Research Article

A Correlative Study to Assess the Relationship among Ameloglyphics, Cheiloscopy, Rugoscopy in Skeletal and Dental Malocclusions

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ABSTRACT

Introduction: Benefits of preventive and interceptive orthodontic procedures can be availed by early prediction of malocclusion. Early diagnosis is achievable when parameters having similar embryological origin and development period, similar to that of the craniofacial structures are identified and studied. Few such parameters are the enamel rod end patterns, lip prints, and palatal rugae patterns. The intent of this study was to assess the correlation between ameloglyphics, cheiloscopy, rugoscopy and skeletal and dental malocclusions.

Materials and Method: A cross-sectional study with one hundred subjects were classified into 3 groups based on cephalometric analysis into skeletal class I, class II and class III malocclusion and were further divided into 4 dental malocclusion groups namely class I, class II division 1, class II division 2 and class III based on the Angle's classification of malocclusion. Ameloglyphics patterns, lip prints and palatal rugae patterns were recorded for each subject and statistically analyzed with chi-square test and Spearman correlation test.

Result: Class I malocclusion subjects revealed a predominant curve palatal rugae pattern, type II lip print pattern and wavy branched ameloglyphics patterns were observed with statistically significant association. In class II malocclusion, the predominant palatal rugae pattern observed was straight pattern, type I lip print pattern and linear branched ameloglyphics patterns were statistically significant. Subjects in class III malocclusion group were associated significantly with the annular pattern of palatal rugae, type I lip print pattern, and stem pattern of ameloglyphics.

Conclusion: A curve rugae pattern in class I malocclusion, a straight pattern in class II malocclusion, and an annular pattern in class III malocclusion were observed. For the Lip Prints, a highly statistically significant association was observed between class I malocclusion and type II lip print pattern. Ameloglyphics, revealed a statistically significant association between wavy branched pattern and class I malocclusion, linear branched pattern and class II malocclusion and stem pattern with class III malocclusion.

KEYWORDS: Ameloglyphics, Cheiloscopy, Dental malocclusion, Rugoscopy, Skeletal malocclusion.

INTRODUCTION

Foreseeing malocclusions reduces the burden of future complex orthodontic treatments.[1] Structures formed during intrauterine life around the timeline of craniofacial development that remain stable throughout life can be used as potential tools to predict malocclusions.[2] Dermal ridges of skin on palms and soles, furrows on lips, palatal rugae, enamel rods of teeth begin to develop around the 6th week of intrauterine life[3] and remain stable throughout life. They are unique to each individual, stable, and highly reproducible. Their use has been extensive in the fields of forensics and human anthropology for person identification.[4] Remarkable work has been done over the years to predict systemic conditions like diabetes mellitus, hypertension[5], psychosis[6], breast cancer[7] and leukemia[8] using dermal ridge patterns of skin on palms and soles[9]. In the field of dentistry, there is a recent upsurge of research focusing on the application of rugoscopy, cheiloscopy and dermatoglyphics to predict future periodontitis, dental caries[10], skeletal and dental malocclusions[11]. This study is the first of its kind applying ameloglyphics to predict skeletal and dental malocclusions.

MATERIALS AND METHODS:

A total of one hundred (sample size calculated with power of the study set at 0.8, effect size of 0.5 and significance level set at 0.05) patients of age group 13 – 30 years who reported for orthodontic treatment were selected from the Department of Orthodontics and Dentofacial Orthopedics, Panineeya Mahavidyalaya Institute of Dental Sciences and Research Center.

This study was conducted after obtaining ethical clearance from the institution (IEC No: PMVIDS&RC/IEC/ORTHO/DN/367-20) (Panineeya Mahavidyalaya, Institute of Dental Sciences & Research Centre, Hyderabad – Communication of Decision of the Institutional Ethics Committee (IEC)- ECR/267/Indt/AP/2016) and informed consent from the patients.

The patients included in the present study were of Asian ethnicity and South Indian demography.

The inclusion criteria[3] were:

1. Patients in the age group 13 – 30 years
2. Systemically healthy patients
3. Patients who did not undergo any orthodontic treatment previously
4. Patients who had consented to the study

The exclusion criteria[3] were:

1. Patients who had undergone orthodontic treatment
2. Patients with any enamel deformation disorders
3. Patients with fluorosis
4. Patients with dental caries or dental restorations
5. Patients with erosions, abrasions, attrition on teeth
6. Patients with tooth fractures
7. Patients with cleft lip and palate and those patients who underwent surgical procedures in the orofacial region
8. Patients with syndromes or systematic anomalies
9. Patients with any lesion on the lips
10. Patients who did not give informed consent

Enamel rod prints and lip prints and palatal rugae patterns from study models were recorded from every subject to evaluate their patterns. Cephalometric X-rays of the subjects were used to divide them on the basis of sagittal skeletal malocclusion into Class I, Class II and Class III groups (Fig. 1) using the following parameters: SNA, SNB, ANB (Steiner's analysis), Wits appraisal, condylion to Point A, condylion to gnathion (McNamara analysis), angle of convexity (Down's analysis). Study models of the subjects were used to group according to dental malocclusion into Class I, Class II division 1, Class II division 2 and Class III groups based on the Angle's classification system (Fig. 2).[3]

Figure 1: Cephalograms showing skeletal class I, II and III pattern

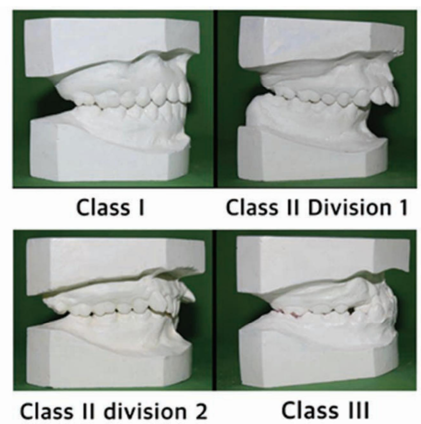

Figure 2: Study models with Class I, Class II division 1, Class II division 2, Class III malocclusion

Cellulose acetate peel technique[12], was used for recording the enamel rod patterns. The subjects were seated in the dental chair. Mandibular right first molar was isolated and etched with 37% Orthophosphoric acid for 15 seconds (Fig. 3). The applied etchant was cleaned from the surface of the tooth with copious amounts of irrigation with water and air-dried using the air jet of a 3-way syringe. A dry field was constantly maintained using a low-volume evacuator. The etched tooth surface was dried till a white frosty appearance was attained. Acetone was applied over a piece of cellulose acetate sheet and transferred onto the etched tooth surface with the help of a tweezer. The cellulose acetate sheet was held in place until the acetone dried completely. The cellulose acetate sheet was peeled gently from the tooth surface, avoiding any warping of the peel and tears. This cellulose acetate peel was then transferred onto a coverslip and was secured in position with the help of cellophane tape and stored in an airtight zip lock bag (Fig 4).

Figure 3: Etching mandibular right first molar for enamel rod pattern

Figure 4: Materials required for ameloglyphics and the sample collected

The attained peels were observed under the stereomicroscope[13] (Fig. 5) and photomicrographs were recorded (Fig. 6). These photomicrographs were then subjected to biometric evaluation using Rapid Sizer® image editing software (Rapid Resizer, Patrick Roberts, Collingwood, Ontario, Canada)[14] (Fig. 7). The patterns attained post-biometric evaluation were classified based on their shapes[12] (Fig. 8). Evaluation of the lip prints was done following the lipstick-cellophane technique[15] (Fig. 9). The lip prints were recorded by making the subjects sit in a relaxed position in a dental chair. The subject's lips were cleaned prior to recording the lip prints with a wet cotton swab. On clean and dry lips, lipstick of a dark color was applied with the help of a lip brush evenly. The glued portion of the cellophane tape was then adapted onto the lips starting from the center of the lips to the corners (Fig. 10). The lip print record was then stuck onto a white A4-sized paper in order to maintain it as a permanent record (Fig. 11). Lip print evaluation was performed by observing the recorded prints using a magnifying glass and classified according to the Suzuki and Tsuchihashi et al.[16] For classification, the middle part of the lower lip (10 mm wide) was taken as the study area.[16] The lip print pattern was determined by counting the highest number of lines in this area (Fig. 12).

Figure 5: Stereomicroscope

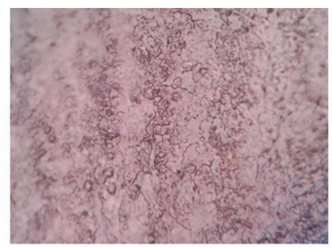

Figure 6: Photomicrograph of enamel rod patterns

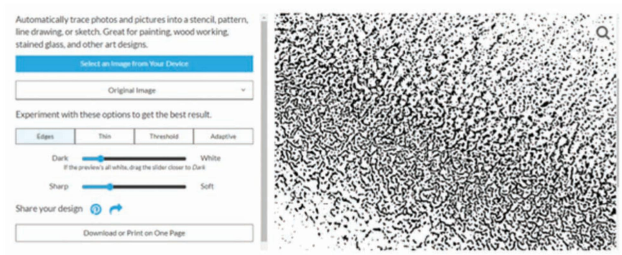

Figure 7: Photomicrograph converted to a stencil image for visual biometric evaluation (Image showing wavy unbranched ameloglyphics patterns)

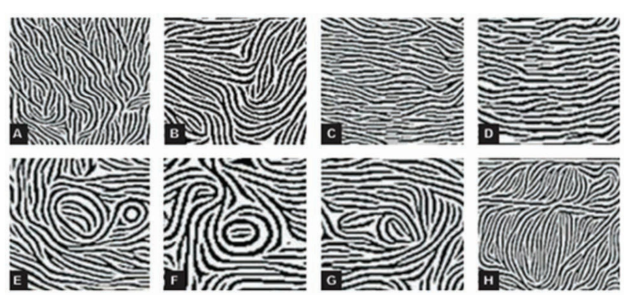

Figure 8: Subtypes of Ameloglyphic pattern. A: Wavy branched; B: Wavy unbranched; C: Linear branched; D: Linear unbranched; E: Whorl open; F: Whorl closed; G: Loop; H: Stem like[12]

Figure 9: Material required for recording lip prints

Figure 10: Lip print recording using cellophane tape technique

Figure 11: Lip prints stuck on to a white paper

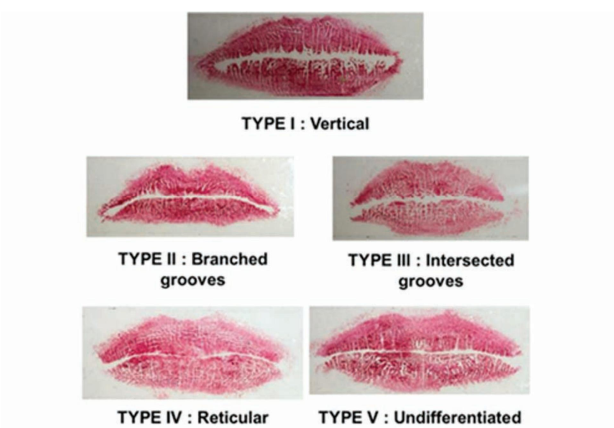

Figure 12: Suzuki and Tsuchihashi classification (1970) for lip prints

Alginate impressions of the subjects were made and study models were prepared using high quality dental plaster. Care was taken that the palatal rugae patterns on the study models were clear and visible, the models with unclear palatal rugae patterns were excluded from the study. The dental malocclusion of the patient was identified clinically and also recorded from the prepared study models (Fig. 13). The number and pattern of palatal rugae were determined from the pretreatment maxillary cast models in all groups[17] (Fig. 14). The modified Thomas and Kotze classification system (Fig. 15) was used to determine the types of palatal rugae.

Figure 13: Materials required for rugoscopy

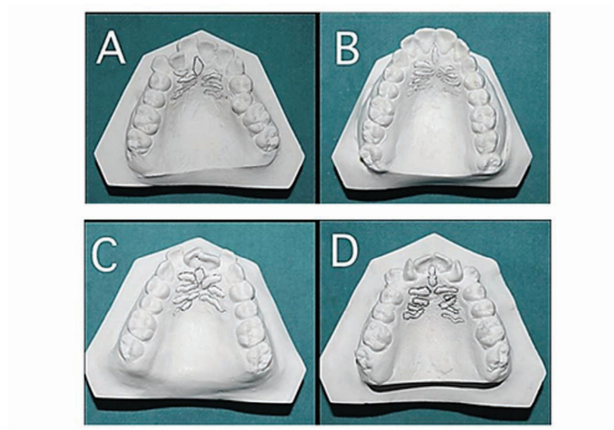

Figure 14: Palatal rugae patterns. A: Class I malocclusion; B: Class II division 1 malocclusion; C: Class II division 2; Class III malocclusion

Figure 15: Modified Thomas and Kotze classification (1983) of the palatal rugae (A) straight, (B)curve, (C) wavy, (D) unification, (E) annular pattern.[11]

RESULTS:

The lip prints, palatal rugae morphology and ameloglyphics data was entered into a master excel sheet and descriptive statistics were performed. The data was analyzed using SPSS (version 23). The frequencies of the patterns were calculated as percentages and chi-square test was done for comparison between the various parameters.

Intragroup comparison was also done for the palatal rugae, morphology on the right and left side for all three skeletal malocclusions and all four dental malocclusions and intergroup comparison was done in all three skeletal malocclusion groups and four dental malocclusion groups for lip prints and palatal rugae morphology and ameloglyphics.

Spearman correlation test was performed among all the groups to evaluate the correlation among ameloglyphics, cheiloscopy and rugoscopy in skeletal and dental malocclusions.

Association of 1st right palatal rugae (RP1) and 1st left palatal rugae (LP1) with dental and skeletal malocclusion revealed that: (Table 1,2 and 3,4)

1.1. In class I malocclusion – Highly statistically significant results were obtained, with curve as common pattern in both RP1 and LP1 in class I malocclusion subjects.

1.2. In class II malocclusion – Highly statistically significant results were obtained. Unification pattern was commonly observed as RP1 and curve pattern as LP1 in class II division 1 malocclusion. RP1 and LP1 in class II division 2 and skeletal class II malocclusion showed a straight pattern predominantly.

1.3. In class III malocclusion – Highly statistically significant association was seen with annular and unification RP1 patterns. When compared with LP1, annular pattern was common.

Table 1: Distribution and association of right palatal rugae pattern 1 (RP1) with the dental malocclusion

Dental malocclusion		RP1						Total	Chi-square	p-value
		Straight	Annular	Curve	Unification	Wavy	None			
Class I	N	2	1	17	8	12	0	40	59.066	<0.001*
	%	5.0	2.5	42.5	20.0	30.0	0	100.0		
Class II Division 1	N	5	0	4	11	3	0	23		
	%	21.7	0.0	17.4	47.8	13.0	0	100.0		
Class II Division 2	N	8	0	4	1	0	0	13		
	%	61.5	0.0	30.8	7.7	0.0	0	100.0		
Class III	N	3	8	2	8	3	0	24		
	%	12.5	33.3	8.3	33.3	12.5	0	100.0		
Total	N	18	9	27	28	18	0	100		
	%	18.0	9.0	27.0	28.0	18.0	0	100.0		

*<0.05 = Statistically significant

Table 2: Distribution and association of left palatal rugae pattern 1 (LP1) with the dental malocclusion

Dental malocclusion		RP1						Total	Chi-square	p-value
		Straight	Annular	Curve	Unification	Wavy	None			
Class I	N	5	1	15	6	13	0	40	61.494	<0.001*
	%	12.5	2.5	37.5	15.0	32.5	0	100.0		
Class II Division 1	N	5	0	7	6	5	0	23		
	%	21.7	0.0	30.4	26.1	21.7	0	100.0		
Class II Division 2	N	10	0	1	2	0	0	13		
	%	76.9	0.0	7.7	15.4	0.0	0	100.0		
Class III	N	5	9	1	8	1	0	24		
	%	20.8	37.5	4.2	33.3	4.2	0	100.0		
Total	N	25	10	24	22	19	0	100		
	%	25.0	10.0	24.0	22.0	19.0	0	100.0		

*<0.05 = Statistically significant

Table 3: Distribution and association of right palatal rugae pattern 1 (RP1) with the skeletal malocclusion

Skeletal malocclusion		RP1						Total	Chi-square	p-value
		Straight	Annular	Curve	Unification	Wavy	None			
Class I	N	2	1	17	8	12	0	40	45.583	<0.001*
	%	5.0	2.5	42.5	20.0	30.0	0	100.0		
Class II	N	13	0	8	12	3	0	36		
	%	36.1	0.0	22.2	33.3	8.3	0	100.0		
Class III	N	3	8	2	8	3	0	24		
	%	12.5	33.3	8.3	33.3	12.5	0	100.0		
Total	N	18	9	27	28	18	0	100		
	%	18.0	9.0	27.0	28.0	18.0	0	100.0		

*<0.05 = Statistically significant

Table 4: Distribution and association of left palatal rugae pattern 1 (LP6) with the skeletal malocclusion

Skeletal malocclusion		RP1						Total	Chi-square	p-value
		Straight	Annular	Curve	Unification	Wavy	None			
Class I	N	5	1	15	6	13	0	40	47.089	0.000*
	%	12.5	2.5	37.5	15.0	32.5	0	100.0		
Class II	N	15	0	8	8	5	0	36		
	%	41.7	0.0	22.2	22.2	13.9	0	100.0		
Class III	N	5	9	1	8	1	0	24		
	%	20.8	37.5	4.2	33.3	4.2	0	100.0		
Total	N	25	10	24	22	19	0	100		
	%	25.0	10.0	24.0	22.0	19.0	0	100.0		

*<0.05 = Statistically significant

Association of lip prints with dental and skeletal malocclusion revealed that: (Table 5 and 6)

2.1. In class I malocclusion – A highly statistically significant association was observed with type II lip print pattern and class I malocclusion

2.2. In class II malocclusion – Highly statistically significant association was observed. Type I lip print pattern was common in class II malocclusion.

2.3. In class III malocclusion – Type I lip print pattern was highly statistically significantly associated with class III malocclusion.

Table 5: Distribution and association of lip prints with the dental malocclusion

Dental malocclusion		Lip prints					Total	Chi-square	p-value
		Type I	Type II	Type III	Type IV	Type V			
Class I	N	6	24	2	8	0	40	32.301	0.001*
	%	15.0	60.0	5.0	20.0	0.0	100.0		
Class II Division 1	N	12	7	4	0	0	23		
	%	52.2	30.4	17.4	0.0	0.0	100.0		

Dental malocclusion		Lip prints					Total	Chi-square	p-value
		Type I	Type II	Type III	Type IV	Type V			
Class II Division 2	N	8	3	1	1	0	13		
	%	61.5	23.1	7.7	7.7	0.0	100.0		
Class III	N	9	7	2	3	3	24		
	%	37.5	29.2	8.3	12.5	12.5	100.0		
Total	N	35	41	9	12	3	100		
	%	35.0	41.0	9.0	12.0	3.0	100.0		

*<0.05 = Statistically significant

Table 6: Distribution and association of lip prints with the skeletal malocclusion

Skeletal malocclusion		Lip prints					Total	Chi-square	p-value
		Type 1	Type 2	Type 3	Type 4	Type 5			
Class I	N	6	24	2	8	0	40	30.706	<0.001*
	%	15.0	60.0	5.0	20.0	0.0	100.0		
Class II	N	20	10	5	1	0	36		
	%	55.6	27.8	13.9	2.8	0.0	100.0		
Class III	N	9	7	2	3	3	24		
	%	37.5	29.2	8.3	12.5	12.5	100.0		
Total	N	35	41	9	12	3	100		
	%	35.0	41.0	9.0	12.0	3.0	100.0		

*<0.05 = Statistically significant

Association of ameloglyphics with dental and skeletal malocclusion revealed that: (Table 7 and 8)

3.1. In class I malocclusion – Statistically significant association of wavy branched pattern of ameloglyphics was observed.

3.2. In class II malocclusion – Statistically significant association was noticed. In class II division 1 dental malocclusion and class II skeletal malocclusion, linear branched pattern was predominant, while in class II division 2 malocclusion, both wavy branched and linear branched patterns were observed.

3.3. In class III malocclusion – Statistically significant association was observed in class III malocclusion with stem pattern of ameloglyphics.

Table 7: Distribution and association of ameloglyphics with the dental malocclusion

Dental malocclusion		Ameloglyphics							Total	Chi-square	p-value
		Wavy B	Wavy UB	Linear B	Linear UB	Stem	Whorl	Loop			
Class I	N	18	4	9	3	5	1	0	40	39.563	0.002*
	%	45.0%	10.0%	22.5%	7.5%	12.5%	2.5%	0.0%	100.0		
Class II Division 1	N	4	3	10	3	1	1	1	23		
	%	17.4%	13.0%	43.5%	13.0%	4.3%	4.3%	4.3%	100.0		

Dental malocclusion		Ameloglyphics							Total	Chi-square	p-value
		Wavy B	Wavy UB	Linear B	Linear UB	Stem	Whorl	Loop			
Class II Division 2	N	3	0	3	2	1	1	3	13		
	%	23.1%	0.0%	23.1%	15.4%	7.7%	7.7%	23.1%	100.0		
Class III	N	6	0	8	0	9	1	0	24		
	%	25.0%	0.0%	33.3%	0.0%	37.5%	4.2%	0.0%	100.0		
Total	N	31	7	30	8	16	4	4	100		
	%	31.0%	7.0%	30.0%	8.0%	16.0%	4.0%	4.0%	100.0		

*<0.05 = Statistically significant

Table 8: Distribution and association of ameloglyphics with the skeletal malocclusion

Skeletal malocclusion		Ameloglyphics							Total	Chi-square	p-value
		Wavy B	Wavy UB	Linear B	Linear UB	Stem	Whorl	Loop			
Class I	N	18	4	9	3	5	1	0	40	28.674	0.004*
	%	45.0	10.0	22.5	7.5	12.5	2.5	0.0	100.0		
Class II	N	7	3	13	5	2	2	4	36		
	%	19.4	8.3	36.1	13.9	5.6	5.6	11.1	100.0		
Class III	N	6	0	8	0	9	1	0	24		
	%	25.0	0.0	33.3	0.0	37.5	4.2	0.0	100.0		
Total	N	31	7	30	8	16	4	4	100		
	%	31.0	7.0	30.0	8.0	16.0	4.0	4.0	100.0		

*<0.05 = Statistically significant

The Spearman's correlation test revealed that there was a statistically significant correlation between the dental and skeletal malocclusions and the first palatal rugae pattern on the right side and a highly statistically significant correlation on the left side. A significant correlation was noticed between dental malocclusions and ameloglyphics patterns. The correlation between the palatal rugae pattern and the ameloglyphics pattern showed a statistically significant correlation between the first and second right palatal rugae pattern and the second left palatal rugae pattern (Table 9 and 10).

Table 9: Correlation between ameloglyphics, cheiloscopy, rugoscopy and dental malocclusion

Correlation	Dental malocclusion		Lip prints		Ameloglyphics	
	R value	P value	R value	P value	R value	P value
RP1	-0.275	0.006*	0.108	0.286	-0.274	0.006*
RP2	-0.147	0.146	-0.049	0.628	-0.255	0.010*
RP3	-0.122	0.228	0.137	0.173	-0.085	0.401
RP4	0.043	0.672	0.001	0.994	-0.041	0.688
RP5	-0.075	0.460	-0.173	0.086	-0.091	0.369
RP6	-	-	-	-	-	-

Correlation	Dental malocclusion		Lip prints		Ameloglyphics	
	R value	P value	R value	P value	R value	P value
LP1	-0.319	0.000*	-0.020	0.844	-0.148	0.142
LP2	-0.096	0.344	0.080	0.432	-0.259	0.009*
LP3	-0.055	0.585	0.079	0.433	-0.146	0.147
LP4	-0.094	0.354	-0.157	0.118	0.014	0.893
LP5	0.046	0.649	-0.159	0.114	0.013	0.895
LP6	-	-	-	-	-	-
LIP prints	-0.142	0.159	-	-	-0.119	0.240
Ameloglyphics	0.273	0.006*	-0.119	0.240	-	-

Table 10: Correlation between ameloglyphics, cheiloscopy, rugoscopy and skeletal malocclusion

Correlation	Skeletal malocclusion		Lip prints		Ameloglyphics	
	R value	P value	R value	P value	R value	P value
RP1	-0.220	0.028*	0.108	0.286	-0.274	0.006*
RP2	-0.136	0.176	-0.049	0.628	-0.255	0.010*
RP3	-0.151	0.135	0.101	0.317	-0.126	0.211
RP4	-0.085	0.402	0.115	0.317	-0.194	0.053
RP5	0.052	0.604	0.118	0.061	0.067	0.511
RP6	-	-	-	-	-	-
LP1	-0.264	0.008*	-0.020	0.844	-0.148	0.142
LP2	-0.087	0.392	0.080	0.432	-0.259	0.009*
LP3	-0.27	0.791	0.0350	0.732	-0.142	0.159
LP4	-0.019	0.850	0.155	0.123	-0.042	0.680
LP5	-0.031	0.761	0.166	0.095	-0.035	0.726
LP6	-	-	-	-	-	-
LIP prints	-0.138	0.171	-	-	-0.119	0.240
Ameloglyphics	-0.256	0.010*	-0.119	0.240		

DISCUSSION:

Malocclusion was defined by orthodontists as ‘an appreciable deviation from ideal occlusion’.[18] In the world’s population, 1/3rd of the population exhibits malocclusions which require orthodontic treatment.[19] Acknowledging the biology underlying craniofacial growth and dental relations allows understanding of the etiology of malocclusion and the concept of multifactorial etiology of malocclusions is agreed upon currently.[19]

A thorough understanding of the etiology will aid in effective prevention and treatment, thereby decreasing the burden of malocclusion in times ahead.[20] A better public health management is an added benefit of understanding the cause of malocclusion and addressing it at an early stage. Malocclusions are affected by more than one genetic influence, often known as polygenic inheritance. These genes are consecutively affected by environmental factors.[19]

Any method which can predict the malocclusions at the earliest possible age with good accuracy, through minimal invasiveness can be an advantage to both clinician and patient. The criteria used to predict the malocclusions should be such that they develop simultaneously along with the craniofacial structures from a common source under similar genetic and environmental influence and remain stable throughout life.

Development of the craniofacial skeleton, especially the jaw bones occurs between fifth to eight weeks of intrauterine life[21] and is subjected to environmental changes later. The dermal ridges on skin and lips begin to develop during the 6th week of intrauterine life, extend till the 12-19 weeks of intrauterine life and remain stable thereafter.[22] The palatal rugae pattern will be established during the 12-14th week of intrauterine life.[23] The enamel formation begins around the 6th week of intrauterine life and extends postnatally.[24] Any major genetic and environmental changes occurring during their development will be established and unchanged throughout life.

The deviations noticed in the dermal ridge patterns, palatal rugae patterns and enamel rod end patterns can be used to predict potential malocclusions at an early stage of life.

In the present study, a total of 100 subjects were taken and analyzed for the ameloglyphics, lip prints and palatal rugae patterns in different dental and skeletal malocclusions. The 100 subjects were divided into three groups based on cephalometric measurements as skeletal class I, class II, and class III malocclusion. They were further divided into four groups based on Angle's classification of malocclusion into dental class I, class II division 1, class II division 2, and class III malocclusion.

In comparison of first palatal rugae patterns on the right side (RP1) in dental malocclusions vs skeletal malocclusions revealed that, in class I dental and skeletal malocclusions, curve RP1 pattern is predominant, similar to Fathima F el al.[25], Dhiman I et al.[26] and Oral E et al.[27], but in contrast to Sapasetty S et al.11, Soans CR et al.[28]. Class II division 1 dental malocclusion showed a unification RP1 pattern commonly, while, the class II division 2 malocclusion and class II skeletal malocclusion revealed a predominant straight rugae pattern. In class III dental and skeletal malocclusion, annular and unification patterns were observed equally (Table 1 and Table 3).

When comparing the first palatal rugae pattern on the left side (LP1) with dental and skeletal malocclusions, it was observed that class I dental as well as the skeletal malocclusion portrayed a prevalent curve rugae pattern. Class II division 1 dental malocclusion revealed a curve rugae pattern, while, the class II division 2 dental and class II skeletal malocclusion revealed a predominant straight LP1 pattern. Both dental and skeletal class III malocclusions revealed a predominant annular rugae pattern (Table 2 and Table 4).

Lip prints in dental and skeletal class I malocclusion revealed a type II pattern. Class II division 1, class II division 2 and skeletal class II malocclusions showed a predominant type I lip print pattern. In class III dental and skeletal malocclusions, type I lip print patterns were common. (Table 5 and Table 6), similar to results obtained by Sapasetty S et al[11], Raghav P et al[15], Rani RMV et al[29], Kalashri KK et al[30].

Ameloglyphics correlation to the dental and skeletal malocclusions revealed a signification correlation, it was observed that the dental and skeletal class I malocclusions predominantly had a wavy branched enamel rod pattern. In class II division 1 and class II skeletal malocclusion, a linear branched pattern of malocclusion was common. In class II division 2 dental malocclusion, both wavy branched and linear branched enamel rod patterns were seen equally. In both dental and skeletal class III malocclusions, stem pattern of enamel rod pattern was common. (Table 7 and Table 8). The results obtained from the present study indicate a potential common genetic and environmental influence between the dental and skeletal malocclusions and ameloglyphics, cheiloscopy, rugoscopy. Hence, the prospect of ameloglyphics, cheiloscopy and rugoscopy in the early prediction of dental and skeletal malocclusions cannot be avoided.

The limitations of the present study are that it is a cross-sectional study with 100 subjects included in the study being those who report to the hospital for orthodontic treatment. For establishing an association between skeletal and dental malocclusion with ameloglyphics, cheiloscopy and rugoscopy a larger study sample with equal number of samples in each malocclusion subgroup would have been superior. Long term progress of the malocclusion and any possible changes occurring in enamel rod end patterns, lip prints and palatal rugae patterns under environmental influence can be studied by undertaking longitudinal data.

Ameloglyphics evaluation was done using cellulose acetate replicating sheet method and observed under stereomicroscope, though it is the most commonly used method for ameloglyphics, the procedure was technique sensitive. An alternative procedure is observing enamel rod end patterns from tooth sections under a stereomicroscope, but this procedure demands tooth sacrifice. Cellulose acetate replicating sheet method of recording the ameloglyphics an alternative conservative method.

Recording the enamel rod patterns from mandibular first molars was laborious as a dry field had to be maintained continuously to allow proper pattern recording and the cellulose acetate replicating sheet deformed in a few subjects when adapted onto the buccal surface of mandibular first molars and thus had to be repeated, selection of a tooth with flat labial surface and easy access could be an effortless alternative. In the present study, mandibular molars were chosen for collecting the ameloglyphics patterns since their enamel development occurs during the perinatal period.

Lip prints for cheiloscopy were collected using the cellophane tape technique, which is a universal method. Few limitations with the cellophane tape technique were the inability to record whole lip print pattern with the cellophane tape in subjects with enhanced lip size if not collected properly, and the improper storage of the lip prints for long term could result in fading away of the lip prints.

Scope for a longitudinal study with a larger sample size including various ethnicities and races provides scope for establishing a widely applicable correlation between skeletal and dental malocclusions with ameloglyphics, cheiloscopy and rugoscopy. Application of digital technology like intraoral scanners for palatal rugae pattern evaluation enhances the accuracy. Ameloglyphics technique in the deciduous dentition could allow for even earlier diagnosis of the malocclusions.

Genetic studies to determine common genetic pathways involved in the etiology of malocclusion and formation of other craniofacial structures lies in the time ahead.

CONCLUSION:

The first palatal rugae patterns on both the right and left sides were statistically highly significant with all dental and skeletal malocclusion groups. Predominantly, a curve rugae pattern in class I malocclusion, a straight pattern in class II malocclusion, and an annular pattern in class III malocclusion were observed. For the Lip Prints, a highly statistically significant association was observed between class I malocclusion and type II lip print pattern. Type I pattern was associated with class II and class III malocclusions. Ameloglyphics, revealed a statistically significant association between wavy branched pattern and class I malocclusion, linear branched pattern and class II malocclusion and stem pattern with class III malocclusion.

Hereby, we can infer that ameloglyphics, cheiloscopy and rugoscopy are significantly associated with skeletal and dental malocclusions. Thus, they can serve as unique and noninvasive markers for the prediction of skeletal and dental malocclusions at an early age, providing scope for important practical and clinical implications of preventive and interceptive orthodontics. Further longitudinal studies on each of these groups on large sample sizes, according to their racial and ethnic backgrounds, are warranted.

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