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Mohanakrishnan PJ
Department of Orthodontics and
Dentofacial Orthopedics,
Government Dental College and
Hospital, Afzalgunj, Hyderabad,
Telangana, India

Chandulal J
Department of Orthodontics and
Dentofacial Orthopedics,
Government Dental College and
Hospital, Afzalgunj, Hyderabad,
Telangana, India

Venkataramana I
Department of Orthodontics and
Dentofacial Orthopedics,
Government Dental College and
Hospital, Afzalgunj, Hyderabad,
Telangana, India

Narasimhalakshmi M
Department of Orthodontics and
Dentofacial Orthopedics,
Government Dental College and
Hospital, Afzalgunj, Hyderabad,
Telangana, India

Kaviya S
Department of Orthodontics and
Dentofacial Orthopedics,
Government Dental College and
Hospital, Afzalgunj, Hyderabad,
Telangana, India

Vaishnavi G
Department of Orthodontics and
Dentofacial Orthopedics,
Government Dental College and
Hospital, Afzalgunj, Hyderabad,
Telangana, India

Corresponding Author:
Mohanakrishnan PJ
Department of Orthodontics and
Dentofacial Orthopedics,
Government Dental College and
Hospital, Afzalgunj, Hyderabad,
Telangana, India

Evaluation of correlation of dermatoglyphic patterns and sagittal skeletal discrepancies and growth patterns

Mohanakrishnan PJ, Chandulal J, Venkataramana I, Narasimhalakshmi M, Kaviya S and Vaishnavi G

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Abstract

Objectives: To test the hypothesis that a correlation exists between dermatoglyphic patterns and sagittal skeletal discrepancies and growth patterns.

Materials and Methods: Lateral cephalograms and digital fingerprint records of 180 subjects (90 males and 90 females) aged 18-40 years were obtained. These subjects were categorized into six sagittal skeletal discrepancy groups based on sagittal skeletal parameters and into growth pattern groups based on Tweed's Frankfurt mandibular plane angle.

Results: The ulnar loop was the most frequent and the radial loop was the least frequent fingerprint pattern. It revealed that ulnar loop pattern was more frequent in Skeletal Class II with mandibular deficiency group and it was least frequent in Skeletal Class III with mandibular excess group; there was also an increase in frequency of plain whorl pattern in Class III with mandibular excess group but these were statistically insignificant. Even in growth pattern there was no statistically significant correlation.

Conclusion: As per our study there was no statistically significant correlation between dermatoglyphic patterns and sagittal skeletal discrepancies and growth patterns.

Keywords: Dermatoglyphic patterns, sagittal skeletal discrepancies, growth patterns

Introduction

The term 'Dermatoglyphics' was derived from two Greek words— 'derma' which means skin and 'glyphe' which means carve. This term was introduced by Dr. Harold Cummins and Dr. Mildo in 1926. It is the science and art of the study of surface markings/patterns of ridges on the skin of the fingers, palm, toes and soles [1-3].

The scientific basis of friction ridge identification has evolved over many years, even centuries. The scientific study of papillary ridges of the hands and feet is credited as the beginning with the work of Joannes Evangelista Purkinje in 1823 [4-6].

The finger, palm and sole impressions are said to be products of both environment and heredity. It is an established scientific fact that no two individuals, including monozygotic twins, have the same fingerprints and other details of dermal ridges [7].

The development of the dentition and the palate occur during the same period as the development of dermal patterns which is around the sixth-seventh week of intrauterine life.⁵ Hereditary and environmental factors causing changes in the lip, alveolus and palate, may also cause abnormalities in the appearance of finger and palm prints [8].

The malocclusion is a common oral disorder affecting facial aesthetics which may involve irregular alignment of teeth, improper position of the jaws or a combination of both [9].

In medical dermatoglyphics, it has been shown that there is an association between fingerprint patterns and various conditions like diabetes mellitus [10], hypertension [11], psychosis [12], breast cancer [13], alcohol embryopathy [14], epilepsy [15], congenital heart diseases [16], alopecia [17] and many other conditions. In the field of dentistry, irregular fingerprints have been observed among patients with periodontitis [18], dental caries [19], certain types of congenital anomalies like cleft lip and palate [8], pre-cancerous lesions [20] and recently dermatoglyphics has been related to malocclusion and other developmental disturbances of the orofacial structures [21].

The genetic and environmental factors can affect the craniofacial development creating a multifactorial etiology for sagittal skeletal discrepancies. It is assumed that the genetic message contained in the genome during this period may reflect in the dermatoglyphic patterns. So dermatoglyphics could thus prove to be an effective screening tool and could also help in the early interceptive treatment of some sagittal, vertical and transverse skeletal discrepancies.

Materials and Methods

Lateral cephalogram and digital fingerprint records of 180 subjects (90 males and 90 females) were obtained. The inclusion criterion includes systemically healthy subjects of the age group 18-40 years who consented to participate in the study. The exclusion criteria includes patients with developmental anomalies like cleft palate and cleft lip, cleidocranial dysplasia, achondroplasia, any systemic disease affecting bone and general health like hyperparathyroidism, hyperthyroidism, etc., children and pregnant women, mentally retarded patients and patients with scars and thick calluses on fingertips.

The total sample of 180 (90 males and 90 females) subjects aged 18-40 years was categorized into six groups of 30 each:

1. Ideal skeletal Class I;
2. Skeletal Class I with bimaxillary protrusion;
3. Skeletal Class II with maxillary excess;
4. Skeletal Class II with mandibular deficiency;
5. Skeletal Class III with mandibular excess;
6. Skeletal Class III with maxillary deficiency.

Along with sagittal skeletal discrepancies, Growth patterns were also grouped based on Tweed’s Frankfurt mandibular plane angle. They are

- A. Average growth pattern
- B. Vertical growth pattern
- C. Horizontal growth pattern

The procedure will be explained to the patients and a written informed consent will be obtained from them with due consideration to ethical issues and confidentiality of fingerprint records. The sagittal jaw relation will be

determined from the patient’s lateral cephalogram with assessment of the following parameters: SNA, SNB, ANB, Wits appraisal, condyilion to Point A, condyilion to gnathion, angle of convexity and facial angle. The Growth pattern will be determined using Frankfort mandibular plane angle. The fingerprints will be recorded using digital fingerprint scanner. To avoid duplication of fingerprints, the fingers were numbered from 1-5 from left thumb to little finger and from 6-10 for right thumb to little finger.

Results

The data was analyzed with SPSS 16. To study the correlation between dermatoglyphic patterns and sagittal skeletal discrepancies and growth patterns, the frequency and the percentage distribution of various fingerprint patterns were recorded for each subject. The collected data was then statistically analyzed using Chi-square tests.

Table 1 shows the frequency of distribution of dermatoglyphic patterns in six sagittal skeletal groups in all the digits. It revealed that the ulnar loop pattern had the highest frequency of repetition in all the digits except left and right ring finger of all the six groups whereas radial loop pattern was the least frequent in these groups. The frequency of ulnar loop pattern was comparatively more in Skeletal Class II with mandibular deficiency group and it was least frequent in Skeletal Class III with mandibular excess group. The radial loop pattern was completely absent in skeletal class III with mandibular excess group and there was an increase in frequency of plain whorl pattern in this group. There were some fingerprint patterns which were frequent in few groups, yet there was no statistically significant correlation between dermatoglyphic patterns and sagittal skeletal discrepancies.

Table 2 shows the frequency of distribution of dermatoglyphic patterns in three growth pattern groups in all the digits. It revealed that the ulnar loop pattern had the highest frequency of repetition in all the digits except left and right ring finger in the growth pattern groups whereas radial loop pattern was the least frequent in these groups. There was no statistically significant correlation between dermatoglyphic patterns and growth pattern groups.

Table 1: Frequency of distribution of dermatoglyphic patterns in six sagittal skeletal groups in all the digits of the left hand

Digit	Fingerprint Pattern	Ideal class I	Class I bimaxillary protrusion	Class II maxillary excess	Class II mandibular deficiency	Class III mandibular excess	Class III maxillary deficiency	Total	%	P value
Left thumb finger	UL	14(46.7%)	17(56.7%)	13(43.3%)	16(53.3%)	12(40%)	18(60%)	90	50	0.217
	RL	0(0%)	1(3.3%)	0(0%)	0(0%)	0(0%)	0(0%)	1	0.6	
	PW	1(3.3%)	3(10%)	4(13.3%)	4(13.3%)	10(33.3%)	3(10%)	25	13.9	
	DWL	10(33.3%)	6(20%)	9(30%)	9(30%)	7(23.3%)	7(23.3%)	48	26.7	
	A	5(16.7%)	3(10%)	4(13.3%)	1(3.3%)	1(3.3%)	2(6.7%)	16	8.9	
Left index finger	UL	11(36.7%)	9(30%)	10(33.3%)	15(50%)	12(40%)	12(40%)	69	38.3	0.897
	RL	2(6.7%)	2(6.7%)	1(3.3%)	1(3.3%)	0(0%)	1(3.3%)	7	3.9	
	PW	6(20%)	10(33.3%)	9(30%)	6(20%)	10(33.3%)	8(26.7%)	49	27.2	
	DWL	4(13.3%)	2(6.7%)	1(3.3%)	4(13.3%)	2(6.7%)	1(3.3%)	14	7.8	
	A	7(23.3%)	7(23.3%)	9(30%)	4(13.3%)	6(20%)	8(26.7%)	41	22.8	
Left middle finger	UL	19(63.3%)	16(53.3%)	22(73.3%)	22(73.3%)	12(40%)	21(70%)	112	62.2	0.384
	RL	1(3.3%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	1	0.6	
	PW	3(10%)	7(23.3%)	4(13.3%)	6(20%)	11(36.7%)	4(13.3%)	35	19.4	
	DWL	2(6.7%)	2(6.7%)	1(3.3%)	0(0%)	2(6.7%)	2(6.7%)	9	5	
	A	5(16.7%)	5(16.7%)	3(10%)	2(6.7%)	5(16.7%)	3(10%)	23	12.8	
Left ring finger	UL	13(43.3%)	8(26.7%)	9(30%)	10(33.3%)	6(20%)	14(46.7%)	60	33.3	0.139
	RL	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0	0	
	PW	17(56.7%)	17(56.7%)	17(56.7%)	18(60%)	16(53.3%)	15(50%)	100	55.6	
	DWL	0(0%)	3(10%)	1(3.3%)	2(6.7%)	4(13.3%)	0(0%)	10	5.6	
	A	0(0%)	2(6.7%)	3(10%)	0(0%)	4(13.3%)	1(3.3%)	10	5.6	

Left little finger	UL	16(53.3%)	21(70%)	20(66.7%)	22(73.3%)	18(60%)	16(53.3%)	113	62.8	0.465
	RL	1(3.3%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	1	0.6	
	PW	10(33.3%)	4(13.3%)	8(26.7%)	7(23.3%)	9(30%)	10(33.3%)	48	26.7	
	DWL	2(6.7%)	3(10%)	1(3.3%)	0(0%)	2(6.7%)	0(0%)	8	4.4	
	A	1(3.3%)	2(6.7%)	1(3.3%)	1(3.3%)	1(3.3%)	4(13.3%)	10	5.6	

Table 2: Frequency of distribution of dermatoglyphic patterns in six sagittal skeletal groups in all the digits of the right hand

Digit	Fingerprint Pattern	Ideal class I	Class I bimaxillary protrusion	Class II maxillary excess	Class II mandibular deficiency	Class III mandibular excess	Class III maxillary deficiency	Total	%	P value
Right thumb finger	UL	14(46.7%)	19(63.3%)	13(43.3%)	13(43.3%)	13(43.3%)	20(66.7%)	92	51.1	0.166
	RL	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0(0%)	0	0	
	PW	7(23.3%)	8(26.7%)	7(23.3%)	6(20%)	9(30%)	7(23.3%)	44	24.4	
	DWL	5(16.7%)	0(0%)	7(23.3%)	10(33.3%)	6(20%)	2(6.7%)	30	16.7	
	A	4(13.3%)	3(10%)	3(10%)	1(3.3%)	2(6.7%)	1(3.3%)	14	7.8	
Right index finger	UL	12(40%)	14(46.7%)	12(40%)	20(66.7%)	15(50%)	11(36.7%)	84	46.7	0.338
	RL	0(0%)	1(3.3%)	1(3.3%)	0(0%)	0(0%)	0(0%)	2	1.1	
	PW	10(33.3%)	10(33.3%)	8(26.7%)	9(30%)	11(36.7%)	7(23.3%)	55	30.6	
	DWL	2(6.7%)	1(3.3%)	2(6.7%)	1(3.3%)	1(3.3%)	4(13.3%)	11	6.1	
	A	6(20%)	4(13.3%)	7(23.3%)	0(0%)	3(10%)	8(26.7%)	28	15.6	
Right middle finger	UL	21(70%)	20(66.7%)	24(80%)	23(76.7%)	16(53.3%)	24(80%)	128	71.1	0.511
	RL	0(0%)	1(3.3%)	0(0%)	0(0%)	0(0%)	0(0%)	1	0.6	
	PW	6(20%)	6(20%)	4(13.3%)	5(16.7%)	6(20%)	2(6.7%)	29	16.1	
	DWL	1(3.3%)	1(3.3%)	0(0%)	1(3.3%)	4(13.3%)	1(3.3%)	8	4.4	
	A	2(6.7%)	2(6.7%)	2(6.7%)	1(3.3%)	4(13.3%)	3(10%)	14	7.8	
Right ring finger	UL	10(33.3%)	9(30%)	8(26.7%)	10(33.3%)	8(26.7%)	11(36.7%)	56	31.1	0.423
	RL	0(0%)	0(0%)	0(0%)	1(3.3%)	0(0%)	0(0%)	1	0.6	
	PW	20(66.7%)	17(56.7%)	21(70%)	19(63.3%)	19(63.3%)	16(53.3%)	112	62.2	
	DWL	0(0%)	2(6.7%)	0(0%)	0(0%)	0(0%)	2(6.7%)	4	2.2	
	A	0(0%)	2(6.7%)	1(3.3%)	0(0%)	3(10%)	1(3.3%)	7	3.9	
Right little finger	UL	18(60%)	23(76.7%)	21(70%)	22(73.3%)	19(63.3%)	19(63.3%)	122	67.8	0.379
	RL	0(0%)	0(0%)	1(3.3%)	0(0%)	0(0%)	0(0%)	1	0.6	
	PW	11(36.7%)	7(23.3%)	7(23.3%)	8(26.7%)	9(30%)	8(26.7%)	50	27.8	
	DWL	1(3.3%)	0(0%)	1(3.3%)	0(0%)	1(3.3%)	0(0%)	3	1.7	
	A	0(0%)	0(0%)	0(0%)	0(0%)	1(3.3%)	3(10%)	4	2.2	

Table 3: Frequency of distribution of dermatoglyphic patterns in Growth pattern groups in all the digits of the left hand

Digit	Fingerprint Pattern	Average growth pattern	Vertical growth pattern	Horizontal growth pattern	Total	%	P value
Left thumb finger	UL	38(55.1%)	23(46%)	29(47.5%)	90	50	0.357
	RL	0(0%)	1(2%)	0(0%)	1	0.6	
	PW	11(15.9%)	4(8%)	10(16.4%)	25	13.9	
	DWL	16(23.2%)	14(28%)	18(29.5%)	48	26.7	
	A	4(5.8%)	8(16%)	4(6.6%)	16	8.9	
Left index finger	UL	22(31.9%)	17(34%)	30(49.2%)	69	38.3	0.529
	RL	4(5.8%)	2(4%)	1(1.6%)	7	3.9	
	PW	21(30.4%)	14(28%)	14(22.9%)	49	27.2	
	DWL	6(8.7%)	3(6%)	5(8.1%)	14	7.8	
	A	16(23.2%)	14(28%)	11(18%)	41	22.8	
Left middle finger	UL	42(60.9%)	31(62%)	39(63.9%)	112	62.2	0.785
	RL	1(1.4%)	0(0%)	0(0%)	1	0.6	
	PW	12(17.4%)	11(22%)	12(19.7%)	35	19.4	
	DWL	2(2.9%)	2(4%)	5(8.2%)	9	5	
	A	12(17.4%)	6(12%)	5(8.1%)	23	12.8	
Left ring finger	UL	21(30.43%)	15(30%)	24(39.3%)	60	33.3	0.816
	RL	0(0%)	0(0%)	0(0%)	0	0	
	PW	40(58%)	29(58%)	31(50.8%)	100	55.6	
	DWL	3(4.3%)	3(6%)	4(6.6%)	10	5.6	
	A	5(7.2%)	3(6%)	2(3.3%)	10	5.6	
Left little finger	UL	41(59.4%)	30(60%)	42(68.9%)	113	62.8	0.483
	RL	1(1.4%)	0(0%)	0(0%)	1	0.6	
	PW	21(30.4%)	13(26%)	14(23%)	48	26.7	
	DWL	2(2.9%)	4(8%)	2(3.3%)	8	4.4	
	A	4(5.8%)	3(6%)	3(4.9%)	10	5.6	

Table 4: Frequency of distribution of dermatoglyphic patterns in Growth pattern groups in all the digits of the right hand

Digit	Fingerprint Pattern	Average growth pattern	Vertical growth pattern	Horizontal growth pattern	Total	%	P value
Right thumb finger	UL	36(52.2%)	28(56%)	28(45.9%)	92	51.1	0.483
	RL	0(0%)	0(0%)	0(0%)	0	0	
	PW	17(24.6%)	8(16%)	19(31.1%)	44	24.4	
	DWL	13(18.8%)	9(18%)	8(13.1%)	30	16.7	
	A	3(4.3%)	5(10%)	6(9.8%)	14	7.8	
Right index finger	UL	37(53.6%)	21(42%)	26(42.6%)	84	46.7	0.230
	RL	0(0%)	1(2%)	1(1.6%)	2	1.1	
	PW	22(31.9%)	13(26%)	20(32.8%)	55	30.6	
	DWL	2(2.9%)	6(12%)	3(4.9%)	11	6.1	
	A	8(11.6%)	9(18%)	11(18%)	28	15.6	
Right middle finger	UL	50(72.5%)	39(78%)	39(63.9%)	128	71.1	0.529
	RL	0(0%)	1(2%)	0(0%)	1	0.6	
	PW	12(17.4%)	5(10%)	12(19.7%)	29	16.1	
	DWL	3(4.3%)	1(2%)	4(6.6%)	8	4.4	
	A	4(5.8%)	4(8%)	6(9.8%)	14	7.8	
Right ring finger	UL	23(33.3%)	14(28%)	19(31.1%)	56	31.1	0.894
	RL	0(0%)	0(0%)	1(1.6%)	1	0.6	
	PW	42(60.9%)	32(64%)	38(62.3%)	112	62.2	
	DWL	1(1.4%)	2(4%)	1(1.6%)	4	2.2	
	A	3(4.3%)	2(4%)	2(3.3%)	7	3.9	
Right little finger	UL	50(72.5%)	31(62%)	41(67.2%)	122	67.8	0.449
	RL	0(0%)	1(2%)	0(0%)	1	0.6	
	PW	17(24.6%)	17(34%)	16(26.2%)	50	27.8	
	DWL	1(1.4%)	1(2%)	1(1.6%)	3	1.7	
	A	1(1.4%)	0(0%)	3(4.9%)	4	2.2	

Discussion:

The dermatoglyphic patterns may serve as a non-invasive marker for identifying individuals with skeletal malocclusion at an early age; this gives an edge as skeletal malocclusion individuals generally undergo a long period of treatment which adds to their psychological burden along with the complexities of malocclusion. The present study was, therefore, conducted to correlate the relationship between fingerprint patterns and skeletal malocclusion.²²

Shreyas Tikare^[2] assessed the relationship between fingerprints and malocclusion. It was concluded that there was no statistically significant difference found in between the fingerprint pattern and malocclusions, which is in accordance with our present study. It was noted that the whorl pattern showed the highest predominance in Class I and Class II malocclusions whereas in our present study we noted that plain whorl pattern was more common in class III with mandibular excess group.

Neda Eslami and Arezoo Jahanbin^[23] evaluated and correlated the dermatoglyphic characteristics of different malocclusions. The participants were classified into three groups according to Angle's classification. It was concluded that there were some slight differences in dermatoglyphic peculiarities of different skeletal malocclusions with loop pattern showing the highest predominance in all the three malocclusions which is in accordance with our study where loop pattern (i.e. ulnar loop pattern) was the most frequent pattern found followed by whorl and arch patterns.

Boggula Rama Mohan Reddy *et al.*^[24] conducted a study on comparison of dermatoglyphics in individuals with normal occlusions and malocclusions and found that particular predictive occurrence of patterns was not found to be associated with each group which is in accordance with our present study where there was no association between dermatoglyphic patterns and sagittal skeletal discrepancies. He also found that there was an absence of radial loops in class III malocclusion and in our present study we have also

found that radial loop pattern was absent in class III skeletal malocclusion with mandibular excess group which is in similar with the previous study.

The amount of literature of available for assessing the correlation between dermatoglyphics and Growth patterns is very minimal. Harmeet Kaur *et al.*^[25] conducted a study on assessment of correlation between dermatoglyphics of individuals with different skeletal growth and found no significant correlation was observed between dermatoglyphics and various growth patterns which is in accordance with the present study where there was no overall significant correlation between dermatoglyphics and various growth patterns.

Conclusion

1. Within the fingerprint patterns, the ulnar loop pattern is the most frequent fingerprint pattern in all the fingers except right and left ring finger and the radial loop pattern was the least frequent.
2. The whorl pattern was the most frequent fingerprint pattern in right and left ring finger.
3. The frequency of ulnar loop pattern was comparatively more predominant in Skeletal class II with mandibular deficiency group and it was least frequent in Skeletal class III with mandibular excess group but there was no statistical significance.
4. There was an increase in frequency of plain whorl pattern in Skeletal class III with the mandibular excess group but there was no statistical significance.
5. There was no statistically significant correlation between dermatoglyphic patterns and sagittal skeletal discrepancies and growth patterns.
6. Hereby, we infer that there was an increase in frequency of certain fingerprint pattern in few groups yet we didn't have statistically significant correlation. The fingerprint pattern analysis even though being an easily accessible and non-invasive procedure yet its usefulness in

predicting skeletal malocclusion is questionable as ethnic and racial variations, congenital, environmental and other local factors can also influence the development of malocclusions which requires further studies.

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