Original Research Article

Determining the relationship between Dermatoglyphics with Malocclusion: A pilot study among the population of Gujarat

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ABSTRACT

***Introduction*: Background**: Dermatoglyphics, defined by Cummins and Midlo (1926), refers to the study of naturally occurring dermal patterns on hands and feet. Dermatoglyphics develops during the 12th week of the intrauterine period, with the development of dental tissues. According to certain theories, dermatoglyphics is believed to be genetically controlled, whereas malocclusion is genetically and environmentally controlled in the most common dental diseases.48 patients ranging in the age of 18-35 years from Gujarat. Malocclusion was classified according to Anglesô class 1, class2 and class3. Dermal patterns of digits were broadly classified into: loop, arch and whorl. Data collected was statistically analyzed by Independent t-test and ANOVA tests.

Result: The result of the study was that the Loop ridge pattern was seen in the majority of class 1 and 2 malocclusions, whereas whorl ridge pattern was seen in the majority of class 2 malocclusions especially in the left and ring fingers. There was relevant significance ($p>0.05$) seen at the right middle finger with the malocclusion.

Conclusion: This study suggests that dermatoglyphics might aid as a cost-effective screening tool. At an early age, it might be used as an indicator of malocclusion, aiding the treatment planning to establish a pleasing occlusion. In Forensics, victim identification and comparison can be done for fragmented, decomposed or burnt bodies.

Key Words: Dermatoglyphics; Malocclusion; Anglesộ Fingerprints; Identification; Dental screening

BACKGROUND:

'Fingerprint' as the word suggests are the traces of an impression left from the frictional ridges of any part of a human or other primate hand. It is a sensitive indicator of intrauterine anomalies and is considered a window of congenital abnormalities and genetic disorders. [1] On the other hand, the term malocclusion was coined by Edward Angle, the "father of modern orthodontics" as a derivative of occlusion. It is the alignment of teeth of the opposing dental arches once the jaws close. The interaction and synergistic effects of genetic and environmental factors gives rise to the development of malocclusion. Around the sixth-seventh week of intrauterine life, the development of the dentition and the palate occur as well as the development of dermal patterns occurs. [2, 3, 4, 5]. Formation of the dermal patterns and craniofacial structures occur from the same embryonic tissues around the same period and hence remain constant. Thus, a possible association between dermal patterns and dental disorders, one of which is malocclusion. Previously, there has been a relationship between dermatoglyphics and oral clefts, periodontitis, and dental caries, which has drawn our attention to correlate dermatoglyphics and malocclusion. Studies says that genetic and environmental factors that cause modifications in the alveolar bone may also cause changes in the pattern of fingerprints.[3] Thus, we sought to determine the usefulness of dermatoglyphics in the prediction of such discrepancies and to measure qualitative parameters such as loops, whorls and arches.

History of Dermatoglyphics

- William Herschel (1858) was the first to experiment with fingerprints in India.[6]
- Sir Francis Galton (1892) with his extensive research demonstrated the hereditary significance of fingerprints and biological variations of different racial groups.[7]
- Sir Edward Henry (1893) published the book "The classification and uses of fingerprints," commencing a modern era of fingerprint identification.[8]
- Cummins and Midlo (1926) coined the term dermatoglyphics.[8]
- Penrose LS (1945) conducted dermatoglyphic investigation in Down's syndrome and other congenital disorders.[4]
- Schaumann and Alter's (1976) published the book "Dermatoglyphics in medical disorders.[9]
- Dermatoglyphics today: The current scenario of dermatoglyphics is that the diagnosis of some disorders can now be done on the foundation of these patterns

alone. In recent times, many researchers profess a high degree of accuracy in their prognostic ability from these features.

METHODS

Sample size

A pilot study was performed with a convenience sample of 48, on systemically healthy subjects ranging in the age of 18-35 year-old specifically from the Gujarati population, from different cities actively residing in state. The study was approved and performed in the university. The procedures and purpose of the study were explained and consent forms were obtained from all the participants of the study. Ethical committee clearance was obtained at the institutional level, as the most procedures involved were carried out as a part of diagnostic evaluation in treating the malocclusions and as they did not cause any harm to the participants. Only samples with completely erupted permanent second molars were included in the study. Patients with developmental anomalies, any systemic disease affecting bone, children and pregnant women, mentally ill patients, patients with both maxillary and mandibular excess and those who did not give an informed consent, acquired deformities, skin diseases, wounds and scars on fingers and those undergoing or with histories of orthodontic treatment were excluded from the study.

Analysis of Malocclusion

Malocclusion was classified under Andrews class of malocclusion (1st molar relationship) (Angle, 1989) and its subdivisions. For analysis, basic diagnostic instruments such as a mouth mirror, mouth prop and a light source was used. (Figure 1)

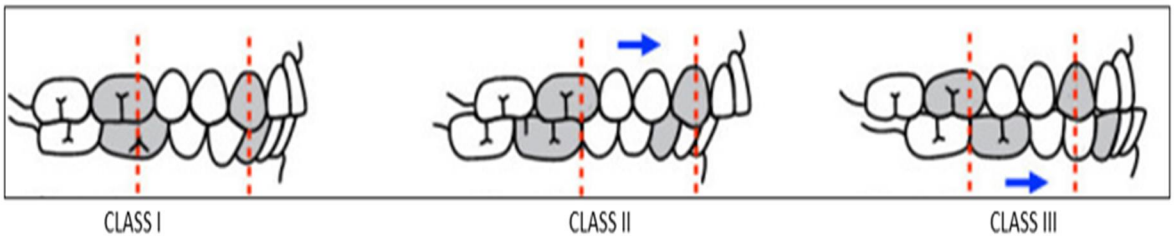

Figure 1 : Angles' (1989) classification of Malooclusion according to 1st molar relationship

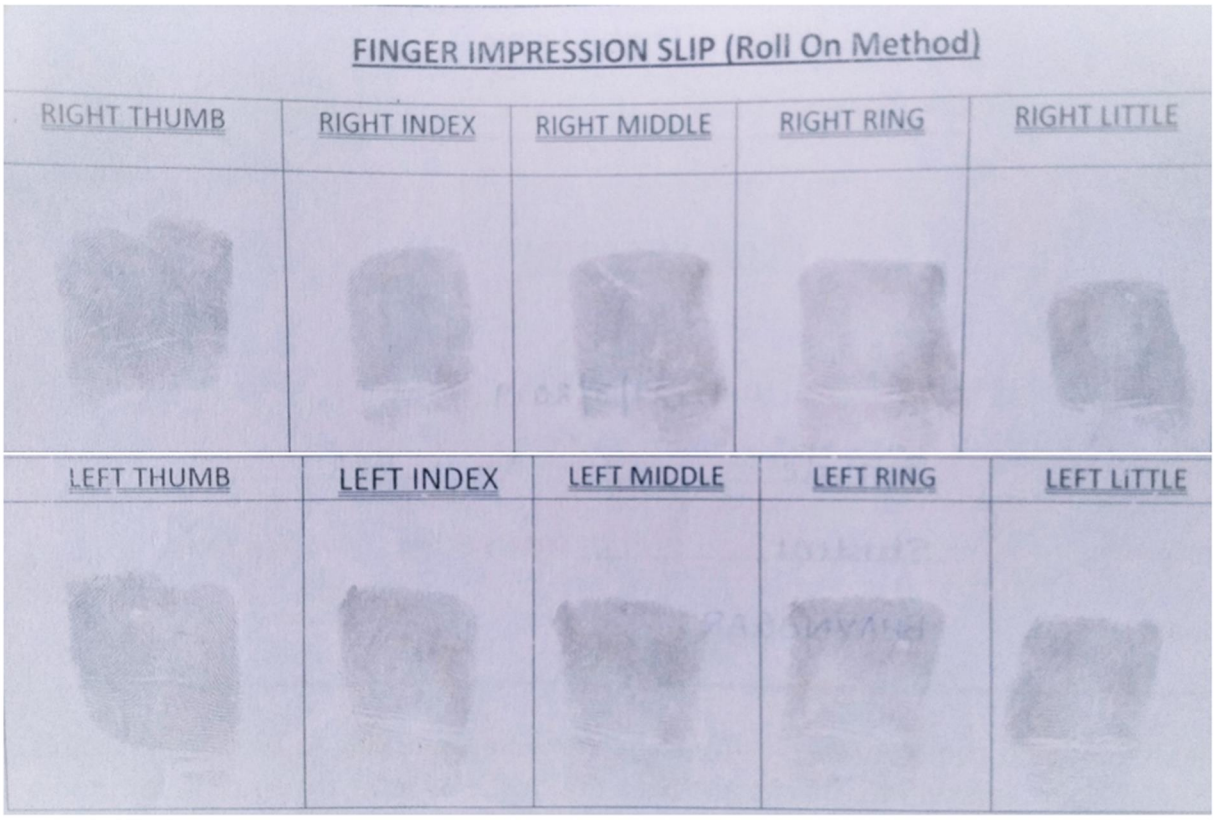

Figure 2 Recording of Fingerprints on a Finger Impression slip using Ink and Stamp method (Roll on technique)

Fingerprint analysis

Fingerprint patterns can be categorized majorly under arch, loop, an whorl. For proper quality of prints, it is essential to remove oil, dirt and sweat from the ridges by washing the ridged areas with soap and water and with ethyl alcohol or ether. The finger prints were recorded using the ink stamp method. The dried phalanges of fingers and thumbs of both the hands were rolled (Roll-on method) on an ink pad and stamped on an A-4 size blank white non blotting paper. For accuracy, all the fingerprints taken were cross checked. (Figure 2)

Interpretation

A magnification lens (simple microscope) power of four or five approximately helped in inspecting the ridge details of printed areas. This strength of magnification is sufficient for most ordinary purposes, including counting ridges. Abbreviations were given from the data obtained for example loop as Whorl as W, Arch as A and were safely preserved. The frequency of the three patterns was then accessed.

Major landmarks on fingerprint: [10]

i) **Triradius:** Formed by the confluence of three ridge systems that form angles of approximately 120° with one another. The geometric center of the triradius is a triradial point. The triradial point makes a terminus of the line along which the ridges are counted.

ii) **Core:** It is in the approximate center of the pattern, of fingerprint pattern. The core may be of different shapes. A) In a loop pattern, the core is usually represented by a straight, rod like ridge or a series of two or more such parallel ridges, over which other recurving ridges pass. If a straight ridge is absent in the center of the loop, the innermost recurving ridge is designated as a core. B) In a whorl, the core appears as a dot or a short ridge (either straight or bent) or shaped as a circle or an ellipse in the center of the patter.

iii) **Radiant:** lines emanating from the tri-radius and enclose the pattern area.

Figure 3 : Important landmarks of a Fingerprint

Galton (1892) divided the fingerprint patterns into three broad groups: [8]

A) Loop It possesses only one triradius. The curved site of the ridge is called head of the loop. From the opposite extremity of the pattern, the ridges flow to the margin of the digits. If the loop opens to the little finger side, it is an ulnar loop and if to the thumb side, it is called a radial loop.

B) Whorl These are the patterns so constructed that the characteristic ridge courses follow circuits around the core. The shape of can be either circular or elliptical of the pattern area. Whorls have two triradii.

C) Arch The plain arch is composed of ridges which pass across the finger with slight bow distally. There are no triradii; therefore, the ridge count cannot be done.

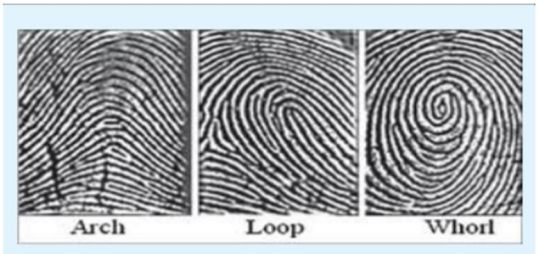

Figure 4 : Broad Classification of fingerprints according to Galton (1892)

STATISTICAL ANALYSIS

The data was analysed in SPSS software version 20. One-way ANOVA test and Independent t-test was applied for comparison between fingerprints of both the

hands and the three classes of malocclusion.

RESULTS:

The study sample consists of 48 students of which 58.3% were female and 41.7% were male participants. Individuals with Class I malocclusion (n=20) Class II malocclusion (n=20) were equal in number, followed by Class III malocclusion (n=8). The distribution of dermatoglyphic patterns based on the type of malocclusion was analysed (FIGURE 5) (TABLE 1).

Table 1: DISTRIBUTION OF DERMAL PATTERNS IN ACCORDANCE WITH TYPES OF MALOCCLUSION

CLASS	LOOP	WHORL	ARCH
I	45%	32%	21%
II	37%	49%	13%
III	53%	43%	4%

Table 2 DISTRIBUTION OF DERMAL PATTERNS OF LEFT- HAND DIGITS

DIGIT	LOOP	WHORL	ARCH
L THUMB	56%	39%	6%
L INDEX	39%	34%	26%
L MIDDLE	52%	32%	15%
L RING	36%	52%	10%
L LITTLE	65%	23%	10%

Table 3 DISTRIBUTION OF DERMAL PATTERNS OF RIGHT-HAND DIGITS

DIGIT	LOOP	WHORL	ARCH
R THUMB	54%	41%	4%
R INDEX	43%	36%	19%
R MIDDLE	67%	*4%	15%
R RING	39%	54%	6%
R LITTLE	69%	21%	8%

Relevant Significance p<0.05

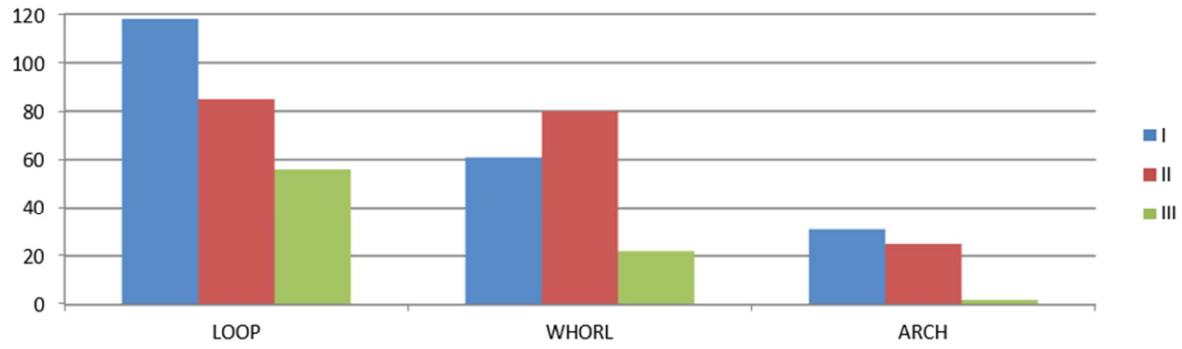

Figure 5 DISTRIBUTION OF DERMAL PATTERNS IN ACCORDANCE WITH TYPES OF MALOCCLUSION

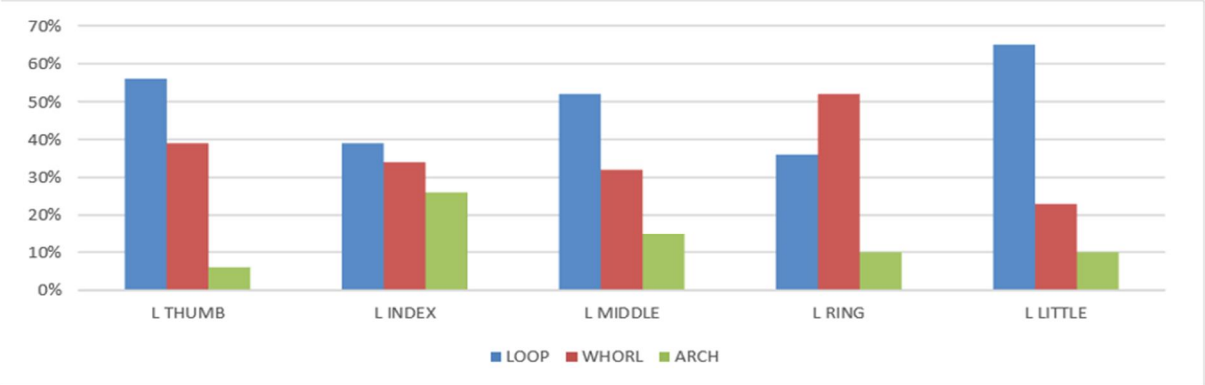

Figure 6 DISTRIBUTION OF DERMAL PATTERNS OF LEFT-HAND DIGITS

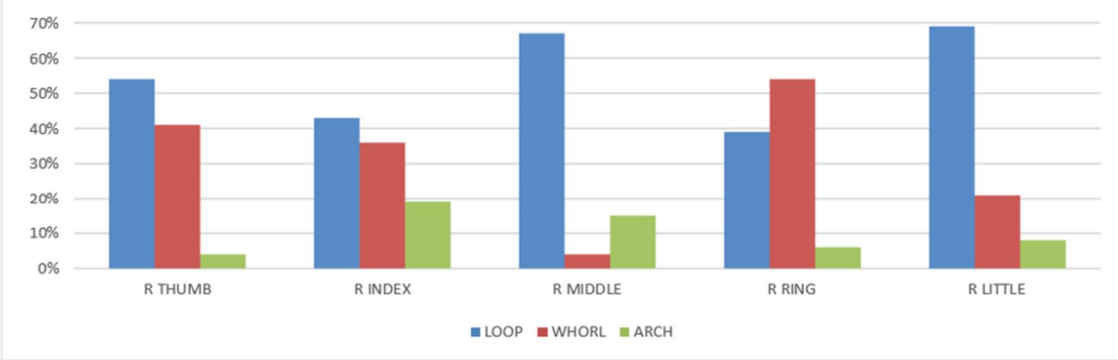

Figure 7 DISTRIBUTION OF DERMAL PATTERNS OF RIGHT-HAND DIGITS

DISCUSSION:

In this study, an increased distribution of whorl ridge pattern in the Class II subjects, while there was an increased distribution of loop ridge pattern in the Class I and class III subjects were seen. Different results have been reported in different studies. In a recent study by

Soni A et al (2013), comparing the dermatoglyphic characteristics of different malocclusions, some slight differences, 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 [11]. In another study by Verbov J. (1970), 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 Class III malocclusion showed an increased frequency of plain arches [2].

A study by Thakkar DP et al (2012) 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 and Class II Div 2 patterns were associated with an increased frequency of arches and ulnar loops and a decreased frequency of whorls [12]. However, in one dermatoglyphic study of normal occlusion and malocclusion by Reddy BRM et al (2013), particular predictive occurrence of patterns was not found to be associated with each group. Moreover, some finger patterns, such as increase of twinned loops in class II and absence of radial loops in class III were found to be statistically significant [13]. Another comparative study by Tikare S et al (2010), 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 in the middle finger [14].

In a recent study by Jindal G. Et al (2015), subjects were divided into 3 groups based on angles classification and children in the age range of 12-16 years were taken. High frequency of plain arches and whorls found in class II and class III malocclusion respectively ulnar loop pattern was predominant in all types of malocclusion was seen[15]. According to our study, dermatoglyphics might be used in clinical situations to add on to the diagnostic impression of the dental arch relationships of maxilla and mandible. An example in this scenario would be the association of an increased whorl pattern with Class II cases especially in both left and right ring fingers. The disparity in results could be due to variations in sample size, differences in protocol for recording fingerprint patterns, ethnic and racial variations etc. However, this dermatoglyphic information not only adds to strengthen the diagnosis, but a quick diagnosis and efficient treatment planning could be used in to catch up

growth of the mandible/maxilla. This is true for early interception in a young child presenting with 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. Also, it may play a pivotal role in forensics in victim identification through comparison techniques where other methods fail to identify the deceased. More studies are thus highly recommended to deliver a generalized impression especially in utilizing the potential of dermatoglyphics.

CONCLUSION:

Dermatoglyphic can be used as an indicator for determining the dental discrepancies at an early stage, assisting in the orthodontic treatment to establish pleasing occlusion and long-term stability. Therefore, we can conclude that it might serve as a cost-effective screening tool and an interceptive and preventive measure before treatment modalities. It might also be an accessible and non-invasive tool in forensics for identification of unidentified bodies (burnt, decomposed, mutilated) for comparison (exclusion and inclusion criteria) as it said that the dead should be respected and the next of kin deserves to see their loved ones for the last time and perform their religious rituals. Though it has its limited merits, limitations include unequal and small sample size, conventional ink and stamp method as the ink can smudge and unequal application of pressure on the print can lead to inaccurate print would be difficult to interpret, and lastly getting consent from patients to participate in this study was moderately difficult.

Inheritance and twin studies on different ethnic group studies, a larger sample size, analysis of palm prints with fingerprints, further sub-classifying fingerprints and analysis using lateral cephalogram are recommended to examine these relationships further. Therefore, substantial, meticulous and multicentre researches in this field are required in order to determine its strong validity.

Conflict of interest: None

Financial assistance: None

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