

A Comparative Study of Dermatoglyphics in Subjects with Hypodivergent and Hyperdivergent Growth Patterns

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ABSTRACT

Aims and Objectives: Dermatoglyphics is the study of fingerprints. Fingerprints are unique for an individual person. This aim of this study was to note if any correlation exists between dermatoglyphics and growth patterns.

Materials and Methods: Lateral cephalograms of 100 patients were recorded and traced. Mandibular plane angle was measured according to Steiner's analysis to determine the type of growth pattern and thus separated into two groups (50 in each group): Group I being horizontal growth pattern (HGP) and Group II being vertical growth pattern (VGP). All statistical analysis was performed with SPSS version 21.

Results: The ulnar loops in Group II were highest in frequency, and central pocket loops were lowest in frequency in both groups.

Conclusion: Ulnar loops were increased in VGP whereas whorls were increased in HGP. There was absence of central pocket loops in VGP.

KEYWORDS: *Dermatoglyphics, growth pattern, ulnar loops, whorls*

INTRODUCTION

Sir Francis Galton, a cousin of Charles Darwin was the first to study dermatoglyphics. Dermatoglyphics is derived from a Greek terminology where derma denotes skin and glyph denotes carving.

Dermal ridges appear around 3rd month of intrauterine life (IUL) and are fully developed by the 6 months of IUL. The dermal configurations remain the same till adulthood except for the change in size.

The impression of papillary ridges of fingertips is used for analysis in dermatoglyphics. Papillary ridges are mostly located in the palms, soles, and flexure surfaces of the digits. They form fine parallel or coiled arrays divided by thin furrow with the opening of sweat ducts at the summit of each ridge.

Dermatoglyphics includes genetics, anthropology, and Egyptology.^[1-3] Finger, palm, and sole impressions are said to be products of both environment and heredity. No two individuals, even monozygotic twins, have the same fingerprints. Thus, fingerprints are unique to each person and not altered during lifetime.

Currently, medical dermatoglyphics is associated with various conditions such as diabetes mellitus, hypertension, psychosis,^[4,5] breast cancer,^[6] alcohol embryopathy,^[7] epilepsy,^[8] congenital heart diseases.^[9] Previous literature suggests the presence of asymmetrical fingerprints amid patients with periodontitis,^[10] dental caries,^[11] and birth defects such as cleft lip and palate.^[12,13]

There is a striking similarity in timing between the development of dentition, palate, and development of dermal patterns. This similarity in timing of the development leads to association between dermatoglyphics and dental occlusion.

Fingerprints are classified into the following three basic types: arches, whorls, and loops^[14] [Figure 1].

Whorls are ridges that encircle a core. Simple whorls are placed as a sequence of concentric rings known as

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concentric whorls. A double or a spiral whorl has ridges about the center in a clockwise or an anticlockwise way. A central pocket loop contains a loop within which a smaller whorl is located. The ridges in an arch run from one edge of the digit to the other with a distal flounce.

The fingerprint is unique for a specific individual as epidermal ridges are genetically determined, and their pattern remains constant throughout life. Hence, it aids in the diagnosis of hereditary disorders as well as the identification of an individual.

AIMS AND OBJECTIVES

The purpose of our investigation is to compare the fingerprint patterns between hypodivergent and hyperdivergent individuals.

MATERIALS AND METHODS

The study was undertaken in the unit of Orthodontics, Kalinga Institute of Dental Sciences, KIIT University, Bhubaneswar, Odisha. Ethical approval was obtained from Institutional Ethics Committee with ref no. KIMS/KIIT/IEC/112/2017. Informed consent was obtained from each participant. The fingerprints were analyzed in the Department of Forensic Medicine and Toxicology, Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha. The sample size determination was done by using the formula:–

$$\text{Sample size} = \frac{Z_{1-\frac{\alpha}{2}} SD^2}{d^2}$$

A sample of 100 patients ranging in the age from 14 to 25 years were included for the study.

Inclusion criteria for the selection of the subjects in this study were as follows:

1. The subjects for the study were residents of Odisha
2. No history of previous orthodontic therapy.

Exclusion criteria were as follows:

1. Subjects with craniofacial abnormalities excluding malocclusions
2. Subjects with a previous history of trauma or road traffic accidents

After selecting the subjects, the following records were:

1. Lateral cephalogram
2. Fingerprints.

LATERAL CEPHALOGRAM

The lateral cephalograms were recorded with the jaws in habitual occlusion, lips stress-free and the head-oriented parallel to the Frankfort horizontal plane. The radiographs were obtained. All the cephalograms were recorded with the same exposure parameters. These cephalograms were

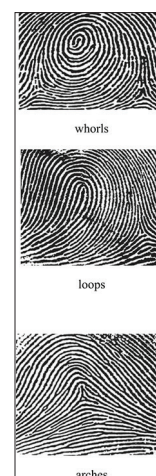


Figure 1: Classification of ridge patterns

traced, mandibular plane angle was measured according to Steiner's analysis to determine the type of growth pattern and thus separated into two groups (50 in each group); Group I being horizontal growth pattern (HGP) and Group II being vertical growth pattern (VGP).

METHOD OF OBTAINING PALMAR AND FINGERPRINTS

In the present study, the impressions of the palm and fingerprints were evaluated by the ink and roller method.^[15] The hands were cleaned to remove and dried to remove the sweat and dirt. A dry and clean inking slab was used and minute quantity of ink was placed onto the slab. The ink was spread evenly so that a thin layer of ink spread over the slab. The palmar surface of both hands was positioned on the inking slab and hard pressed on an A4 sheet white paper as shown in Figure 2.

The fingerprints were recorded in a similar manner. The bulb of the finger was positioned perpendicular to the surface of the plate. The finger was moved on the slab from one side to the opposite side as shown in Figure 3.

The impressions of the palm and fingerprints of all the samples were evaluated. The percentage frequency of different types of patterns of the hands and digits were studied. The fingertip pattern was also statistically evaluated.^[1,14,15] The total finger ridge count (TFRC) which depicts the accumulation of the ridge counts of 10 fingers were also calculated.

RESULTS

The results were evaluated using Version 20 of the Statistical package for social sciences (SPSS INC, Chicago, Illinois, USA). Student *t*-test and ANOVA was done to calculate the percentage and frequency of occurrence of different patterns.

The results of right and left hands are shown in Tables 1a and b. The percentage of highest frequency

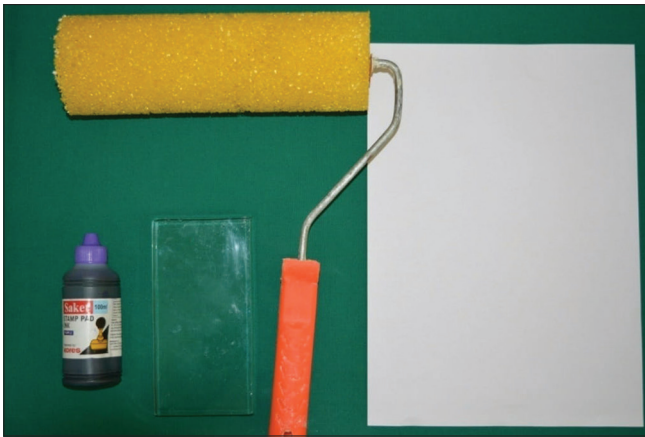


Figure 2: Armamentarium for the fingerprints

was noted for ulnar loops in Group II, and the lowest was noted for central pocket loops in both growth patterns. The absence of central pocket loop in Group II was a significant finding. The presence of twinned loops in digit II of Group I was a striking feature. The presence of radial loops in Group II of digit III of the right hand was a noteworthy finding.

The average TFRCs of left and right hands of both the groups had a statistically insignificant result as shown in Table 2.

The graphical representation of the various types of patterns of the right and left hands and digits are shown in Figures 4-7.

DISCUSSION

Dermatoglyphics is one of the oldest sciences, and it is a mystery for many. A proper knowledge of phylogenetic and odontogenic history helps us in understanding dermatoglyphics. The ridge patterns are developed during 3rd-6th month of IUL. Abnormalities in the areas of palm and fingerprints are predisposed by a permutation of genetic and epigenetic factors.

Dermatoglyphics as a procedure is simple, economical, and a traumatic. It is linked with dentistry as there is striking similarity in the timing of development between dentition and palate. Both their development is influenced strongly but not exclusively by genetics. Hence, epigenetic factors also play a role, and it might reflect in the dermal patterns.

The study of palmar and fingerprints is useful in the field of criminology, anthropology, and cytogenetic studies.^[1]

Some physical and topographic growth forces are accountable for the formation of ridge patterns as stated by past hypotheses.^[1] According to one school of thought during early embryogenesis, the tensions, and pressures in the skin establish the orientations of the epidermal



Figure 3: Impression of palmar surface of the ridges

Table 1a: Percentage frequency of different types of finger print patterns

Type of pattern	Group	Hand	Digits					Total
			I	II	III	IV	V	
Arches	HGP	Right	10	5	40*	0	4	11.8
		Left	0	10	50*	0	2	12.4
	VGP	Right	0	5	10	5	0	4
		Left	0	5	20	0	0	5
Whorls	HGP	Right	30	50	36	70*	38	44.8
		Left	40	30	40	60*	40	42
	VGP	Right	20	35	15	70*	20	32
		Left	25	30	15	70*	25	33
Ulnar Loops	HGP	Right	20	33	30	66*	30	35.8
		Left	20	10	33	65*	40	33.6
	VGP	Right	60	40	20	40	65	45
		Left	50	40	20	30	60	40

*P<0.05 statistically significant difference between the different types of pattern. Percentage frequency of different types of pattern - Arches, Whorls, Ulnar Loops on right and left hand separately. HGP=Horizontal growth pattern, VGP=Vertical growth pattern

ridges. These ridges lead to the formation of narrow parallel or curved arrays which are demarcated by a thin furrow. At the apex of each ridge, there lies a miniature notch of a sweat gland.

These epidermal ridges or pad is useful in supporting the weight. Sometimes, these pads carry clusters of small epidermal warts which are placed in a concentric manner around a raised apex. The apex is the draining point of a sweat gland. The fusion of these warts formed transverse lines which provided a friction surface that prevented slipping.

With the evolution process, as the habits changed, the pattern of warts became flattened, and a unique pattern was formed. The pads assumed patterns of whorls and the total friction surface became covered with ridges.

Table 1b: Percentage frequency of different types of finger print patterns

Type of pattern	Group	Hand	Digits					Total
			I	II	III	IV	V	
Radial loops	HGP	Right	10	10	0	0	0	4
		Left	20	10	0	0	5	7
	VGP	Right	0	0	5*	0	0	1
		Left	0	0	0	0	0	0
Twinned loops	HGP	Right	0	20*	0	0	0	4
		Left	0	10	0	0	0	2
	VGP	Right	5	0	5	0	0	2
		Left	5	0	0	0	5	2
Central pocket loops	HGP	Right	0	0	0	0	0	0
		Left	0	0	5	0	0	1
	VGP	Right	0	0	0	0	0	0
		Left	0	0	0	0	0	0

* $P < 0.05$ statistically significant difference between the different types of pattern. Percentage frequency of different types of pattern - Radial loops, twinned loops, central pocket loops on the right and left hand separately. HGP=Horizontal growth pattern, VGP=Vertical growth pattern

Table 2: Average total finger ridge counts of left and right hands

Groups	Right		Left		Total	
	Mean	SD	Mean	SD	Mean	SD
HGP	83.66	91.74	81.66	86.6	165.33	180.74
VGP	70	101.82	66.66	94.8	145.45	183.5
F	0.3		1.71		0.159	
P	0.86 (NS)		0.68 (NS)		0.69 (NS)	

Average total finger ridge counts of left and right hands. NS=Nonsignificant, SD=Standard deviation, HGP=Horizontal growth pattern, VGP=Vertical growth pattern

Extraneous factors during the growth and development will also produce changes in the dermal pattern. The current study was carried to evaluate the dermatoglyphic parameters of individual with different growth pattern of the jaws. The study sample was divided into two groups: Group I - HGP and Group II - VGP.

Review of literature suggests several studies done by Kharbanda *et al.*, Reddy *et al.* and Trehan *et al.* on dermatoglyphics.

Kharbanda *et al.*^[16] evaluated and compared dermatoglyphics of 25 males of north India with true mandibular excess with Class I occlusions. The authors inferred that in the sample with skeletal Class III base there was an increased incidence in arches and ulnar loops on all digits, except digit II.

Our study concluded an increase in ulnar loops, whorls, and arches on an overall percentage basis. Central pocket loops had the lowest frequency.

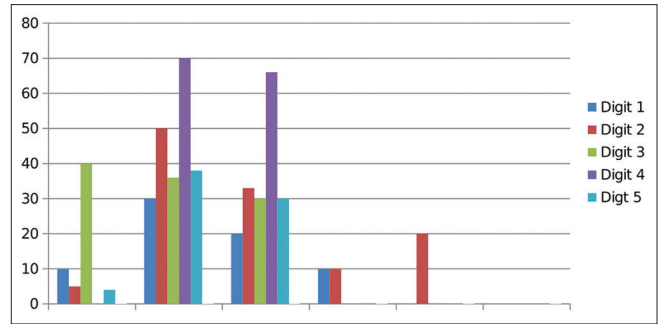


Figure 4: Graphical representation of the finger patterns of the right hand in a horizontal grower

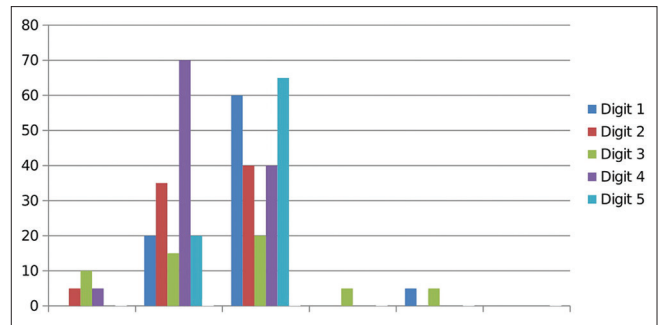


Figure 5: Graphical representation of the finger patterns of the right hand in a vertical grower

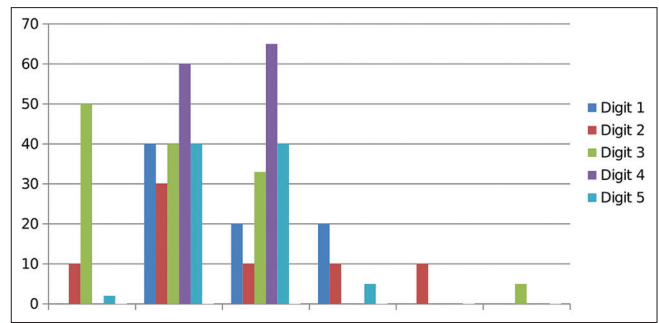


Figure 6: Graphical representation of the finger patterns of the left hand in a horizontal grower

Our study was similar to Reddy *et al.*^[17] who compared normal and malocclusion and had similar findings. The average TFRCs of both hands were 0.68 and 0.86, respectively. The whorls of digit IV of both groups of both hands had statistically significant result whereas the ulnar loops of HGP had statistical significance in relation to digit IV. The striking feature was the absence of central pocket loops in VGPs. Twinned loop of the right hand of HGP had a significant result.

Reddy *et al.*^[18] predicted and compared Class I, Class II (div 1 and div 2), and Class III malocclusions with dermatoglyphics. They concluded that craniofacial Class II div I and II had an increase in

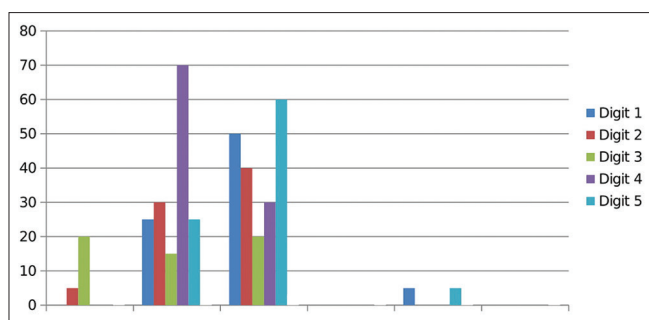


Figure 7: Graphical representation of the finger patterns of the left hand in a vertical grower

number of arches and ulnar loops and a reduced count of whorls.

The dermatoglyphic parameters of normal occlusions were compared and analyzed with Class I and Class III malocclusions by Trehan *et al.*^[19] The authors suggested and concluded that there was an increased occurrence of whorls in Class I and Class III malocclusions as compared to normal occlusions. Radial loops and arches were seen in large numbers in Class I and Class II div 1 malocclusion.

A study conducted by Divyashree *et al.*^[20] concluded that there is an increased frequency of whorls which were found both in right and left hands in skeletal class i pattern group. Increased frequency of ulnar loops was found in the right hand of skeletal class ii pattern group.

A significant association between dermatoglyphic patterns and sagittal skeletal discrepancies was found in a research done by George *et al.* They concluded that dermatoglyphics could serve as a cost-effective screening tool of these craniofacial problems.^[21] Whereas another investigation done by Eslami *et al.*^[22] concluded that palm and fingerprint characteristics did not show any significant differences between different skeletal malocclusions.

The strength of the present study is that as literature review suggests no study has been done till date which compares the dermatoglyphic variance between the growth patterns.

According to the author, the limitation of the study is that might be more number of samples could have been examined which would have added to the merit of the study.

The key findings of the current investigation were an increase in ulnar loops in VGP and increase in whorls in HGP. The significant finding of this study was an absence of central pocket loops in VGP.

All the previous studies were conducted on North Indian and South Indian populations whereas our sample was

derived from an urban set up in Odisha population. The difference in the findings of our study may be attributed to the environmental influences.

In future might be more number of studies with an increase of sample size be carried out in different zones of India to evaluate whether there is any discrepancy between the dermatoglyphic variance in various growth patterns. Factors such as racial and ethnic differences, developmental, environmental, and other local factors might also influence the development of malocclusions. Extensive research of ridge pattern has to be carried out with several groups based on their ethnic and racial backgrounds.^[23,24]

CONCLUSION

Our study concluded an increase in ulnar loops in VGP and an increase in whorls in HGP with an absence of central pocket loops in VGP.

CLINICAL SIGNIFICANCE

The fingerprints develop during the same time as dentition and palate. Genetics will definitely play a key role during their time of development. Every individual has a certain basic pattern of craniofacial growth which might be reflected in the dermatoglyphic pattern. Hence, our study was undertaken to investigate if any correlation exists between dermatoglyphics and growth patterns.

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Nil.

CONFLICTS OF INTEREST

There are no conflicts of interest.

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