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A Study In Correlations Between Skeletal And Dental Malocclusion And Dermatoglyphic Patterns

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Abstract

Background : Craniofacial growth and development takes place concomitantly with digital ridge patterns. This concept has been an object of scientific enquiry by many researchers.

Aim : The objective of this study is to determine any correlation among skeletal malocclusion, dental malocclusion (Angle's criteria) and ridge patterns.

Settings and Design : A study cohort comprising of 60 subjects reporting for orthodontic correction; aged between 18 to 23 years was randomly selected.

Materials and Methods : Skeletal malocclusion was determined by Steiner's (ANB angle) analysis on pretreatment lateral cephalograms. Dental occlusion relationship was determined as per Angle's criteria. Dermatoglyphic patterns were obtained using stamp pad and paper.

Statistical Analysis : Statistical analysis was performed using one-way analysis of variance (ANOVA) and Tukey-Kramer tests for statistical significance.

Results and Conclusion : Extremely significant correlations (P<0.0001) were observed between gender on comparing with skeletal and dental malocclusions and class II dental/skeletal malocclusions and ridge patterns. Gender exhibited significant correlation between gender and ridge patterns and dental and skeletal malocclusions. No correlations were observed between skeletal and dental class I/III malocclusions and ridge patterns. This study provides statistical evidence of an association between class II dental/skeletal malocclusions and ridge patterns in a North Indian population subset.

Key Words

Dermatoglyphics, Skeletal Malocclusion, Dental Malocclusion, North Indian Population Subset, Craniofacial, Growth, Development, Embryological, Angle, Steiner, Gender.

Introduction

Victim identification using hard tissue evidence from skeletal and dental tissue remains an important tool in forensic identification. These evidentiary materials unlike soft tissue landmarks are more stable and can provide valuable information by observational analysis and radiographic assessment of antemortem and postmortem data.[1],[2] Similarly, soft tissue parameters like digital ridge patterns are indicative of genetic variations among different population pools and can aid as important anthropological parameters in establishing racial placement and genetic linkage.

Defects in embryological developmental milestones are evident as postnatal deviations from normal human anatomical structure. Craniofacial developmental anamolies have been extensively studied in the past either as population characteristics or as isolated genetic defects. Most common craniofacial developmental anomalies include skeletal and dental malocclusions.[2],[3] The digital ridge patterns are indicators of growth-related developmental patterns. These patterns start to appear during 12th week of intrauterine life. Their development completes by 24th week after which they persist throughout life.[3] Study of ridge patterns is known as 'Dermatoglyphics'. Cummins and Midlo (1926) defined 'dermatoglyphics' as the study of patterned traceries of fine ridges on digits, palms and soles. Abnormal dermatoglyphics patterns have been observed in conditions like Down's syndrome, Turner's syndrome, Klinefelter's syndrome, leukemia and thalidomide exposure.[4] Digital ridge patterns were first classified by Sir Francis Galton (1892) into- arches, loops and whorls.[5] These patterns are formed around the same time as the craniofacial skeletal and dental growth. Hence, it is necessary to determine any probability of correlation between dental (Angle's classification) and skeletal (ANB) malocclusions and digital ridge patterns in the North Indian population subset analyzed in this study. The null hypothesis of this study was that there is an existence of correlations among dental and skeletal malocclusions and digital ridge patterns. Both of these parameters can have geographic and racial bearings, since the genetic profiles of different populations vary in expressivity. Hence, their phenotypes exhibit genetic variability pertaining to geographical differences and various racial profiles.

Methods

This pilot study cohort comprised of 60 subjects (44 females and 16 males) age ranging between 18 to 23 years who reported for orthodontic correction. Subject selection criteria included- presence of permanent dentition and the absence of any systemic conditions affecting musculoskeletal system. Informed written consent was obtained from participants as per guidelines of Declaration of Helsinki. Lateral cephalogram radiographs were studied using Steiner's analysis for skeletal malocclusion (ANB angle) **(Figure 1)**. Dental malocclusion was assessed using Angle's classification. Digital imprints were obtained using an ink stamp pad and plain paper. Finger print patterns observed were identified as- loop, plain arch, tented arch, whorl, outer whorl and meet whorl patterns **(Figure 2)**. The ridge patterns were analyzed and correlated with corresponding dental and skeletal malocclusion.

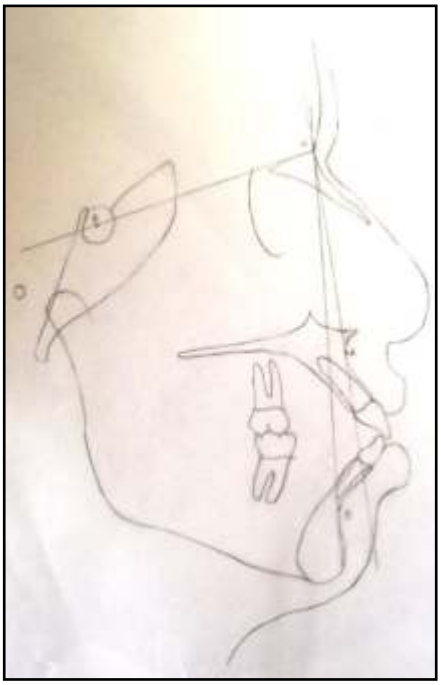

Figure 1 : Tracing Photograph Of Skeletal Class Ii Malocclusion.

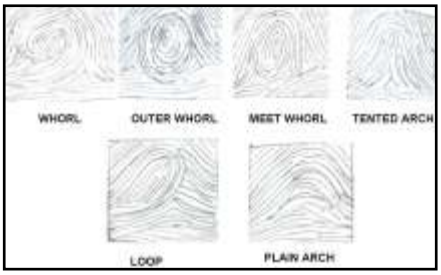

Figure 2 : Digital Ridge Patterns Evaluated In The Study.

For correlative purposes, groups were formed as: Group 1: Skeletal and dental malocclusions; Group 2: Females and dental malocclusion; Group 3: Males and dental malocclusion; Group 4: Females and skeletal malocclusion; Group 5: Males and skeletal malocclusion; Group 6: Females and ridge pattern; Group 7: Males and ridge patterns; Group 8: Class I dental occlusion and ridge patterns; Group 9: Class II dental malocclusion and ridge patterns; Group 10: Class III dental malocclusion and ridge patterns; Group 11: Class I skeletal (2±2°) malocclusion and ridge patterns; Group 12: Class II skeletal (>4°) malocclusion and ridge patterns; Group 13: Class III skeletal (<2°) malocclusion and ridge patterns; Group 14: Combined Class I and Class II dental malocclusions and ridge patterns; Group 15: Combined Angle Class II and III malocclusions and ridge patterns; Group 16: Combined Angle Class I and III malocclusion and ridge patterns.

One way Analysis of Variance (ANOVA) and Tukey-Kramer multiple comparison tests were employed for ascertaining P value.

Table 1 : Table Showing Statistical Relationship Between Dental And Skeletal Malocclusions

	Subjects With Angle Class I	Subjects With Angle Class II	Subjects With Angle Class III	Subjects With Mixed Occlusions
Mean Anb Angle	4.7	6.0	6.4	4.23
Sd	3.42	1.84	2.7	2.4
Standard Error Of Mean	0.4	0.46	0.9	0.65
Lower 95% Conf. Limit	3.85	4.92	4.325	2.79
Upper 95% Conf. Limit	5.52	6.8	8.47	5.6
P Value	0.0437			

Table 2 : Table Showing Relationship Between Gender And Dental Malocclusion

Females				Males		
	Class I	Class II	Class III	Class I	Class II	Class III
Mean	6.23	0.18	6	0.06	0.01	0.01
SD	3.34	0.34	3.34	0.03	0.001	0.001
N	60	60	60	60	60	60
SEM	0.4312	0.4312	0.4312	0.0038	0.0038	0.0038
Lower 95% conf. limit	5.137	-0.6328	-0.6328	0.052	0.002	0.002
Upper 95% conf. limit	6.863	1.093	1.043	0.067	0.017	0.017
P value	< 0.0001					

Table 3 : Table Showing Relationship Between Gender And Skeletal Malocclusion (Anb Angle)

Females				Males		
	Class I	Class II	Class III	Class I	Class II	Class III
Mean	1.4	3.73	7.36	1.0	3.4	2.2
Sd	0.64	0.73	1.47	0	0.8	-0.54
N	44	44	44	16	16	16
Sem	0.096	0.056	0.22	0	0.2	-0.13
Lower 95% Conf. Limit	1.2	2.59	6.9	1.0	2.97	2.48
Upper 95% Conf. Limit	1.590	4.86	7.8	1.0	3.8	1.91
P Value	< 0.0001					

Results

Statistical observations indicated that a significant relationship (P=0.04) exists between dental and skeletal malocclusions **(Table 1)**. Extremely significant correlations (P<0.0001) were observed between gender and skeletal and dental malocclusions **(Tables 2 and 3)**. No significant relationship was observed between Class I/III dental malocclusions and ridge patterns (table 4). On the other hand, a significant correlation (P=0.02) was observed between Class II dental malocclusion and ridge pattern **(Table 4)**. Similarly, no correlation was observed between Class I/III skeletal malocclusions and ridge patterns **(Table 5)**. Class II skeletal malocclusion and ridge patterns exhibited extremely significant (P<0.0001) correlation **(Table 5)**. Sexual dimorphism had a significant correlation with ridge patterns **(Table 6)**. No correlations were observed in groups 14, 15 and 16 (P=0.98, 0.99, 0.99,

Table 4 : Table Showing Association Between Digital Ridge Patterns And Dental Malocclusion

Females				Males	
Class I Occlusal Relation					
	Loop	Plain Arch	Tented Arch	Meet Whorl	Whorl
Mean	1.63	0.1	0.33	0.21	0.21
SD	1.0	0.04	0.0	0.01	0.0
N	60	60	60	60	60
SEM	2.81	0.18	0.47	0.11	0.03
Lower 95% Conf. Limit	-4.0	-0.26	-0.61	-0.01	-1.06
Upper 95% Conf. Limit	7.26	0.46	1.27	0.43	1.48
P Value	0.917				
Class II Occlusal Relation					
	Loop	Plain Arch	Tented Arch	Meet Whorl	Outer Whorl	Whorl
Mean	1.35	0.05	0.15	0.11	0.76	0.06
SD	0.2	0	0.01	0.0	0.6	0.01
N	60	60	60	60	60	60
SEM	0.41	0	0.16	0.45	0.46	0.18
Lower 95% Conf. Limit	0.52	0.05	-0.18	-0.8	-0.17	-0.3
Upper 95% Conf. Limit	2.17	0.05	0.48	1.022	1.69	0.42
P Value	0.02					
Class III Occlusal Relation						
	Loop	Plain Arch	Tented Arch	Meet Whorl	Outer Whorl	Whorl
Mean	0.9	0.01	0.16	0.01	0.36	0.03
SD	0.5	0	-3.21	0	0.21	0
N	60	60	60	60	60	60
SEM	0.45	0	-0.41	0	0.54	0
Lower 95% Conf. Limit	-0.004	0.01	0.98	0.01	-0.72	0.03
Upper 95% Conf. Limit	1.8	0.01	-0.66	0.01	1.44	0.03
P Value	0.36					
Combined occlusal relation						
	Loop		Tented Arch		Outer Whorl	
Mean	0.26		0.05		0.35	
SD	0.01		0		0.06	
N	60		60		60	
SEM	0.75		0		0.98	
Lower 95% Conf. Limit	-1.25		0.05		-1.61	
Upper 95% Conf. Limit	1.7		0.05		2.3	
P Value	0.99					

Table 5 : Table Showing Relationship Between Skeletal Malocclusion And Ridge Patterns

Class I Skeletal Malocclusion (2 ± 2°)				
	Loop	Tented Arch	Plain Arch	Meet Whorl
Mean	0.53	0.08	0.01	0.06
Sd	0.45	0	0	0
N	60	60	60	60
Sem	1.34	0	0	0
Lower 95% Conf. Limit	-2.17	6.08	0.01	0.06
Upper 95% Conf. Limit	3.2	0.08	0.01	0.06
P Value	0.98			

Class II skeletal malocclusion (> 4°)						
	Loop	Tented Arch	Plain Arch	Meet Whorl	Outer Whorl	Whorl
Mean	2.95	0.6	0.05	0.23	2.11	0.15
SD	0.2	0.21	0	0.02	0.42	0.03
N	60	60	60	60	60	60
SEM	0.41	0.28	0	0.24	0.44	0.10
Lower 95% conf. limit	2.12	0.02	0.05	-0.26	1.22	-0.06
Upper 95% conf. limit	3.77	1.17	0.05	0.72	2.9	0.36
P value	< 0.0001					

Class Ii Skeletal Malocclusion (< 2°)				
	Loop	Tented Arch	Meet Whorl	Outer Whorl
Mean	0.53	0.2	0.08	0.16
Sd	0.35	0.05	0.01	0.08
N	60	60	60	60
Sem	1.33	0.72	0.14	0.30
Lower 95% Conf. Limit	-2.1	-1.26	-0.21	-0.45
Upper 95% Conf. Limit	3.2	1.66	0.37	0.77
P Value	0.97			

respectively) **(Table 4)**.

Discussion

Alterations in embryological development influence the craniofacial structures, dental development and other bodily parameters such as appendage features like digital ridge patterns. These manifest as malocclusions and variations in dermatoglyphics patterns that might have demographical and racial differences. This study analyzed correlations between skeletal and dental malocclusions and dermatoglyphics patterns that have strong genetic association. Sexual dimorphism exhibited extremely significant inter-relationship with skeletal and dental malocclusions. De Freitas et al (2005) reported no statistically significant difference between Class II division1 skeletal malocclusion and genders.[6]

Table 6: Table Showing Relationship Between Gender And Ridge Patterns

Females	Males										
	Loop	Tented arch	Plain arch	Outer whorl	Meet whorl	Whorl	Loop	Tented arch	Outer whorl	Meet whorl	Whorl
Mean	7.11	1.11	0.18	2.25	0.72	0.18	4.12	1	2.18	0.43	0.87
SD	2.81	0.56	0.04	0.4	0.33	0.03	2.65	0.96	0.15	0.02	0.05
N	44	44	44	44	44	44	16	16	16	16	16
SEM	0.42	0.38	0.44	0.51	0.35	0.05	0.66	0.49	0.78	0.25	0.98
Lower 95% conf. limit	6.25	0.33	-0.71	1.21	0.01	0.067	2.708	0.044	0.501	-0.11	-1.22
Upper 95% conf. limit	7.96	1.88	1.07	3.28	1.42	0.29	5.53	2.04	3.85	0.97	2.97
P value	< 0.0001						< 0.0001				

Strong genetic association was observed between genders and dermatoglyphic patterns in this study. A positive association was observed between skeletal Class II and Angle's Class II dental malocclusions and ridge patterns. Sidlauska et al (2006) also observed that Class II div 1 malocclusion is the most common skeletal malocclusion.[7] This study is in contradiction to Reddy et al (1997) who reported no correlation between dermatoglyphic patterns and various dental parameters.[8] Mridula et al (2001) also reported negative correlation between ridge patterns and dental malocclusion.[3] Osunwake et al (2008) studied ethnic Nigerian population and observed no statistical significant relation between Class II division I skeletal malocclusion and genders.[5] Bacetti et al (2005) observed a significant degree of association between Class III dental malocclusion and sexual dimorphism. No such relation was observed in this study.[9] Current study provided essential and important information regarding malocclusions of dental and skeletal variety and digital ridge patterns which was unique to the population subset studied i.e., significant correlation was observed between Class II skeletal and Angle's Class II malocclusions with digital finger print patterns. Hence, it can be concluded that genetic differences exist among various population subsets which are reflected in developmental growth patterns manifesting in neural crest derived structures. These findings provide a baseline framework reference for anthropological analysis for comparison of phenotypic variations among different genetic pools and hence, act as important personnel identification forensic tool.

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