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Original Article

Dentistry Section

An Assessment of Correlation between Dermatoglyphic Patterns and Sagittal Skeletal Discrepancies

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ABSTRACT

Introduction: Investigators over years have been fascinated by dermatoglyphic patterns which has led to the development of dermatoglyphics as a science with numerous applications in various fields other than being the best and most widely used method for personal identification.

Aim: To assess the correlation between dermatoglyphic patterns and sagittal skeletal discrepancies.

Materials and Methods: A total of 180 patients, aged 18-40 years, were selected from those who attended the outpatient clinic of the Deparment of Orthodontics and Dentofacial Orthopedics, Mar Baselios Dental College, Kothamangalam, Kerala, India. The fingerprints of both hands were taken by ink and stamp method after proper hand washing. The patterns of arches, loops and whorls in fingerprints were assessed. The total ridge count was also evaluated. Data was also sent to the fingerprint experts for expert evaluation. The sagittal jaw relation was determined from the patient's lateral cephalogram. The collected data was then statistically analyzed using Chi-square tests, ANOVA and Post-hoc tests and a Multinomial regression prediction was also done.

Results: A significant association was observed between the dermatoglyphic pattern exhibited by eight fingers and the sagittal skeletal discrepancies ($p<0.05$). An increased distribution of whorl pattern was observed in the skeletal Class II with maxillary excess group and skeletal Class II with mandibular deficiency group while an increased distribution of loop pattern was seen in the skeletal Class III with mandibular excess group and skeletal Class III with maxillary deficiency group. Higher mean of total ridge count was also seen in the groups of skeletal Class II with maxillary excess and skeletal Class II with mandibular deficiency. Multinomial regression predicting skeletal pattern with respect to the fingerprint pattern showed that the left thumb impression fits the best model for predicting the skeletal pattern.

Conclusion: There was a significant association between dermatoglyphic patterns and sagittal skeletal discrepancies. Dermatoglyphics could serve as a cost effective screening tool of these craniofacial problems.

Keywords: Fingerprints, Jaw abnormalities, Malocclusion, Screening

INTRODUCTION

Valleys and ridges together form unique patterns on the skin of palms, fingers, soles and toes. The term 'dermatoglyphics', which is the study of dermal ridge configurations on the palmar and plantar surfaces of the hands and feet, was coined by Harold Cummins and Midlo in 1926 [1,2]. Investigators over years have been fascinated by dermatoglyphic patterns which have led to the development of dermatoglyphics as a science with numerous applications in various fields like biology, medicine, genetics and evolution. It is the best and most widely used method for personal identification [3]. Dermatoglyphic analysis has proven to be a useful preliminary diagnostic investigation aid in conditions with a suspected genetic base [4,5].

Fingerprint analysis is based on the uniqueness of the fingerprints which is determined by the minute changes in the local foetal environment and the fact that they do not change during a person's life. Presence of pores on the surface of the ridges of fingers results in accumulation of perspiration on the fingertips which remains on the surface of the object a person touches, leaving prints [6,7]. Finger prints are usually categorized into three basic groups namely arches (60-65%), loops (30-35%) and whorls (5%) [3,8] [Table/Fig-1]. A person may have the same pattern on all ten fingers but various patterns often occur on different digits [3,9-11].

In medical dermatoglyphics, it has been shown that there is an association between fingerprint patterns and various conditions like diabetes mellitus, hypertension [12], psychosis [13], breast cancer [14], alcohol embryopathy [15], epilepsy [16], congenital heart diseases [17] and many other conditions [18]. In the field of dentistry, irregular fingerprints have been observed among patients with periodontitis [19], dental caries [20,21], certain types of congenital anomalies like cleft lip and palate [22,23] and recently, dermatoglyphics has been related to malocclusion [24-26] and other developmental disturbances of the orofacial structures [27-29].

Malocclusion is a common oral condition affecting facial aesthetics which may involve irregular alignment of teeth, faulty positioning of the jaws or a combination of both [30]. 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 [11,23,31,32]. Hereditary and environmental factors causing changes in the lip, alveolus and palate, may also cause abnormalities in the appearance of finger and palm prints [22,23]. Recent recognition of correlation between dermatoglyphics and oral clefts, periodontitis, and dental caries has drawn our attention to correlate dermatoglyphics and malocclusion such as sagittal skeletal discrepancies. Both genetic and environmental factors can affect the craniofacial development creating a multifactorial aetiology for sagittal skeletal discrepancies. It is assumed that the genetic message contained in the genome during this period may reflect in the dermatoglyphic patterns [33,34]. Dermatoglyphics could thus prove to be an effective screening tool and help to strengthen the diagnosis. It could also help in the early interceptive treatment of some sagittal skeletal discrepancies.

The aim of this study was to assess the correlation between dermatoglyphic patterns and sagittal skeletal discrepancies by

comparing and evaluating the palmar digital dermatoglyphic patterns in sagittal skeletal discrepancies: Ideal skeletal Class I, skeletal Class I with bimaxillary protrusion, skeletal Class II with maxillary excess, skeletal Class II with mandibular deficiency, skeletal Class III with mandibular excess and skeletal Class III with maxillary deficiency.

MATERIALS AND METHODS

The present cross-sectional study was conducted on 180 subjects (90 males, 90 females), aged 18-40 years randomly selected from the outpatient clinic of Department of Orthodontics and Dentofacial Orthopaedics, Mar Baselios Dental College, Kothamangalam from 20th April 2013 to 20th April 2014. The sample size was calculated by the formula

$$n = \left[\frac{z\alpha\sigma}{\frac{1}{E}}\right]^2 \left[\frac{1.96.6.95}{1}\right]^2$$

= $[13.62]^2$ =185.55=186 where n is the sample size, a 95% degree confidence corresponds to α=0.05, z the standard normal deviation, E the margin of error E=1 and standard deviation=6.95. To bring about uniformity during categorization, the total sample was adjusted to 180. The total sample of 180 subjects was categorized into six groups of 30 each:

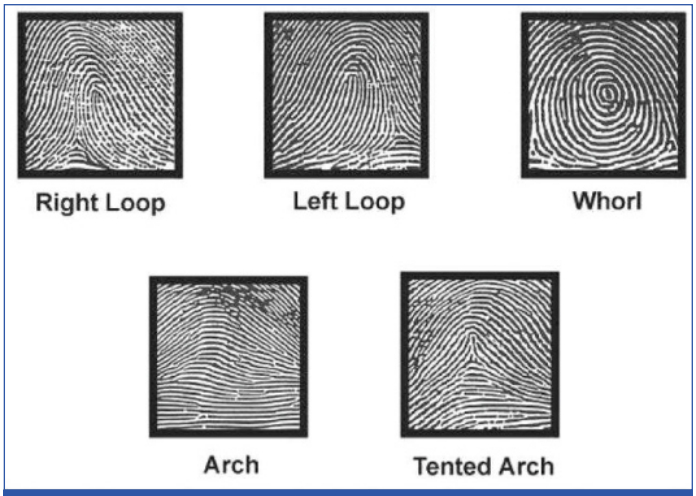
i. Ideal skeletal Class I;
ii. Skeletal Class I with bimaxillary protrusion;
iii. Skeletal Class II with maxillary excess;
iv. Skeletal Class II with mandibular deficiency;
v. Skeletal Class III with mandibular excess;
vi. Skeletal Class III with maxillary deficiency.

Only systemically healthy subjects of the age 18-40 years, who consented to participate in the study, and had not undergone any previous orthodontic treatment or oro maxillofacial surgery, were included. Patients with developmental anomalies, any systemic disease affecting bone and general health, children and pregnant women, mentally retarded patients, patients with both maxillary and mandibular excess and patients who did not give an informed consent were excluded from the study.

The study protocol was approved by the Institutional Ethics Committee of Mar Baselios Dental College, Kothamangalam, Kerala, India (IEC/31/2012/MBDC). The procedure was explained to the patients and a written informed consent was obtained from them with due consideration to ethical issues and confidentiality of fingerprint records.

The sagittal jaw relation was determined from the patient's lateral cephalogram with assessment of the following parameters: SNA, SNB, ANB, Wits appraisal, condylion to Point A, condylion to gnathion, angle of convexity and facial angle (Steiner's, Down's, Mcnamara and COGS analyses and Wits Apraisal). Points A and B were regarded as the anterior limits of the apical bases of maxilla and mandible and cephalometric norms of South Indian population were taken into consideration [Table/Fig-2]. The patients were thus categorized into six groups according to the skeletal relationship of maxilla and mandible.

The subjects were asked to clean their hands with soap and water and wipe with ethyl alcohol to remove the sweat, oil and dirt from the skin surface. The finger prints were recorded using the ink stamp method. The dried distal phalanges of both hands were rolled on an ink pad and stamped on bond paper which was fixed in place with adhesive tape [Table/Fig-3]. 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 [Table/Fig-4]. All the fingerprints taken, were verified for perfection. In order to protect this sensitive data, a double coding system was used i.e., the groups were coded and the data from each patient were also coded and was stored securely. The prints obtained were assessed for the frequency of arches, loops and whorls. The total ridge count was also evaluated. Interpretation of patterns was assessed according to the method by Cummins and Midlo [1]. Data was also sent to the fingerprint experts for expert evaluation.



[Table/Fig-1]: Types of fingerprint patterns.

STATISTICAL ANALYSIS

Data pertaining to the fingerprints were obtained and entered into an Excel spread sheet and imported to statistical software SPSS version 16.0 for descriptive and Chi-square analysis. The percentage frequency of arches, loops and whorls were assessed in the six groups and noted separately for the ten fingers of the right and left hands. The values obtained were statistically analysed using Chi-square tests, ANOVA and Post-hoc tests and a Multinomial regression prediction was also done. The level of significance was set at 5% and 95% confidence interval was taken.

RESULTS

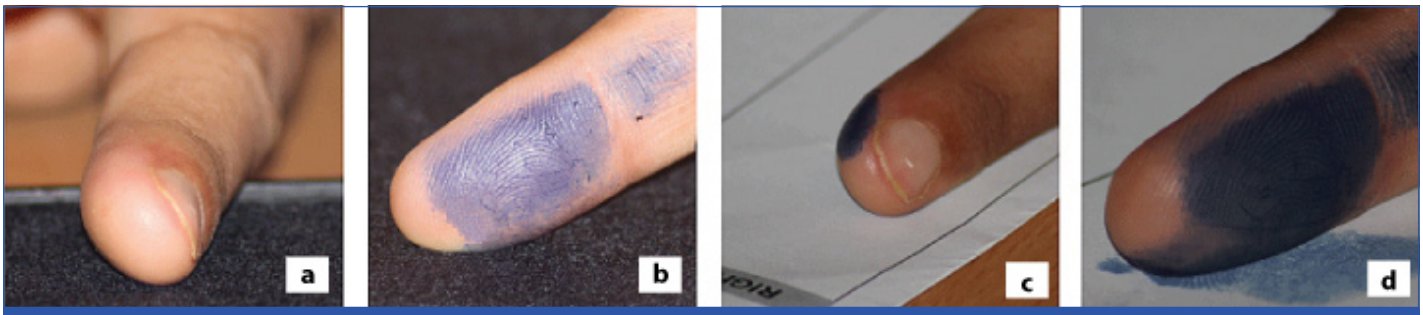
A total sample of 180 subjects was categorized into six groups with 30 subjects in each group based on the skeletal relationship of maxilla and mandible. The dermatoglyphic patterns for the ten fingers of these 180 subjects were recorded using ink stamp method. The fingerprints were observed and identified into arches, loops and whorls. These results were entered and calculated for each subject (N=180). The frequency distribution of the different dermatoglyphic patterns on the right and left hands in the 180 subjects categorized into six groups were assessed.

Loop and whorl patterns were more frequent than the arch pattern which was less than 5%. There was an increased distribution of whorl pattern in the skeletal Class II with maxillary excess group and skeletal Class II with mandibular deficiency group while there was an increased distribution of loop pattern in the skeletal Class III with mandibular excess group and skeletal Class III with maxillary deficiency group. Out of the ten fingers of each subject analysed, a significant association (p-value < 0.05) between the dermatoglyphic patterns was exhibited by eight fingers (left thumb, left index finger, left middle finger, left fourth finger, left fifth finger, right thumb, right index finger and right middle finger) and the sagittal skeletal discrepancies. It was seen that when the Chi-square test was done, the expected frequency was lower than what was expected within cells, so the Fisher's exact test was utilized to rule out the independency of these dermatoglyphic patterns and the sagittal discrepancies based on the statistical rule that when the total sample (N) is greater than 40, the Chi-square test should be used with Yates' correction [Table/Fig-5].

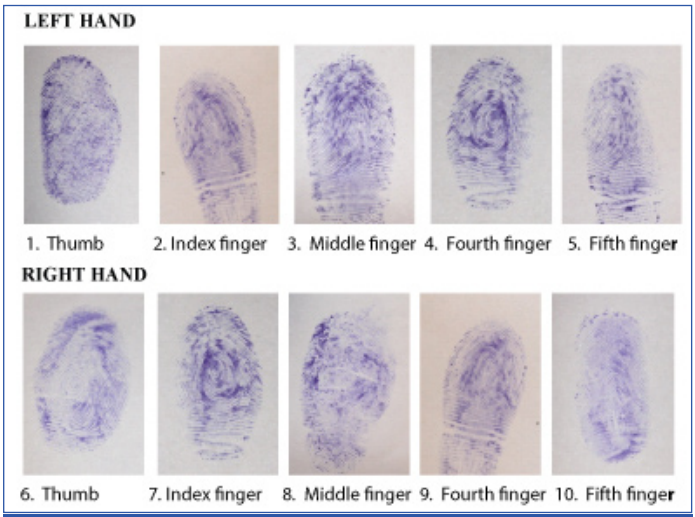
The mean total ridge count of the dermatoglyphic patterns was assessed for the ten fingers of the right and left hands in the six groups of sagittal skeletal discrepancies. The mean of total ridge count was higher in the groups of skeletal Class II with maxillary excess and skeletal Class II with mandibular deficiency [Table/Fig-6].

Category	Parameters									
	SNA	SNB	ANB	Wits Appraisal	Condylion to point A	Condylion to Gnathion	N to ANS	ANS to Gn	Angle of Convexity	Facial Angle
Ideal skeletal class I	82^0	79^0	2-4^0	0 to -1mm	92-96 mm	121-126 mm	50-53mm	66mm	2-4^0	82^0
Skeletal Class I with bimaxillary protrusion	82-84^0	79-80^0	4^0	0 to 1mm	92-98mm	121-126mm	48-50mm	67-69mm	7-10^0	82-86^0
Skeletal Class II with maxillary excess	>84^0	79^0	>4^0	>4mm	98-103mm	120-124 mm	>54mm	64mm	>10^0	80-82^0
Skeletal Class II with mandibular deficiency	82-84^0	<79^0	>4^0	3-4mm	90-92mm	<118mm	50-53mm	< 64 mm	>10^0	<82^0
Skeletal Class III with mandibular excess	82-83^0	>80^0	< -4^0	-4mm	90-92mm	>135mm	50-54mm	> 69 mm	-6 to -8^0	>95^0
Skeletal Class III with maxillary deficiency	<80^0	80-81^0	1 to -4^0	-2.5mm to -4mm	78-90mm	124mm	48-53mm	67-69mm	-2 to - 7^0	95-96^0

[Table/Fig-2]: Categorization of sagittal skeletal discrepancies.



[Table/Fig-3]: Method of taking finger prints.



[Table/Fig-4]: Types of fingerprint patterns.

As the dependent variables were multiple a multinomial regression prediction was done. This showed that the ridge count could be considered for predicting skeletal pattern [Table/Fig-7]. Multinomial regression predicting skeletal pattern with respect to the fingerprint pattern showed that the left thumb impression fits the best model for predicting the skeletal pattern [Table/Fig-8].

DISCUSSION

Dermatoglyphic patterns are genetically determined and their inheritance is considered to follow a classic polygenic model which has proved useful to study many genetic disorders [5]. Dermatoglyphic investigation being convenient, cost effective and non invasive, had been applied in many fields and dentistry has been no where behind in the race of investigation with several investigators utilizing this useful diagnostic tool to unveil genetic factors related to many oral diseases [34]. An early diagnosis and correction of deviated growth patterns of jaws through early interceptive orthodontic treatment may help preventing some of the future orthognathic surgeries [35].

It has been seen that though a person may have the same pattern on all ten fingers, various patterns often can occur on different digits. Loops were however the most common pattern on the fingertips. Whorls were most likely to be found on the thumb and the ring finger while radial loops and arches were most common on the index finger. On the little finger, the most frequent pattern was an ulnar loop [3,7,9-11].

In our study, an increased distribution of whorl pattern in the skeletal Class II with maxillary excess group and skeletal Class II with mandibular deficiency group while there was an increased distribution of loop pattern in the skeletal Class III with mandibular excess group and skeletal Class III with maxillary deficiency group. The mean of the total ridge count of the dermatoglyphic patterns were also assessed for the ten fingers of the right and left hands in the six groups of sagittal skeletal discrepancies. The ANOVA and Post-hoc tests showed that the percentage of total ridge count was also higher in skeletal Class II with maxillary excess and skeletal Class II with mandibular deficiency. Multinomial regression predicting skeletal pattern with respect to ridge count showed that the ridge count could be considered for predicting skeletal pattern. On the other hand the multinomial regression predicting skeletal pattern with respect to the fingerprint pattern showed that the left thumb impression fits the best model for predicting the skeletal pattern.

Previous studies have reported varying results. In a recent study comparing the dermatoglyphic characteristics of different malocclusions, some slight differences in dermatoglyphic peculiarities especially between Class I and Class III patients in terms of a-b ridge count were seen, while most other dermatoglyphic characteristics failed to indicate significant differences [35]. In another study on the association of dermatoglyphic features with different classes of malocclusion, although no fingerprint pattern was found to be specific for a particular class of malocclusion, in subjects with Class II malocclusion increased frequency of whorl pattern especially on the thumb was observed, while subjects with

	Dermatoglyphic Patterns	Ideal Skeletal Class I (n=30)	Skeletal Class I with Bimaxillary Protrusion (n=30)	Skeletal Class II with Maxillary excess (n=30)	Skeletal Class II with Mandibular deficiency (n=30)	Skeletal Class III with Mandibular excess (n=30)	Skeletal Class III with Maxillary deficiency (n=30)	Total (N=180)	%	(i), (ii), (iii) (Significance Level)
Left Thumb	Arch	1 (3.3%)	0 (0.0%)	0 (0.0%)	3 (10%)	0 (0.0%)	0 (0.0%)	4	2.2	35.517 31.988 0.314 (<0.001)*
	Loop	19 (63.3%)	18 (60%)	12 (40%)	13(43.3%)	28(93.3%)	23(76.7%	113	62.8	
	Whorl	10 (33.3%)	12(40%)	18(60%)	14 (46.7%)	2(6.7%)	7(23.3%)	63	35.0	
Left Index finger	Arch	0(0.0%)	0(0.0%)	0(0.0%)	7(23.3%)	4(13.3%)	12(40%)	23	12.8	59.383 55.362 0.409 (<0.001)*
	Loop	21(70%)	25(83.3%)	12(40%)	7(23.3%)	18(60%)	11(36.7%	94	52.2	
	Whorl	9(30%)	5(16.7%)	18(60%)	16(53.3%)	8(26.7%)	7(23.3%)	63	35.0	
Left middle finger	Arch	1 (3.3%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	6(20%)	7	3.9	30.019 18.198 0.289 (<0.001)*
	Loop	20(66.7%)	24(80%)	19(63.3%	24(80%)	19(63.3%)	17(56.7%	123	68.3	
	Whorl	9(30%)	6(20%)	11(36.7%	6(20%)	11(36.7%)	7(23.3%)	50	27.8	
Left fourth finger	Arch	0(0.0%)	0(0.0%)	0(0.0%)	2(6.7%)	0(0.0%)	3(10%)	5	2.8	21.098 17.799 0.242 (0.019) *
	Loop	14(46.7%)	12(40%)	14(46.7%	7(23.3%)	11(36.7%)	18(60%)	76	42.2	
	Whorl	16(53.3%)	18(60%)	16(53.3%	21(70%)	19(63.3%)	9(30%)	99	55.0	
Left fifth finger	Arch	2(6.7%)	0(0.0%)	0(0.0%)	2(6.7%)	0(0.0%)	0(0.0%)	4	2.2	21.427 18.252 0.244 (.012) *
	Loop	26(86.7%)	24(80%)	25(83.3%	17(56.7%)	28(93.3%)	23(76.7%	143	79.4	
	Whorl	2(6.7%)	6(20%)	5(16.7%)	11(36.7%)	2(6.7%)	7(23.3%)	33	18.3	
Right Thumb	Arch	0(0.0%)	0(0.0%)	0(0.0%)	3(10%)	6(20%)	0(0.0%)	9	5.0	27.881 21.388 0.278 (0.006) *
	Loop	16(53.3%)	13(43.3%)	18(60%)	14(46.7%)	18(60%)	15(50%)	94	52.2	
	Whorl	14(46.7%)	17(56.7%)	12(40%)	13(43.3%)	6(20%)	15(50%)	77	42.8	
Right Index finger	Arch	0(0.0%)	2(6.7%)	0(0.0%)	3(10%)	6(20%)	6(20%)	17	9.4	36.838 36.506 0.320 (<0.001)*
	Loop	15(50%)	18(60%)	3(10%)	15(50%)	11(36.7%)	12(40%)	74	41.1	
	Whorl	15(50%)	10(33.3%)	27(90%)	12(40%)	13(43.3%)	12(40%)	89	49.4	
Right middle finger	Arch	4(13.3%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	3(10%)	7	3.9	27.847 23.393 0.278 (0.002)*
	Loop	14(46.7%)	27(90%)	21(70%)	26(86.7%)	20(66.7%)	20(66.7%	128	71.1	
	Whorl	12(40%)	3(10%)	9(30%)	4(13.3%)	10(33.3%)	7(23.3%)	45	25.0	
Right fourth finger	Arch	2(6.7%)	0(0.0%)	0(0.0%)	0(0.0%)	0(0.0%)	3(10%)	5	2.8	16.540 12.756 0.214 (0.138)
	Loop	10(33.3%)	12(40%)	9(30%)	8(26.7%)	14(46.7%)	14(46.7%	67	37.2	
	Whorl	18(60%)	18(60%)	21(70%)	22(73.3%)	16(53.3%)	13(43.3%	108	60.0	
Right fifth finger	Arch	0(0.0%)	0(0.0%)	0(0.0%)	2(6.7%)	0(0.0%)	0(0.0%)	2	1.1	19.148 14.917 0.231 (0.053)
	Loop	26(86.7%)	22(73.3%)	22(73.3%	20(66.7%)	28(93.3%)	20(66.7%	138	76.7	
	Whorl	4(13.3%)	8(26.7%)	8(26.7%)	8(26.7%)	2(6.7%)	10(33.3%	40	22.2	

[Table/Fig-5]: Distribution of dermatoglyphic patterns within the six groups of sagitttal skeletal discrepancies for the 10 fingers (N = 180) using: Pearson Chi-square test, Fisher test and Cramer test. * shows p-value significant at 0.05. (i) is the Chi-square value, (ii) is the Fisher exact value and (iii) is the Cramer's V value.

Class III malocclusion showed an increased frequency of plain arches [34]. Results of a previous study using dermatoglyphics to predict and compare Class I, Class II Div 1, Div 2 and Class III malocclusions revealed that the craniofacial Class II Div 1, Class II Div 2 patterns were associated with an increased frequency of arches and ulnar loops and a decreased frequency of whorls [24]. However, in one dermatoglyphic study of normal occlusion and malocclusion, as compared to normal occlusion, Class I and Class III malocclusions were associated with an increased frequency of whorls but both Class I and Class II Div 1 malocclusions were associated with an increased frequency of radial loops and arches [25]. Another comparative study of dermatoglyphics in individuals with normal occlusion and malocclusions indicated a decreased frequency of radial loops, twinned loops and central pocket loops associated with Class III malocclusions. No significant increase in arches in Class III malocclusions was found except on the middle finger.

In another study comparing the dermatoglyphic patterns with normal, hypodivergent and hyperdivergent subjects, an increased presence of loop pattern followed by whorls and arches was observed in hypodivergent growth pattern. However, an increased presence of whorl pattern followed by loops and arches was seen in the hyperdivergent growth pattern. Nearly the same pattern of distribution of loops and whorls was observed in subjects with average growth pattern. These average growth subjects also showed an increased presence of arch pattern than hypodivergent and hyperdivergent growth pattern [36]. There was a significant increase in whorls in Class II Div 1 cases. The sensitivity values were found to be higher and more reliable in predicting Class III malocclusions based on the frequency of arches, than those of Class II Div 1 and Div 2 malocclusions [37]. Another study assessing the relationship between fingerprints and malocclusion found that though there was no overall statistical association observed between fingerprint patterns and malocclusion, a significant statistical association was

Groups	Mean	Std. Deviation	F statistic	p-value
Ideal Skeletal Class I (n=30)	85.9333	21.82838	13.441	<0.001
Skeletal Class I with Bimaxillary Protrusion (n=30)	92.4333	11.43402		
Skeletal Class II with Maxillary Excess (n=30)	111.6667	9.11359		
Skeletal Class II with Mandibular Deficiency (n=30)	102.1667	23.89933		
Skeletal Class III with Mandibular Excess (n=30)	78.1667	19.48843		
Skeletal Class III with Maxillary Deficiency (n=30)	77.9	28.45002		
Total	91.3778	23.46021		

[Table/Fig-6]: ANOVA (F statistic) test for mean of ridge count between the six groups of skeletal sagittal discrepancies.

Parameter Estimates						
Groups[a]		Intercept[b]	Sig. (p-value)	Odds ratio	95% Confidence Interval	
					Lower Bound	Upper Bound
Ideal Skeletal Class I	Intercept	-1.337	0.183			
	ridge count	0.016	0.167	1.016	.993	1.040
Skeletal Class I with bimaxillary protrusion	Intercept	-2.616	0.017			
	ridge count	0.031	0.013	1.031	1.006	1.056
Skeletal Class II with maxillary excess	Intercept	-9.850	<0.001			
	ridge count	0.100	<0.001	1.106	1.064	1.149
Skeletal Class II with mandibular deficiency	Intercept	-5.239	<0.001			
	ridge count	0.058	<0.001	1.059	1.030	1.089
Skeletal Class III with mandibular excess	Intercept	-0.041	0.965			
	ridge count	0.001	0.963	1.001	0.978	1.023

[Table/Fig-7]: Multinomial regression predicting skeletal pattern with respect to the ridge count.
a. The reference category is: Skeletal Class III with maxillary deficiency
b. A statistical term used for the multinomial regression

Parameter Estimates						
Groups[a]		Intercept[b]	Sig. (p-value)	Odds ratio	95% Confidence Interval	
					Lower Bound	Upper Bound
Ideal Skeletal Class I	Intercept	0.452	0.350			
	(Left thumb print=2.00)	-0.643	0.263	0.526	0.171	1.620
	(Left thumb print=3.00)	0[b]	-	-	-	-
Skeletal Class I with bimaxillary protrusion	Intercept	0.539	0.257			
	(Left thumb print=2.00)	-0.784	0.169	0.457	0.149	1.396
	(Left thumb print=3.00)	0[b]	-	-	-	-
Skeletal Class II with maxillary excess	Intercept	0.944	0.034			
	(Left thumb print=2.00)	-1.595	0.005	0.203	0.066	0.620
	(Left thumb print=3.00)	0[b]	-	-	-	-
Skeletal Class II with mandibular deficiency	Intercept	0.887	0.048			
	(Left thumb print=2.00)	-1.458	0.010	0.233	0.077	0.708
	(Left thumb print=3.00)	0[b]	.	-	-	-
Skeletal Class III with mandibular excess	Intercept	-1.253	0.118			
	(Left thumb print=2.00)	1.449	0.088	4.261	0.806	22.532
	(Left thumb print=3.00)	0[b]	-	-	-	-

[Table/Fig-8]: Multinomial regression predicting skeletal pattern with respect to the finger print pattern.
a. The reference category is: Skeletal Class III with maxillary deficiency. b. This parameter is set to zero because it is redundant.

seen with whorl patterns and Class I and Class II malocclusion [26]. A dermatoglyphic evaluation of twenty five North Indian males with true mandibular prognathism revealed an association with an increase in arches and ulnar loops at the expense of whorls on all digits except the index finger with the craniofacial skeletal Class III pattern. There was an increased frequency of whorls and radial loops and carpel loops on the interdigital area of palms [28]. The disparity in results could be due to variations in sample size, differences in protocol for recording fingerprint patterns, ethnic and racial variations etc.

According to the current study, dermatoglyphics can be used in clinical situations to add on to the diagnostic impression of the sagittal skeletal relationships of maxilla and mandible. An example in this context would be the association of an increased whorl pattern with skeletal Class II with maxillary excess and skeletal Class II with mandibular deficiency. This dermatoglyphic information not only adds to strengthen the diagnosis, but a prompt diagnosis and efficient treatment planning could be used in utilizing the catch up growth of the mandible. This is true for early interception in a young child presenting with skeletal Class II with mandibular deficiency. Thus, in the long run the duration and complexity of the next phase of comprehensive treatment would be greatly reduced. Multicentre studies are thus highly recommended to deliver a generalized impression especially in utilizing the potential of dermatoglyphics

as a screening tool which will eventually lead to early and timely orthodontic interception.

The present study had some limitations. This was a hospital based study as the subjects recruited were those who visited the hospital for treatment purposes. In order to establish an association with dermatoglyphic patterns and sagittal discrepancies, observations should be made on a larger sample which is representative of entire population. The recording of fingerprints was much dependent on the pliable nature of application of fingerprint pressure which could lead to incomplete fingerprints. The ink stamp method has its limitations with many a times recording of smudged fingerprints. Digitalized fingerprint sensors could be useful to overcome this limitation. Galton's classification of dermatoglyphic patterns into arches, loops and whorls was used in the current study, however, composite fingerprint patterns were noted in a few patients and these patterns were recorded according to the majority of the patterns exhibited by ten fingers. The presence of scars, warts and deterioration of ridge minutiae patterns in people who did a lot of manual work did bring about difficulty in identification of fingerprints and thus errors in the fingerprint recognition system. The training in fingerprint recognition is mostly for good quality fingerprints and not for worn and damaged fingerprint patterns.

CONCLUSION

There is a significant association between dermatoglyphic patterns and sagittal skeletal discrepancies. Dermatoglyphics could be used as a cost effective tool for the preliminary investigation of sagittal skeletal discrepancies and could also strengthen the diagnostic impression of these craniofacial problems. Identifying these problems at an early age by the utilization of this dermatoglyphic information could eventually lead to formulate an efficient treatment plan.

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