RELATIONSHIP OF DERMATOGLYPHICS PATTERN AND MALOCCLUSION AMONG INDIVIDUAL VISITING A TERTIARY DENTAL CARE CENTER IN KATHMANDU

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ABSTRACT

Dermatoglyphics is used as diagnostic and research tool in many fields including forensics to identify the individuals by forensic experts and in association with various medical conditions. The development of teeth and its associated structures coincide with the development of epidermal ridges during the 6th to 13th week of intrauterine life. This forms the basis for studying the association of dental anomalies with fingerprint pattern, malocclusion being most commonly reported oral conditions and is widely prevalent. Individuals including students and interns within the age group of 18-24 years visiting Nepal Medical College and Teaching Hospital, Attarkhel, Gokarneshwor-8, Kathmandu from April 2024 - June 2024 were included after signing the written consent form. Malocclusion was assessed based on Angle's classification according to which participants were grouped into Class I, Class II, and Class III malocclusion. The fingerprints of all ten fingers of both the hands of the participants were recorded with ink by using roller method as suggested by Cummins and Midlo. Descriptive statistics was presented in the form of frequency, percentage, mean and standard deviation. Chi square test was done to find out the association of dermatoglyphic pattern with malocclusion using SPSS-17 software with significance level set at P <0.05. Most of the study participants (120, 71.4%) had Angle's Class I malocclusion followed by Class II (26, 15.5%) and Class III (22, 13.1%). The most common dermatoglyphic pattern among all the fingers was the loop pattern seen in little finger of left hand of study participants with Class I malocclusion (88, 73.3%) and little finger of right hand among those with Class II malocclusion (22, 84.6%) and Class III malocclusion (17, 77.3%). There was no statistically significant association between dermatoglyphic patterns and type of malocclusion (p-value 0.156 for loop pattern, p-value 0.915 for whorl pattern and p-value 0.126 for arch pattern) dermatoglyphic investigation being convenient, cost effective and non invasive, had been applied in many fields including dentistry. It has been used as a diagnostic tool to unveil genetic factors related to many oral diseases, however, it cannot be relied upon as a sole factor.

KEYWORDS

Dermatoglyphics, finger pattern, malocclusion, occlusion

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INTRODUCTION

Dermatoglyphics is the study of fingerprints, which is being used as one of the parameters for individual identification for more than 2000 years.[1] The term dermatoglyphics was coined by Cumins and Midlo and is derived from two Greek words – derma meaning skin and glyphe meaning carve. It refers to formation of the friction ridges that appear on the palms of the hands and soles of the feet.[2] It is used as diagnostic and research tool in many fields including forensics. It is used to identify the individuals by forensic experts and in association with various medical conditions including cancer.[3,4] This branch has gained significant popularity in forensic sciences, as everybody's fingerprints are unique and remain constant throughout life.

In 1982, Sir Francis Galton began the first rigorous study of fingerprint-based identification. Among many contributions to the field, he proposed a basic classification for fingerprints as Whorls, Loops and Arches.[5]

Dermal configurations appear at the 12th week of intra-uterine life and they are established by the 24th week. Thereafter, they remain constant throughout life, except for the change in their sizes.[6,7] Recently, dermatoglyphics have been related to various medical disorders, through several investigations, as a result of which dermatoglyphic analysis has been established an useful diagnostic and research tool in medicine, providing important insights into the inheritance and embryologic development of many studied clinical disorders.[2,8,9]

Genetic plays a predominant role during embryonic craniofacial morphogenesis, but environment is also thought to influence dentofacial morphology postnatally, particularly during facial growth. Both genetic and environmental factors affect craniofacial development creating multifactorial etiology for malocclusion.[10] Cummins was the first one to report association of specific dermatoglyphic patterns in patients with Downs's syndrome.[11]

In dentistry, the significance of dermatoglyphics has been investigated by several investigators, wherein it has been used to exhibit oral diseases like dental caries, oral cancer, bruxism, anomalies of teeth, cleft lip and palate, periodontal disease, dental fluorosis, occlusion etc.[12-15]

The development of teeth and its associated structures coincide with the development of epidermal ridges during the 6 to 13th week of intrauterine life.[5] This forms the basis of studying the association of dental anomalies with fingerprint pattern. Development of teeth and associated malocclusion is one of the most commonly reported oral conditions and is widely prevalent.[16] It is hypothecated that hereditary and environmental factors leading to malocclusions may also set off peculiarities in fingerprint patterns.[17,18]

Various studies have reported different results of dermatoglyphic pattern in individuals with different malocclusion type in different countries.[13,14] Therefore, present study was conducted to identify the dermatoglyphic pattern and the type of malocclusion among individuals visiting a medical institution of Nepal. This study also attempts to establish relationship of dermatoglyphic pattern with different types of malocclusion.

MATERIALS AND METHODS

This study was conducted at the Department of Orthodontics and Dentofacial Orthopaedics in Nepal Medical College Teaching Hospital (NMCTH) involving the students and interns of 18-24 years from April 2024 - June 2024. The work was done after obtaining ethical approval from Research and Institutional Review Committee, NMCTH, Gokarneshwor, Nepal. Each patient selected for the study was explained about the study and they were instructed to sign a written consent form. Malocclusion was assessed based on Angle's classification according to which participants were grouped into Class I, Class II, and Class III malocclusion.

Convenience sampling technique was used for selecting the sample. Sample size was be calculated by using the formula for finite population size,

$$n = \frac{(Z^2pq)}{d^2+(Z^2pq) / N} = 168$$

where, Z = 1.96, p = expected prevalence = 50%= 0.5, q = 1-p, d = sampling error = 0.05, N = Finite population (Total number of BDS students from first year to interns) = 304. Therefore, the minimum sample size was 168.

Informed consent was received from the participants before oral examination and record of fingerprints. Individuals with all permanent teeth present in each arch (excluding third molars) were included in the study. Individuals with previous history of orthodontic treatment in either arch, history of trauma or surgical procedures done in the orofacial region and

large coronal restorations that might alter both coronal shape and size were excluded.

Using roller method as suggested by Cummins and Midlo, the ink was used to record the fingerprints of all ten fingers of both the hands of the participants.[18] Initially, the hands of the participants were cleaned and dried. Then, duplicating ink was applied to the distal phalanges of all the fingers of both hands and the fingerprint impressions were obtained on a white proforma sheet with blocks for each finger. In case of unclear fingerprints, the procedure was repeated. The fingerprints impressions that were recorded were then assessed as loop, whorl and arch patterns (Fig. 1) using classical method and configurational types.[19]

The loop pattern consists of series of ridges entering the pattern area on one side of the digit and leaving the area on the same side. Whorl pattern consists of two or more tri-radii in which one tri-radius is on radial and the other on the ulnar side of the pattern. The arch pattern consists of ridges lying one above the other in a general arching formation.[20]

Data were entered, coded and edited using Microsoft Excel. The data were transferred to SPSS-17 software for further analysis. Descriptive statistics were presented in the form of frequency, percentage, mean and standard deviation. Chi-square test was done to find out the association of dermatoglyphic pattern with malocclusion using SPSS-17 software with significance level set at $P < 0.05$.

RESULTS

A total of 168 study participants were included in the study of which 38 (22.6%) were males and 130 (77.4%) were females. The age of the participants ranged from 18 to 24 years with mean age 21.90±1.95 years. Most of the study participants (120, 71.4%) had Angle's Class I malocclusion followed by Class II (26, 15.5%) and Class III (22, 13.1%).

The most common dermatoglyphic pattern among all the fingers was the loop pattern seen in little finger of left hand of study participants with Class I malocclusion (88, 73.3%) and little finger of right hand among those with Class II malocclusion (22, 84.6%) and Class III malocclusion (17, 77.3%) as in table 1.

Most common type of dermatoglyphic pattern seen among the study participants was loop (991) followed by whorl (579) as in Table 2.

Table 1: Distribution of dermatoglyphic patterns in various malocclusion types.

Study parameters		Class I			Class II			Class III		
		Loop	Whorl	Arch	Loop	Whorl	Arch	Loop	Whorl	Arch
Thumb	Right n (%)	80 (66.7)	36 (30.0)	4 (3.3)	15 (57.7)	10 (38.5)	1 (3.8)	11 (50.0)	7 (31.8)	4 (18.2)
	Left n (%)	70 (58.3)	40 (33.3)	10 (8.4)	10 (38.5)	12 (46.2)	4 (15.4)	10 (45.5)	7 (31.8)	5 (22.7)
Index finger	Right n (%)	68 (56.7)	45 (37.5)	7 (5.8)	10 (38.5)	13 (50.0)	3 (11.5)	11 (50.0)	7 (31.8)	4 (18.2)
	Left n (%)	60 (50.0)	47 (39.2)	13 (10.8)	14 (53.8)	9 (34.6)	3 (11.5)	11 (50.0)	7 (31.8)	4 (18.2)
Middle finger	Right n (%)	86 (71.7)	26 (21.7)	8 (6.7)	16 (61.5)	8 (30.8)	2 (7.7)	14 (63.6)	7 (31.8)	1 (4.5)
	Left n (%)	77 (64.2)	30 (25.0)	13 (10.8)	18 (69.2)	7 (26.9)	1 (3.8)	10 (45.5)	9 (40.9)	3 (13.6)
Ring finger	Right n (%)	56 (46.7)	61 (50.8)	3 (2.5)	13 (50.0)	13 (50.0)	-	9 (40.9)	10 (45.5)	3 (13.6)
	Left n (%)	51 (42.5)	63 (52.5)	6 (5.0)	15 (57.7)	11 (42.3)	-	8 (36.4)	13 (59.1)	1 (4.5)
Little finger	Right n (%)	87 (72.5)	31 (25.8)	2 (1.7)	22 (84.6)	4 (15.4)	-	17 (77.3)	4 (18.2)	1 (4.5)
	Left n (%)	88 (73.3)	28 (23.3)	4 (3.3)	21 (80.8)	5 (19.2)	-	13 (59.1)	9 (40.9)	-

Table 2: Distribution of dermatoglyphic patterns with different malocclusion types				
Dermatoglyphic pattern	**Type of malocclusion (Angle's classification)**			**Total**
	Class I n (%)	**Class II n (%)**	**Class III n (%)**	
Number of loop present	723	154	114	991
Number of whorl present	407	92	80	579
Number of arch present	70	14	26	110
Total	**1200**	**260**	**220**	**1680**

Table 3: Association between dermatoglyphic patterns and type of malocclusion.					
Dermatoglyphic pattern	**Status**	**Types of Malocclusion**			**p-value**
		Class I	**Class II**	**Class III**	
Loop	Present (at least one)	117 (97.5)	25 (96.2)	20 (90.9)	0.156
	Absent	3 (2.5)	1 (3.8)	2 (9.1)	
Whorl	Present (at least one)	96 (80.0)	20 (76.9)	17 (77.3)	0.915
	Absent	24 (20.0)	6 (23.1)	5 (22.7)	
Arch	Present (at least one)	25 (20.8)	6 (23.1)	9 (40.9)	0.126
	Absent	95 (79.2)	20 (76.9)	13 (59.1)	

LOOP WHORL ARCH

There was no statistically significant association between dermatoglyphic patterns and type of malocclusion (p -value 0.156 for loop pattern, p-value 0.915 for whorl pattern and p-value 0.126 for arch pattern) as in Table 3.

DISCUSSION

The etiology of malocclusion is multifactorial. Both genetic and environment are thought to influence the dentofacial morphology postnatally, particularly during facial growth affecting the craniofacial development causing malocclusion.[12]

The time of development and completion of primary lip and palate and the dermal ridges are approximately same, coinciding at 6 -13 week of intrauterine life.[17] It is known that any factor active during the time period of genetic expression can affect all structures developing at that time.[20]

Since both dermal patterns and craniofacial structures are strongly but not exclusively genetically governed structures, it may be hypothesised that hereditary and genetic factors causing changes in the lip, alveolus, teeth and palate may also cause peculiarities in fingerprint patterns. This forms basis for studying the correlation between dental anomalies and fingerprints.[5]

Hence, this study was done to assess the pattern of malocclusion, dermatoglyphic patterns and

their association in individuals visiting a dental department at Nepal Medical College, Attarkhel, Gokarneshwor-8, Kathmandu.

Many studies have provided evidence that dermatoglyphic traits are associated with dental as well as skeletal malocclusion.[16,21] This study was performed considering the dental malocclusion. The association between dermatoglyphics and skeletal malocclusion in similar population would be recommended in near future considering larger sample size. In the present study, most of the study participants (120, 71.4%) had Angle's Class I malocclusion followed by Class II (26, 15.5%) and Class III (22, 13.1%) which is similar to the other few studies done in Nepalese population.[22,23]

The dermatoglyphic pattern most commonly seen in the present study was loop, whorl and arch respectively which was similar to other studies done in Nepalese population, Indian population and Sinhalese population.[7,19,24,25] However the result is different from another study done in Nepalese population in which loop, arch and whorl pattern were more commonly found respectively.[26]

In the study done by Poudel *et al*[19] in Nepalese population, loop pattern was most commonly seen in right middle finger of subjects with Class II malocclusion while in the present study, loop pattern was more predominant in little finger of left hand in Class I samples, which is contradictory. In the same study, whorl pattern was more in right ring finger in Class I cases and arch pattern in left index finger of Class I cases. This again contradicts to the findings of the present study, as whorl pattern was more in left ring finger of Class I malocclusion. These variations could be due to regional and ethnic differences in sample selection and environmental influences.

The findings of this study also contradicts to the findings done by Reddy *et al*[21] and Deepti *et al*[27] observed more loop patterns in right little finger of Class II cases.

Dermatoglyphics serves as a diagnostic tool for predicting malocclusion at an early age. Hence it can aid in planning preventive and interceptive orthodontics procedures in pediatric patients. Dermatoglyphics has been reported to be associated with a number of physiological and pathological conditions in the oral cavity: dental caries, cleft lip and palate, periodontal diseases, oral carcinomas, bruxism, malocclusions in both permanent and deciduous dentition etc.

In a study done by Vignesh *et al*[28] in deciduous dentition, arch pattern was more predominant in cases with mesial step in little finger. Whorl patterned was seen in middle finger of desial step cases whereas whorl or loop pattern were predominant in index finger in cases with flush terminal plane. In the present study performed in permanent dentition, the loop pattern was predominantly seen in little finger of left hand of study participants with Class I malocclusion (73.3%) and little finger of right hand among those with Class II malocclusion (84.6%) and Class III malocclusion (77.3%). But association between dermatoglyphics and malocclusion was not statistically significant.

In the present study, loops and whorls were found to be increased in Class I and Class II patients compared to Class III patients whereas arches were found to be increased in Class I and Class III patients compared to Class II patients. This is different from the study conducted by Belludi *et al*[29] in which the percentage frequency of digital pattern whorls and arches was found to be increased in Class I when compared to Class III. An increased number of loops in the the present study could be due to the variable ridge configuration determined partly by genetic factors compounded by other factors such as stress and tension in the growth of the part during fetal life.

In another study done by Achalli *et al*,[24] the loop pattern was predominantly seen with decreased frequency of the whorl pattern in subjects with skeletal Class I and II malocclusion, and the arch pattern was absent in group I subjects. In subjects with skeletal Class III malocclusion, the whorl pattern was predominantly seen, while the loop and arch patterns had a decreased frequency.[24] In contrary to this study, loop pattern was more predominant in Class I and II and arch pattern was mostly seen in Class I and III and least in Class II but was not statistically significant.

In a study conducted by Tikare *et al*,[16] it was concluded that there was a statistical association between whorl patterns and Class I and II malocclusions ($p<0.05$). However, no overall statistical association was observed between fingerprint patterns and malocclusions ($p>0.05$) similar to the present study. Number of sample size could be the reason for statistically insignificant results, which could be overcome by increasing the sample size.

Studies have provided evidence that dermatoglyphic traits are associated with dental and skeletal malocclusion.[30] In a study performed by Kharbanda, Sharma and Gupta performed

in skeletal Class III subjects, arches and ulnar loops were increased in thumb, middle finger, ring and little finger which is different from our study which was performed considering only dental malocclusion.[31] A significant association between dermatoglyphics pattern and sagittal skeletal malocclusion was seen in another study done by George *et al*.[32] Whorl pattern was predominant in skeletal Class II with maxillary excess group and skeletal Class II with mandibular deficiency group while loop pattern was predominant in the skeletal Class III with mandibular excess group and skeletal Class III with maxillary deficiency group.

The present study has few limitations. Being hospital based study; the results may lead to lack of generalizability. Larger sample size would be recommended. The ink stamp method has its limitations with most of the times recording of smudged fingerprints. Digitalized fingerprint sensors could be useful to overcome this limitation.

It would be highly advantageous clinically if those findings achieved from the study could be substantiated since dermatoglyphic markers could then be used for screening out individuals who might be at a higher risk of developing malocclusion. Dermatoglyphic investigation being convenient, cost effective and non invasive, had been applied in many fields including dentistry. It has been used as a diagnostic tool to unveil genetic factors related to many oral diseases, However, it cannot be relied upon as a sole factor. Numerous other factors such as ethnic and racial variations, congenital, environmental and other local factors can also influence the development of malocclusions. An early diagnosis and correction of malocclusion and treatment through early interceptive orthodontic treatment may help preventing some of the future orthognathic surgeries.

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