whether a specific dermatoglyphic trait exists in cataract associated with diabetes mellitus and if exists whether it is significant.
- To compare dermatoglyphic configuration of diabetic cataract patients with normal population in central India region.
- To apply results of the study in early diagnosis of the disease.

3.1 Material & methods

The present work was carried out in Department of Anatomy during the period from March 2010 to November 2011.

The sample constituted 200 (100 men and 100 women) patients suffering from cataract associated with diabetes mellitus, all above 40 years of age group. The patients were obtained from Ophthalmology wards, of a government medical college, in central India. The age matched control group of 200 (100 men and 100 women) were obtained from general population which were normal healthy individuals with no other obvious genetic disorders, all above 40 years of age group.

Material used

1) Kores quick drying duplicating ink
2) A Rubber roller
3) An inking slab – Thick glass sheet fixed over wooden support
4) Century board
5) White 'Map Litho' paper
6) Pressure pad made up of rubber foam
7) Cotton puffs
8) Scale
9) Pencil
10) Protractor – to measure 'atd' angle
11) Magnifying lens
12) Needle with a sharp point, for ridge counting
13) Soap for washing hands
14) Napkin to dry the hands

Figure 1: Photograph showing material used for the study of palmar dermatoglyphics

3.1 METHODS OF DERMATOGLYPHIC PRINTING

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.

Various methods used as of today are

1) Ink Method
2) Chemical Method
3) Adhesive type Method
4) Photographic Method
5) Special Methods
   - Hygrophotography
   - Radiodermatography
   - Plastic Moulds

In the present study dermatoglyphic prints were taken by 'INK METHOD' described by **Cummins (1936)**[4] and **Cummins and Midlo (1961).**[5] This method was selected from the various methods described in literature because of following advantages:

1) It possesses simple technique
2) It has low cost
3) It gives clarity of prints
4) It is less time consuming

The prints were taken on one side of paper separately for each hand.

STEPS IN THE PRINTING METHOD:-

1) The subjects were asked to clean their hands with soap and water and to dry them but leave some moisture.
2) The requisite amount of ink was placed on the glass slab. It was uniformly spread by the rubber roller to get a thin even ink film on the glass slab.
3) The thin film of ink was applied on the palm by passing the inked rubber roller uniformly over the palm and digits taking care that the hollow of the

palm and the flexor creases of the wrist were uniformly inked.

4) The palm was examined for the uniformity of the ink. The un–inked area or hollows of palm were inked with the help of cotton puffs.
5) Right hand of subject was then placed on the sheet of paper (kept over the pressure pad) from proximal to distal end. The palm was gently pressed between inter–metacarpal grooves at the root of fingers and on the dorsal side corresponding to thenar and hypothenar regions. The palm was then lifted from the paper in the reverse order from distal to proximal end. The fingers were rolled from the paper in reverse order from distal to proximal end. The fingers were rolled from radial to ulnar side to include all the patterns.
6) The same procedure was repeated for left hand. Separate paper was used for left hand.
7) The printed sheets were coded with the name, age, and whether it was of cataract or of control group.

The prints were subjected for detail dermatoglyphic analysis with the help of magnifying hand lens. The ridge counting was done with the help of sharp needle and the details were noted on the same paper with the pencil.

3.2 MORPHOLOGY:-

DERMATOGLYPHIC CONFIGURATIONS: RIDGE DETAIL (MINUTIAE) (FIG.1):-

Minutiae are the characteristics of individual ridges (Galton, 1892).[6] Intricate details of structure of epidermal ridges are termed as minutiae. They occur universally and are useful for personal identification.

Penrose (1968)[7] proposed a classification based on the six common types of minutiae described by **Cummins and Midlo (1961)**[5] and added comb as seventh type.

Penrose's Classification:

i. ***Island or point:*** - It is very short ridge lying independent of other ridges, circular in shape and bears only one sweat pore.
ii. ***Short Ridges:*** - It contains two to five sweat gland pores.
iii. ***Fork:*** - It is the bifurcation of a ridge or a Y – formation.
iv. ***Enclosures:*** - It is formed by two forks being in opposition.
v. ***End:*** - ¬ It is an abrupt termination of the ridge.
vi. ***Interstitial line:*** - It is narrow subsidiary ridge in the furrows between individual ridges. It is inconstant and does not have sweat pores. It is omitted in ridge counting.

Comb: - Is a ridge formation in which three or more parallel ridges join another ridge almost at right angles to their direction of flow.

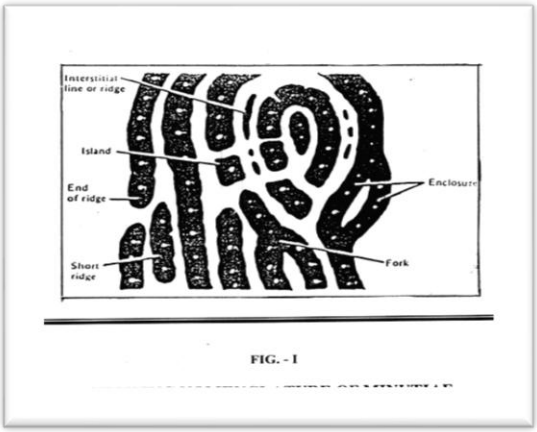


FIG. - I

➢ **PATTERN CONFIGURATIONS:-**

A. FINGERS

- Fingertip Pattern Configurations.
- Dermatoglyphic Landmarks.

B. PALM

Palmar Pattern Configuration:-

Thenar and first interdigital area (The. / I)
Second, third and fourth interdigital areas (II, III, IV)
Hypothenar Area (Hyp.)

- Palmar Landmarks
  Axial triradii
  Digital triradii

➢ **FINGERTIP PATTERN CONFIGURATIONS**

Galton (1892)[8] divided fingertip patterns into three groups,

I Arches
II Loops
III Whorls

According to **Henry (1900)**[6] there are four main types of fingertip patterns – arches, loops, whorls and composites. Thus **Henry (1900)** added fourth group 'composite' to determine more complex patterns.

I. ARCH: - An arch is the simplest pattern. It consists of more or less parallel ridges. The ridges curve the pattern area. The curve is proximally concave.

i. **Simple or Plain Arch:** - (fig.2) Ridges cross the fingertips from one side to the other without recurving. It is not a true pattern.
ii. **Tented Arch:** - (fig.3) The ridges meet at a point so that their smooth sweep is interrupted. The triradius is located near the midline axis of distal phalanx. The distal radiant of triradius usually points vertically towards the apex of fingertip. The

ridges passing over this radiant are abruptly elevated and form a tent like pattern.

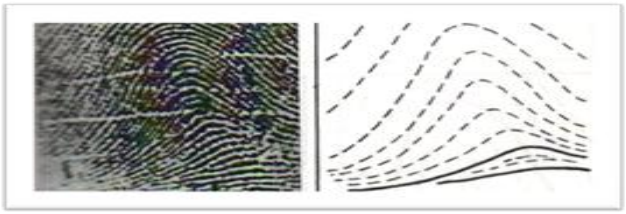
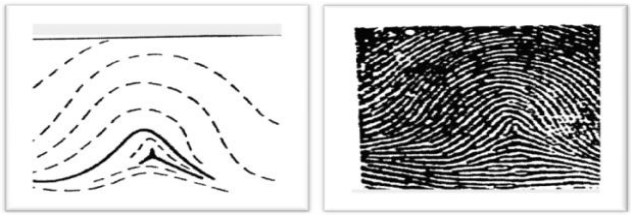


Fig.2 Simple or Plain Arch



II. LOOP: - (fig.4)

Loop is the most frequent pattern on fingertip. In this configuration, a series of ridges enter the pattern area on one side of digit, recurves abruptly and leaves the pattern area on the same side. It has one triradius.

i. Ulnar Loop: - The ridges open on the ulnar side.
ii. Radial Loop: - The ridges open on the radial side.

Triradius is usually located laterally on the fingertip and always on the side where the loop is closed.

Fig.4 Loop Ulnar/Radial

III. WHORL: - (fig.5)

According to **Galton's classification (1892)**,[6] whorl is any ridge configuration with two or more triradii. According to **Henry's classification (1900)**,[8] whorl is a ridge configuration in which ridges encircle core and more complex patterns are formed called as 'composites'.

i. **TRUE WHORLS:** - True whorls typically posses two triradii, and are patterns so constructed that characteristic ridge courses follow circuits around core.
   a. ***Concentric Whorl:*** - The ridges are commonly arranged as a succession of concentric ridges or ellipses (around the core).
   b. ***Spiral Whorl:*** - The ridges spiral around the core in either clockwise or counter clockwise direction.
   c. ***Mixed Whorl:*** - It contains circles and ellipses or circles and spirals in the same pattern.

ii. **COMPOSITES:** - Composites are compound patterns in which two or more designs, each conforming to general aspect of one of the similar types are combined in one pattern area.
   a. ***Central pocket loop:*** - It is pattern containing a loop within which a smaller whorl is located. It is sub-classified as ulnar or radial according to the side on which outer loop opens.
   b. ***Double loop:*** - These are comprised of two interlocking loops. The lines traced from two cores of each loop emerge out on the same or opposite side (radial and/or ulnar). They are of two types - Lateral pocket and Twin loop.

   Lateral pocket and Twin loop:-
   These types are morphologically similar and have two triradii. In lateral pocket whorl both ridges emanating from each core emerge on the same side of pattern. In twin loop the ridges emanating from each core open towards the opposite margin of the finger.

   c. ***Accidentals:*** - Complex patterns which cannot be classified as one of the above patterns are called accidentals. They represent a combination of two or more configurations.

A person may have the same pattern on all ten fingers, but various patterns often occur on different digits.

Fig.5a Concentric Whorl **Fig. 5b spiral Whorl**

Fig 5c Composit Whorl **Fig.5d Double Loop**

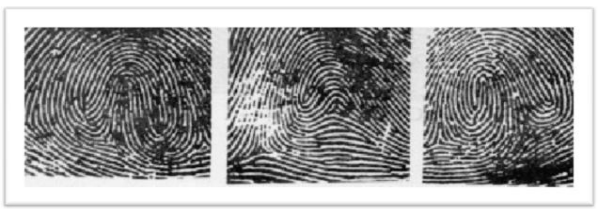


Fig. 5e Accidentals Whorls

RIDGE COUNTING: - (fig.)

Ridge counting is used to indicate the pattern size and the ridge density in a given area. It denotes the distance between triradius to the core.

I) Finger Ridge Counting:-

It is done along a straight line connecting the triradial point to the point of core. In ridge counting triradial point and point of core are excluded. In whorls with two triradii and one point of core, two different counts are made. The two counts are specified as first radial and second ulnar corresponding to the side of triradius to which it belongs.

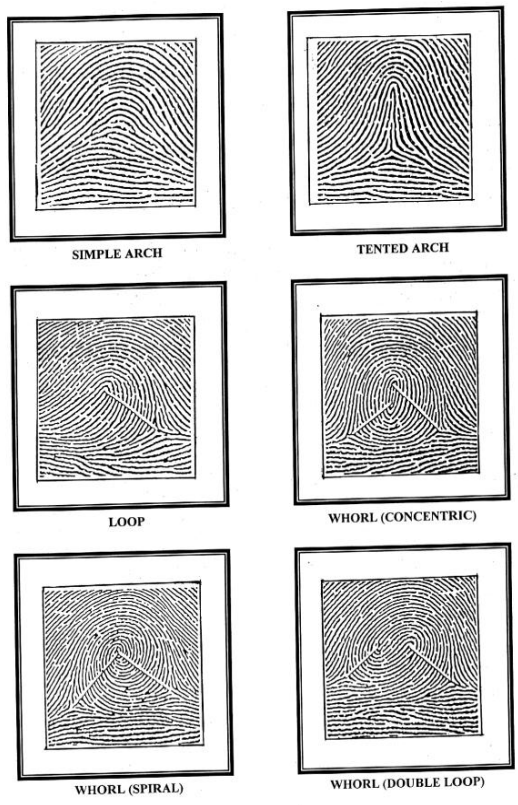
Usually the ridge counts are recorded in order, beginning with little finger of the left hand and counting to the thumb, while digits of right hand started with thumb and continued up to little finger. As the ridge counts are used to express the size, only the largest count is scored in a pattern with more than one possible count. Simple and tented arches have '0' count.

I. Total Finger Ridge Count (TFRC):-

TFRC represent the sum of ridge counts of all the ten digits, only the larger count is used on digits with more than one ridge count. It expresses the size of pattern.

Il. Absolute Finger Ridge Count (AFRC):-

AFRC represent the sum of ridge counts from all the separate triradii on the fingers. It reflects the pattern size as well as pattern intensity, which depends on the pattern type.



STATISTICAL ANALYSIS

The prints obtained by ink method were studied in right and left hand separately. For statistical analysis of qualitative data 2 x 2 chi-square test and for quantitative data student's t-test were applied.

4. Observations & results

In the present study the dermatoglyphic prints of 200 diabetic cataract cases (100 men and 100 women and 200 normal persons (100 men and 100 women) were taken. The prints obtained by the ink method were studied in right and left hand separately. They are subjected to non parametric statistical tests to evaluate the significant patterns of identifiable differences between the cases and controls.

The prints were analyzed under following headings -

1. Quantitative analysis of fingerprints.
   -Total Finger Ridge Count (TFRC)
   -Absolute Finger Ridge Count (AFRC)
2. Qualitative analysis of fingerprints. i.e. fingertip patterns.
   -Loops
   -Whorls
   -Arches

List of Symbols Used in Tables

M	-	Male
F	-	Female
M+F	-	Male + Female
NM	-	Normal male
NF	-	Normal female
CM	-	Cataract male
CF	-	Cataract female
R	-	Right
L	-	Left
R + L	-	Right + Left
%	-	Percentage
The. /I	-	Palmar thenar and first interdigital area
II	-	Palmar second interdigital area
III	-	Palmar third interdigital area
IV	-	Palmar fourth interdigital area
Hyp.	-	Palmar hypothenar area
X2	-	Chi-square
df	-	Degree of freedom
S.D.	-	Standard deviation
S.E.	-	Standard error of Mean
CV	-	Coefficient of variation
S	-	Significant
NS	-	Non significant
Lu	-	loop ulnar
Lr	-	loop radial
Ws	-	whorl spiral
Wc	-	whorl concentric
Wd	-	whorl composite
Ap	-	arch plain
At	-	arch tented
MLF	-	main line formula
MLI	-	main line index
NOT	-	number of triradii
POT	-	position of triradii

Quantitative analysis of fingerprints

The ridge counts, which are size related numerical representatives of pattern types, are being considered to be of greatest significance in genetic terms (Holt, 1960). The total and absolute finger ridge counts effectively summarize the quantitative characteristics of all digits of either hand.

TOTAL FINGER RIDGE COUNTS (TFRC):-

TFRC represents the sum of ridge counts of all the ten digits, only the larger count is used on digits more than one ridge count.

ABSOLUTE FINGER RIDGE COUNTS (AFRC):-

AFRC represents the sum of ridge counts from all the separate triradii on all the ten digits.

Table 1: Frequency Percentage Distribution of Total Finger Ridge Count (TFRC) Among Cataract and Control Group

Sex	Mean		S.D.		SEM		Range		Comparision	P value	Remark
	Cases	Control	Cases	Control	Cases	Control	Cases	Control			
M	168.5	153.6	43.83	46.45	4.383	4.645	50-259	32-235	CM X NM	0.024	S
F	171.5	143.1	43.14	48.24	4.314	4.824	72-299	23-253	CF X NF	0.0001	S
M+F	170	148.3	43.4	47.53	3.069	3.361	50-299	23-253	C(M+F) X N(M+F)	0.0001	S

Table 1 shows frequency percentage distribution of total finger ridge count among diabetic cataract and control group. Mean TFRC in cataract men is 168.5, in cataract women is 171.5.The mean TFRC in control group in men 153.6 and in women 143.1. The bisexual TFRC in cataract group is 170 that of control group are 148.3.

Table 2: Test significance for Total Finger Ridge Count (TFRC)

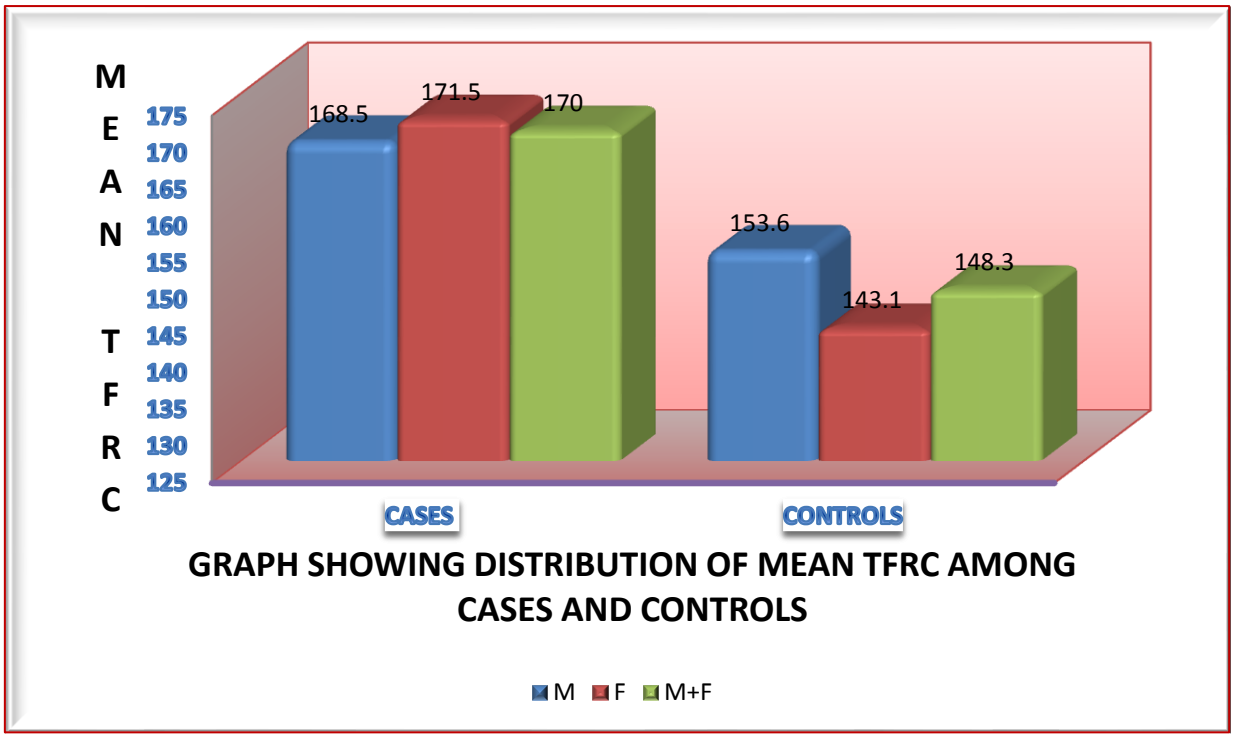


Table 2 shows statistical calculation for total finger ridge count. It shows p values of comparison groups with their statistical significance for total finger ridge count.

Table 3: Frequency Percentage Distribution of Absolute Finger Ridge Count (AFRC) Among Cataract and Control Group

Sex	Mean		S.D.		SEM		Range		p value	Remark
	Cat.	Cont.	Cat.	Cont.	Cat.	Cont.	Cat.	Cont.		
M	200.3	181.1	64.93	58.17	6.493	5.817	50-381	38-297	0.0295	S
F	206.4	173.7	58.12	62.09	5.812	6.209	78-359	23-288	0.0002	S
M+F	203.3	177.4	61.54	60.13	4.352	4.252	50-381	23-297	0.0001	S

Table 3 shows frequency percentage distribution of absolute finger ridge count among diabetic cataract and control group. Mean AFRC in cataract men is 200.3, in cataract women is 206.4. The mean AFRC in control group in men 181.1 and in women 173.7.The bisexual TFRC in cataract group is 203.3 that of control group are 177.4.

Table 4: Test significance for Total Finger Ridge Count (AFRC)

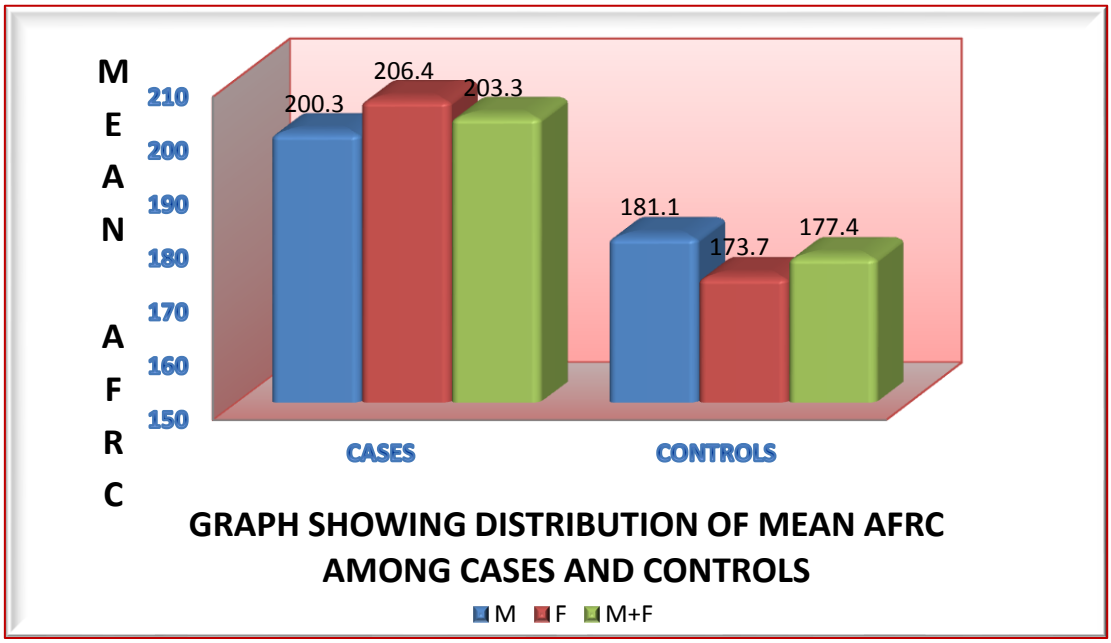


Table 4 shows statistical calculation for absolute finger ridge count. It shows p value of comparison groups with their statistical significance for absolute finger ridge count.

Table 5: Frequency Percentage Distribution Of Loop Pattern On Fingertips Among Cataract And Control Group (Henry's Classification)

LOOPS											
Sex	Side	Ulnar		Radial							
		Lu		Lr		Total					
		Cases	Cont-rols	Cases	Cont-rols	Cases	Cont-rols	Comparison	x2 value	p value	Remark
Male	Right	298	305	13	12	311	317	NMRXCMR	0.1541	0.6946	NS
	Left	307	296	10	7	317	303	NMLXCML	0.8319	0.3617	NS
	Right + Left	605	601	23	19	628	620	NM(R+L)XCM(R+L)	0.1364	0.7119	NS
Female	Right	317	246	13	4	330	250	NFRXCFR	26.27	< 0.0001	S
	Left	278	261	14	5	292	266	NFLXCFL	2.741	0.0978	NS
	Right + Left	595	507	27	9	622	516	NF(R+L)XCF(R+L)	22.91	< 0.0001	S
Male + Female	Right	615	551	24	16	641	567	N(M+F)RXC(M+F)R	11.45	0.0007	S
	Left	585	557	24	12	609	569	N(M+F)LXC(M+F)L	3.305	0.0691	NS
	Right + Left	1200	1108	48		1250	1136	N(M+F)(R+L)XC (M+F)(R+L)	13.5	0.0002	S

			Loop					
Group	Sex	Side	Ulnar		Radial			
			Lu	%	Lr	%	Total	%
Cases	Male	Right	298	59.60	13	2.60	311	62.20
		Left	307	61.40	10	2.00	317	63.40
		Right + Left	605	60.50	23	2.30	628	62.8
	Female	Right	317	63.40	13	2.60	330	66.00
		Left	278	55.60	14	2.80	292	58.40
		Right + Left	595	59.50	27	2.70	622	62.2
	Male + Female	Right	615	61.50	24	2.40	641	64.1
		Left	585	58.50	24	2.40	609	60.9
		Right + Left	1200	60.00	48	2.40	1250	62.5
Control	Male	Right	305	61.00	12	2.40	317	63.4
		Left	296	59.20	7	1.40	303	60.6
		Right + Left	601	60.10	19	1.90	620	62
	Female	Right	246	49.20	4	0.80	250	50

		Left	261	52.20	5	1.00	266	53.2
		Right + Left	507	50.70	9	0.90	516	51.6
		Right	551	55.10	16	1.60	567	56.7
	Male + Female	Left	557	55.70	12	1.20	569	56.9
		Right + Left	1108	55.40	28	1.40	1136	56.8

Table no.5 shows frequency percentage distribution of loop pattern on fingertips among cataract and control group (Henry's Classification). The table shows 62.8% loops in cataract males while 62% loops in control males. The percentage of loops in female cataracts is 62.2% while in control females it is 51.6%. The loop pattern in right and left hand of male cataracts show slight variation while female cataracts shows increase in the loop pattern in the right hand as compared to left hand.

Table 6: Frequency Percentage Distribution of Whorl Pattern on Fingertips among Cataract and Control Group (Henry's Classification)

WHORLS												
Sex	Side	Spiral		Concentric		Composite						
		Ws		Wc		Wd		Total				
		Cases	Cont-rols	Cases	Cont-rols	Cases	Cont-rols	Cases	Cont-rols	Comparison	x2 value	p value	Remark
Male	Right	34	75	58	55	67	37	159	167	NMRXCMR	0.2913	0.5894	NS
	Left	31	71	73	38	53	74	157	183	NMLXCML	3.012	0.0826	NS
	Right + Left	65	146	131	93	120	111	316	350	NM(R+L)XCM (R+L)	2.602	0.1067	NS
Female	Right	68	61	60	106	31	51	159	218	NFRXCFR	14.82	0.0001	S Decrease In Cases
	Left	50	61	59	96	81	45	190	202	NFLXCFL	0.6042	0.437	NS
	Right + Left	118	122	119	202	112	96	349	420	NF(R+L)XCF (R+L)	10.65	0.0011	S Decrease In Cases
Male + female	Right	102	136	118	161	98	88	318	385	N(M+F)RXC (M+F)R	9.847	0.0017	S Decrease In Cases
	Left	81	132	132	134	134	119	347	385	N(M+F)LXC (M+F)L	3.111	0.0777	NS
	Right + Left	183	268	250	295	232	207	665	770	N(M+F)(R+L)XC(M+F)(R+L)	11.98	0.0005	S Decrease In Cases

			Whorl							
Group	Sex	Side	Spiral		Concentric		Composite			
			Ws	%	Wc	%	Wd	%	Total	%
Cases	Male	Right	34	6.80	58	11.60	67	13.40	159	31.80
		Left	31	6.20	73	14.60	53	10.60	157	31.40
		Right + Left	65	6.50	131	13.10	120	12.00	316	31.6
	Female	Right	68	13.60	60	12.00	31	6.20	159	31.80
		Left	50	10.00	59	11.80	81	16.20	190	38.00
		Right + Left	118	11.80	119	11.90	112	11.20	349	34.9
	Male + female	Right	102	10.20	118	11.80	98	9.80	318	31.8
		Left	81	8.10	132	13.20	134	13.40	347	34.7
		Right + Left	183	9.15	250	12.50	232	11.60	665	33.25
Control	Male	Right	75	15.00	55	11.00	37	7.40	167	33.40
		Left	71	14.20	38	7.60	74	14.80	183	36.60
		Right + Left	146	14.60	93	9.30	111	11.10	350	35
	Female	Right	61	12.20	106	21.20	51	10.20	218	43.60
		Left	61	12.20	96	19.20	45	9.00	202	40.40
		Right + Left	122	12.20	202	20.20	96	9.60	420	42
	Male + female	Right	136	13.60	161	16.10	88	8.80	385	38.5
		Left	132	13.20	134	13.40	119	11.90	385	38.5
		Right + Left	268	13.40	295	14.75	207	10.35	770	38.5

Composite whorls = double loop+ central pocket ulnar and central pocket radial whorls.

Table no.6 shows frequency distribution of different subtypes of whorl patterns. The table shows 31.6% of whorls in cataract males, of which 6.5% are spiral, 13.10% are concentric and 12% are composites. In cataract females 34.9% whorls are seen of which 11.80% are spiral whorls, 11.90% are concentric whorls and 11.20% are composite whorls. The table shows 35% of whorls in control males, of which 14.60% are spiral, 9.30% are concentric and 11.10% are composites. In control females 42% whorls are seen of which 12.20% are spiral whorls, 20.20% are concentric whorls and 9.60% are composite whorls.

Table 7: Frequency Percentage Distribution Of Arch Pattern On Fingertips Among Cataract And Control Group (Henry's Classification)

Arch											
Sex	Side	Plain		Tented							
		Ap		At		Total					
		Cases	Controls	Cases	Cont-rols	Cases	Cont-rols	Comparison	x2 value	p value	Remark
Male	Right	21	14	8	2	29	16	NMRXCMR	3.933	0.0474	S INCREASE IN CASES
	Left	20	6	6	8	26	14	NMLXCML	3.75	0.0528	NS
	Right + Left	41	20	14	10	55	30	NM(R+L)XCM (R+L)	7.679	0.0056	S INCREASE IN CASES
Female	Right	7	18	4	14	11	32	NFRXCFR	10.72	0.0011	S DECREASE IN CASES
	Left	12	14	7	18	19	32	NFLXCFL	3.492	0.0617	NS
	Right + Left	19	32	11	32	30	64	NF(R+L)XCF (R+L)	12.9	0.0003	S DECREASE IN CASES
Male + Female	Right	28	32	13	16	40	48	N(M+F)RXC (M+F)R	0.7607	0.3831	NS
	Left	32	20	13	26	45	46	N(M+F)LXC (M+F)L	0.0115	0.9146	NS
	Right + Left	60	52	26	42	85	94	N(M+F)(R+L) XC(M+F)(R+L)	0.4737	0.4913	NS

			Arch					
Group	Sex	Side	Plain		Tented			
			Ap	%	At	%	Total	%
Cases	Male	Right	21	4.20	8	1.60	29	5.80
		Left	20	4.00	6	1.20	26	5.20
		Right + Left	41	4.10	14	1.40	55	5.5
	Female	Right	7	1.40	4	0.80	11	2.20
		Left	12	2.40	7	1.40	19	3.80
		Right + Left	19	1.90	11	1.10	30	3
	Male + Female	Right	28	2.80	13	1.20	40	4.00
		Left	32	3.20	13	1.30	45	4.50
		Right + Left	60	3.00	26	1.30	85	4.25
Controls	Male	Right	14	2.80	2	0.40	16	3.20
		Left	6	1.20	8	1.60	14	2.80
		Right + Left	20	2.00	10	1.00	30	3
	Female	Right	18	3.60	14	2.80	32	6.40
		Left	14	2.80	18	3.60	32	6.40
		Right + Left	32	3.20	32	3.20	64	6.4
	Male + Female	Right	32	3.20	16	1.60	48	4.8
		Left	20	2.00	26	2.60	46	4.6
		Right + Left	52	2.60	42	2.10	94	4.7

Table no.7 shows frequency distribution of arch patterns. The table shows 5.5% arches in cataract males while 3% in control males. The percentage of arches in female cataracts is 3% and that of control females is 6.4%. The arch pattern is lower in cataracts than in controls.

Table 8: Frequency Percentage Distribution Of Different Patterns On Fingertips Among Cataract And Control Group (Galton's Classification)

Group	Sex	Side	Loops		Whorls		Arches	
			No.	%	No.	%	No.	%
Cases	Male	Right	311	62.20	159	31.80	29	5.80
		Left	317	63.40	157	31.40	26	5.20
		Right + Left	628	62.8	316	31.6	55	5.5
	Female	Right	330	66.00	159	31.80	11	2.20
		Left	292	58.40	190	38.00	19	3.80
		Right + Left	622	62.2	349	34.9	30	3
	Male + Female	Right	641	64.1	318	31.8	40	4.00
		Left	609	60.9	347	34.7	45	4.50
		Right + Left	1250	62.5	665	33.25	85	4.25
Control	Male	Right	317	63.4	167	33.40	16	3.20
		Left	303	60.6	183	36.60	14	2.80
		Right + Left	620	62	350	35	30	3
	Female	Right	250	50	218	43.60	32	6.40
		Left	266	53.2	202	40.40	32	6.40
		Right + Left	516	51.6	420	42	64	6.4
	Male + Female	Right	567	56.7	385	38.5	48	4.8
		Left	569	56.9	385	38.5	46	4.6
		Right + Left	1136	56.8	770	38.5	94	4.7

Table no.8 shows percentagewise distribution of patterns on fingertips among cataracts and controls. It is observed that the percentage distribution of loops in cataract as well as control males is similar, while female cataracts shows increase percentage of loops as compared to control females.

It is also observed that the whorl pattern is reduced in cataracts in both the sexes as compared to controls.

The arch pattern is higher in cataract males than control males, while it is lower in cataract females as compared to control females.

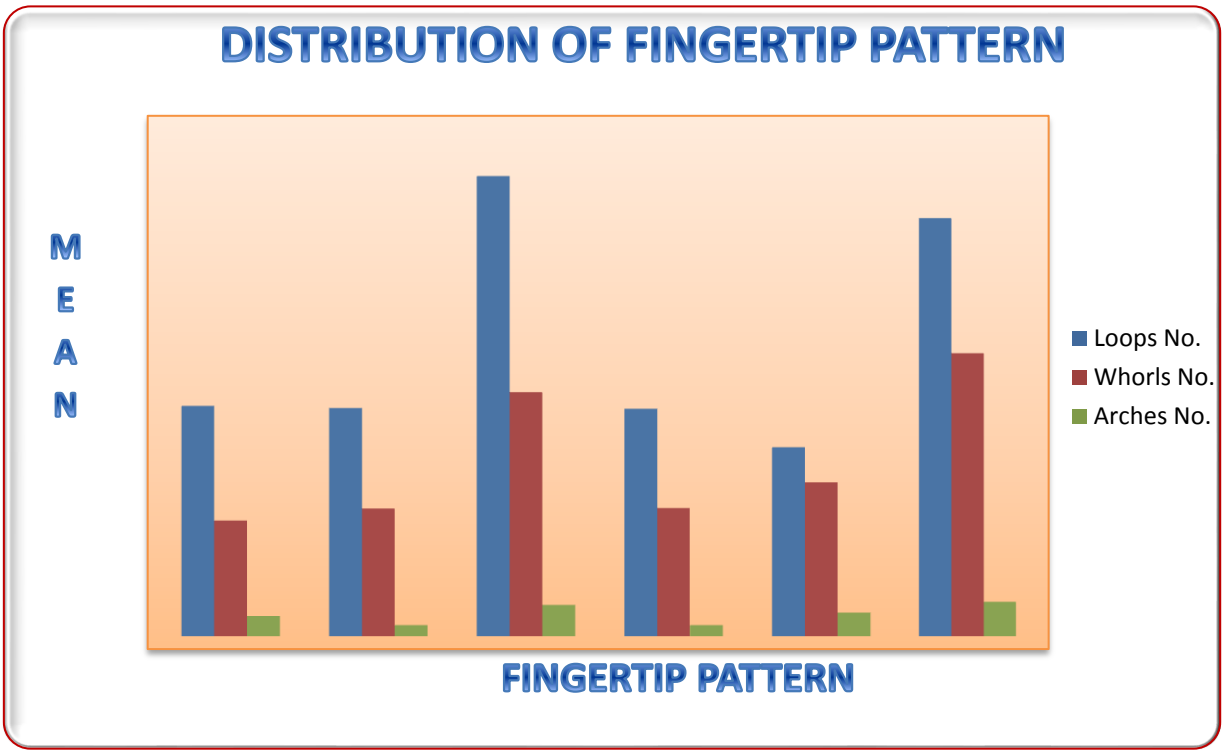


Table 9: Significance Test for Different Patterns on Fingertips among Cataract and Control Group

Pattern Type	Comparison	x2 value	p value	Remark
LOOPS	NMRXCMR	0.1541	0.6946	NS
	NMLXCML	0.8319	0.3617	NS
	NM(R+L)XCM(R+L)	0.1364	0.7119	NS
	NFRXCFR	26.27	< 0.0001	S
	NFLXCFL	2.741	0.0978	NS
	NF(R+L)XCF(R+L)	22.91	< 0.0001	S
	N(M+F)RXC(M+F)R	11.45	0.0007	S
	N(M+F)LXC(M+F)L	3.305	0.0691	NS
	N(M+F)(R+L)XC(M+F)(R+L)	13.50	0.0002	S
WHORLS	NMRXCMR	0.2913	0.5894	NS
	NMLXCML	3.012	0.0826	NS
	NM(R+L)XCM(R+L)	2.602	0.1067	NS
	NFRXCFR	14.82	0.0001	S DECREASE IN CASES
	NFLXCFL	0.6042	0.437	NS
	NF(R+L)XCF(R+L)	10.65	0.0011	S DECREASE IN CASES
	N(M+F)RXC(M+F)R	9.847	0.0017	S DECREASE IN CASES
	N(M+F)LXC(M+F)L	3.111	0.0777	NS
	N(M+F)(R+L)XC(M+F)(R+L)	11.98	0.0005	S DECREASE IN CASES
ARCHES	NMRXCMR	3.933	0.0474	S INCREASE IN CASES
	NMLXCML	3.750	0.0528	NS
	NM(R+L)XCM(R+L)	7.679	0.0056	S INCREASE IN CASES
	NFRXCFR	10.72	0.0011	S DECREASE IN CASES
	NFLXCFL	3.492	0.0617	NS
	NF(R+L)XCF(R+L)	12.90	0.0003	S DECREASE IN CASES
	N(M+F)RXC(M+F)R	0.7607	0.3831	NS
	N(M+F)LXC(M+F)L	0.0115	0.9146	NS
	N(M+F)(R+L)XC(M+F)(R+L)	0.4737	0.4913	NS

Table no. 9 shows the statistical analysis of different patterns of fingertips among cataracts and controls. Loop pattern among control males compared with cataract males shows no significant difference in right and left hand as well as both hands combined. In case of females loop pattern in right hand of cataract is significantly higher than controls, while left hand shows no significant difference. Both hands combined compared in females shows significant higher loops in cataract females. Comparing both the sexes and both the hands taken together, significant higher values are observed among cataracts and controls.

Whorl patterns in males shows no significant difference in right and left hand comparison as well as when both hands taken together. Significant lower number of whorls is observed in right hand of female cataracts, also right and left hand taken together shows decreased number in cataract females. The comparison of right hands of males and females taken together shows significantly low values as compared to controls.

The arch pattern in case of male cataracts significantly decreased in right and left hand taken together. In case of females the right hand of cataracts as well as both hands comparison with the control females shows decreased number in cataracts.

The other comparison shows no significant variations.

5. Discussion

The hypothesis, that antenatal factors may be involved in the pathogenesis of a disorder which becomes apparent later in life, would be suggested if a relationship between a prenatal event such as dermal ridge formation and the disorder could be established. Thus, the dermal ridges have various notable characteristics which make them important, not only in personal identification of a person but also in human biology for various reasons such as

1. Unlike many bodily traits the dermal ridges and configuration once formed remain unchanged except in dimensions.
2. The ridges are environment stable and begin to appear from 5th month of I. U. life.
3. Although the patterns formed by ridges vary in size, shape and detailed structures, still they can be classified into definite main types. Realizing the need for objective means to study genetics many investigators have been exploiting the quantitative and qualitative features of dermal ridges such as ridge counting, angles, etc.,

Prior to 1926 when word "Dermatoglyphics" was not proposed, there had been no satisfactory term embracing the skin patterning of fingers, toes, palms and soles. Dermatoglyphics is a collective name for all those integumentary features, within the limit to be defined and it also applies to the division of Anatomy which embraces their study. Thus H. Cummins emphasized that dermatoglyphics is a division of anatomy.

At present there is an agreement that dermatoglyphic features confirm to polygenic system with individual genes contributing a small additive effect. A genetic theory put forward by Herman M. Slats assumes that the basic finger print pattern sequence is all ulnar loops and that various genes cause deviations from this pattern sequence.[8]

In recent past, a number of investigators have focused their attention in finding out an association of morphological and genetical characters with a number of pathological conditions. Dermatoglyphics determined by polygenic inheritance is one of such tools, used in scientific studies. It has been demonstrated by many that dermatoglyphics is of aid in the diagnosis and understanding the genetics of many human pathogenic abnormalities[9]

Cataract and diabetes mellitus both have strong hereditary background. Diabetes mellitus acts as major predisposing factor for cataract, so certain dermatoglyphic variations are supposed to be expected in cataract associated with diabetes mellitus.

The present study consists of 200 cases including 100 men and 100 women having cataract associated with diabetes mellitus. This study group is compared with the control group consisting of 100 men and 100 women of same age group with no observable genetic abnormality.

The sample has been drawn from the heterogeneous group in central India region. Taking into consideration the nature of dermatoglyphic variations in the given region, the social and ethnic variations are minimal in homogenous background. Hence, some conspicuous variations can be observed apart from the regular variations found in the general population.

The parameters observed among the diabetic cataract and control groups are

1. Quantitative analysis of fingerprints. i.e. absolute and total finger ridge count.
2. Qualitative analysis of fingerprints. i.e. fingertip patterns.
3. Qualitative analysis of palmar patterns.

These observations were subjected to test for statistical significance. The categorical variables were compared using chi square test and the continuous variables were subjected to unpaired two tailed t-test of significance.

Literature is available on dermatoglyphic variations in cataract and in diabetes but few studies are available on dermatoglyphics in cataract associated with diabetes mellitus. Hence, the findings of the present study are compared with the above studies.
The findings of the present study are discussed and compared under following headings.

Total Finger Ridge Count (TFRC) and Absolute Finger Ridge Count (AFRC)

The present study shows that there is significant increase in total finger ridge count (TFRC) and absolute finger ridge count (AFRC) in cataract patients of both the sexes.

Barta L., Vari A., Susa E. (1970) found significant high incidence of total finger ridge count in male diabetics patients.[11] **R. Ravindranath, I. M. Thomas (1995)** observed significant values of TFRC and AFRC in maturity onset diabetes mellitus.[12] **M Pramila Padmini, B Narasinga Rao and B Malleswari (2011)** in their Study of Dermatoglyphics in Diabetics of North Coastal Andhra Pradesh Population observed a significant increase in TFRC and AFRC in diabetics than in controls of both sexes.[13]

The findings of the present study coincide with the findings of the above workers.

Fingertip patterns:
Present study shows increase frequency of loops in female cataracts also male cataracts shows slight increase in loops. The increase in right hand is more prominent than that of left hand in both the sexes. Whorls pattern is decreased in right hand of female diabetics. The arch pattern found significantly higher in diabetic cataract males while it is lower in diabetic cataract females.

Jullian Verbow (1973) studied fingertip patterns in patients with early onset diabetes mellitus. He found that the female diabetics show decreased frequency of whorls and increased frequency of arches.[14] **S.M. Sant et al (1983)** reported significant differences between diabetics and controls in fingertip patterns. They observed that frequency of whorls is increased and frequency of ulnar loops is decreased in diabetics of both the sexes. Frequency of arches is increased in diabetic females while frequency of radial loops is decreased in diabetic males.[15] **Roopa Ravindranath, I. M. Thomas (1995)**[12] reported preponderance of ulnar loops pattern in diabetes mellitus. **Bets L. V. et al (1994)** examined clinically diagnosed diabetes mellitus patients for fingertip patterns. They found that in males the incidence of arches was higher and loops were lower than in controls. In females there were no arches and the incidence of radial and ulnar loops were low.[16] **Vera (1995)** in his study with 158

Insulin Dependent Diabetes Mellitus (IDDM) children with limited joint mobility found higher frequency in the number of arches.[17] **R. Ravindranath et al (1995)** studied finger print patterns in maturity onset diabetes mellitus. They observed an increase in radial and ulnar loops and arches in males, decrease in whorls in males, and an increase in ulnar loops and decrease in whorls in left hand of females.[12] **M Pramila Padmini, B Narasinga Rao and B Malleswari (2011)** found higher incidence of arch pattern in female diabetics, higher incidence of variations are seen in ulnar loops ,simple arch, composite whorl and double pocket whorl in diabetics than in controls.[13]

6. Summary

The study of epidermal ridges of palms and soles is known as dermatoglyphics. It is a valuable method for medico-legal and anthropological studies.

Dermatoglyphic pattern are determined by genetic factors. The cataracts as well as diabetes mellitus have strong genetic background. So some dermatoglyphic variations are expected in the present study.

The study was undertaken to see whether specific dermatoglyphic patterns are present in diabetic cataract patients, which will help for the early diagnosis of the disease. The study sample consisted of 200 cases including 100 men and 100 women having cataract associated with diabetes mellitus. This study group is compared with the control group consisting of 100 men and 100 women of same age group with no observable genetic abnormality.

The palmar prints were obtained by ink method described by Cummins and Midlo (1961). The observations were tested for statistical significance.

Observations and results in this study are summarized below.

1. Increase in total finger ridge count (TFRC) and absolute finger ridge count (AFRC) in cataract patients of both the sexes.
2. Increase in frequency of loops in female cataracts, also male cataracts shows slight increase in loops. The increase in right hand is more prominent than that of left hand in both the sexes. Whorls pattern is decreased in right hand of female diabetics. The arch pattern found significantly higher in diabetic cataract males while it is lower in diabetic cataract females.

7. Conclusion

The present study was undertaken with an aim to evaluate the dermatoglyphic pattern in diabetic cataract patients.

Significant variations are observed in the various dermatoglyphic parameters among normal population and persons having cataract associated with diabetes mellitus.

On the basis of results obtained, the study can be used for early detection of the predisposed persons from the normal population so that they can be subjected to preventive measures, to avoid the future burden of the disease on the community. However, further extensive studies are necessary to find out other hidden dermatoglyphic features.

The advantages observed during the project are as follows:

1. The method is very simple and readily accessible for the study.
2. Patterns can be recorded quickly.
3. Materials required for the test are simple and cost effective.
4. This method is non-invasive and non-traumatic.
5. The simplicity of test qualifies it for mass screening of large population.

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