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Can Dermatoglyphics Be Used as a Marker for Predicting Future Malocclusions?

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Abstract

Introduction: Dermal ridges and craniofacial structures form from the same embryonic tissues during the same embryonic period. Thus, this might indicate a possible association between dermatoglyphics and facial skeletal disorders, such as malocclusions. Early diagnosis of skeletal malocclusions sometimes can prevent future surgical procedures. The aim of this study was to compare the dermatoglyphic characteristics of different malocclusions.

Methods: In this cross-sectional study, 323 patients who were referred to Orthodontic Department of Mashhad Dental School were recruited. The participants were classified into three groups according to Angle´s classification, i.e., Skeletal Class 1 (n = 163), Skeletal Class 2 (n = 111), and Skeletal Class 3 (n = 49). For all participants, we recorded the total ridge counts of each finger (TRC), atd angles, a-b ridge counts, and types of fingerprint patterns. Right- and left-hand asymmetry scores were calculated. The chi-squared test was used to compare the dissimilarity of the types of patterns for each finger. Asymmetry of other parameters was analyzed statistically using the ANOVA or Kruskal-Wallis tests. P-values greater than 0.05 were considered to be significant.

Results: A significant difference was determined between Class I and Class III patients in terms of left a-b ridge count (p=0.049). Loop was the most frequent pattern in the three groups, whereas the arch pattern occurred with the lowest frequency. No significant difference was found in the other parameters that were studied.

Conclusion: Although there were some slight differences in dermatoglyphic peculiarities of different skeletal malocclusions, most of the palm and fingerprint characteristics failed to indicate any significant differences.

Keywords: dermatoglyphics, malocclusion, prediction

1. Introduction

The term dermatoglyphics, as defined by Cummins, refers to the study of naturally occurring dermal patterns in the surface of the hands and feet (1). These patterns remain constant throughout life and are not altered by disease or age. Fingerprints are unique for each person; even monozygotic twins do not have the same pattern (2). Recently, some researchers have claimed a high degree of accuracy in their prognostic ability from fingerprint patterns (3). Dermatoglyphic characteristics have been proved to be an effective adjunct to other diagnostic methods in identifying some diseases of genetic origin, such as diabetes mellitus (4, 5), hypertension (5), congenital heart disease (6), cystic fibrosis (7), and cleft lip and palate (8, 9). Some studies have reported specific variations in fingerprints and palm prints of patients with dental caries (10, 11) and periodontal diseases (12). Dermal ridges are

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developed by the sixth week of gestation and reach their maximum size between the twelfth and thirteenth weeks. The development of teeth begins during the sixth week of intra-uterine life. Since craniofacial characteristics and dermal ridge patterns are mainly, but not exclusively, genetically-governed structures, it has been assumed that genetic and environmental factors that cause changes in alveolar bone may also cause peculiarities in the appearance of fingerprints and palm prints (3). Malocclusion is one of the most prevalent oral conditions. Early diagnosis and correction of deviated growth patterns of the jaws have been among the main goals of orthodontics for many years. Genetic factors are one of the main etiologic factors of malocclusion. There are some controversial results about dermatoglyphic features of patients with different malocclusions (13, 14). Since late diagnosis of skeletal malocclusions leads patients to orthognathic surgery, this study was undertaken to assess the possible correlation between fingerprints' characteristics and different growth patterns that can lead to skeletal Class 2 or Class 3 malocclusion. We also sought to determine the usefulness of dermatoglyphics in the prediction of skeletal discrepancies.

2. Material and Methods

2.1. Research setting

For this cross-sectional study, we recruited 323 patients (107 males, 228 females) between the age range of 17-35.

2.2. Sampling Method

All patients referred to Orthodontic Department of Mashhad Dental School during the year 2014 were enrolled.

2.3. Research ethics

This study was approved by the Regional Ethics Committee of Mashhad University of Medical Sciences. A written informed consent form was signed by all participants or their guardians before the study began.

2.4. Data collection

The type of malocclusion was determined by clinical examination and also by cephalometric radiographs. The patients were classified into three groups according to Angle´s classification, i.e., Skeletal Class 1, Skeletal Class 2, and Skeletal Class 3. The patients with major craniofacial anomalies, such as cleft lip and palate, were excluded from the study. Subjects who had indistinct palm patterns also were excluded (n = 12). The 323 patients who were evaluated in the study consisted of 163 Skeletal Class 1 subjects, 111 Skeletal Class 2 subjects, and 49 Skeletal Class 3 subjects. Dermatoglyphic patterns were recorded using graphite powder. Fingers and palms were covered with powder using a small brush. Afterwards, the participants pressed their hands on a strip, and then it was attached to a sheet of white paper. Fingerprints were taken by rolling each finger separately across another strip and then transferring the print to a sheet of white paper. Each paper was labelled for sides (right or left), and the fingers were numbered using Roman numerals ('I" for the thumb and 'V' for the little finger). Three basic types of ridge patterns were found in the distal phalanges of the digits, i.e., loop (L), arch (A) and whorl (W) (Figure 1).

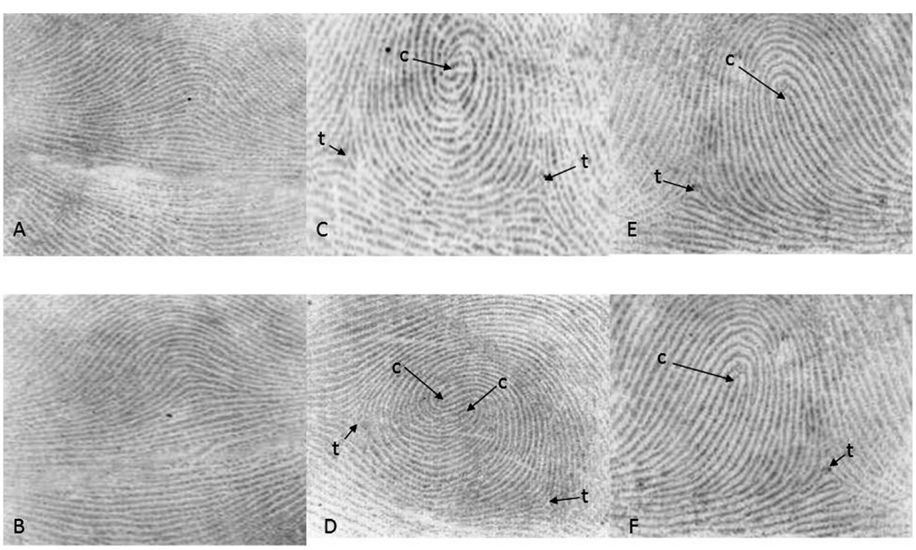

Figure 1. Three types of ridge pattern and method of ridge counting: Arch, Loop, and Whorl

The whorl pattern was divided further into simple whorl (W) and double whorl (2W). The loop had one triradius and one core, and, instead of coursing in complete circuits, the ridges curved around one extremity of the pattern and flowed to the margin of the digit. Radial and ulnar loops were considered as identical patterns (15). The arch pattern had no triradius and is known to be the simplest form. The whorl pattern is the configuration with two or more triradii, in which most of the ridges make circuits around the core. Patterns of homologous fingers of both hands were compared. A score of '0' was considered whenever the patterns of the paired fingers were identical. A score of '1' was considered in the case of unmatched pattern types between the homologous fingers. The pattern dissimilarity score was calculated by summing the score of all 10 fingers, and it ranged from 0 to 5. The score of 5 indicated unmatched patterns for all five pairs of fingers, whereas the score of 0 showed a similar pattern in all 10 fingers. In order to calculate the total ridge count (TRC), the center of each pattern (core) and corresponding triradii were defined, and a straight line was drawn passing through these two points. The TRC was calculated by counting the number of ridges cut by this line. Since there is no triradius in the arch pattern, the ridge count of this pattern is always zero, while the whorl pattern has two (Figure 1). In this study, we used the standard conventions to count the ridges, and the largest of the two ridge counts of each finger was summed over all 10 fingers and also for each hand separately. There are four triradii on each palm, one at the base of digits II through V. These digital triradii are named as (a), (b), (c) and (d), and (t) was the triradius located on the proximal palm. The location of (t) varied from just distal to the wrist up to the center of the palm (Figure 2). The atd angle was measured on both palms using these three points. A straight line was drawn through (a) and (b) triradii, and the number of ridges cut by this line was determined as the a-b ridge count. Asymmetry of each measurement was assessed. To compare the asymmetry of atd angles, TRC and a-b ridges between the right and left hands, paired values were subtracted from each other, and the absolute values were reported. Dermatoglyphic patterns were analyzed twice by a trained person using a magnifying lens and mean results were reported.

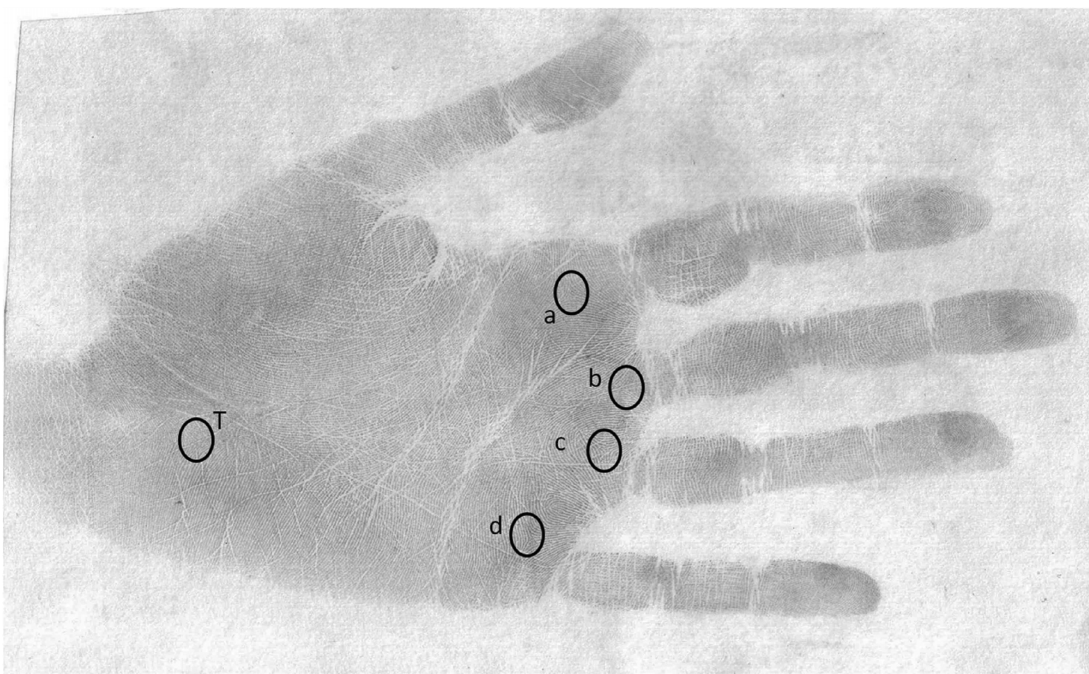

Figure 2. Triradii located on the palm of patients

2.5. Statistical analyses
Dermatoglyphic patterns were compared between the three types of malocclusions using the chi-squared test. To analyze the difference in TRC, atd angle, a-b ridge count, and their asymmetries between the left and right hands in three groups, ANOVA (for parametric data) or the Kruskal-Wallis test (for nonparametric variables) were used. A value of $p < 0.05$ was set as significant.

3. Results
Descriptive data for TRC of patients with different malocclusions are shown in Table 1. As is shown in this table, no significant difference was found between the three types of malocclusions in terms of their TRC. Also, there was no

significant difference in TRC asymmetry between the three groups (Table 2). However, according to Table 3, ANOVA revealed a significant difference in the left a-b ridge count (p = 0.046). Further analysis with the Tukey test showed a significant difference between Class I and Class III patients in terms of left a-b ridge count (p = 0.049). However, no significant difference was found in atd angles (right and left), atd asymmetry, right a-b ridge count, a-b ridge asymmetry, or pattern dissimilarity scores. The chi-squared analysis showed that the loop was the most frequent pattern in the three groups, whereas the arch pattern had the lowest frequency in all types of malocclusions (Table 4).

Table 1. Mean (standard deviation) for total ridge count (TRC) of patients with different malocclusions

Group	Digit	Class 1, mean (SD)	Class 2, mean (SD)	Class 3, mean (SD)	p-value
I	R	17 (5) [a]	16 (6.5)[a]	17 (5.7)[a]	0.221
	L	15.0 (5.3)	14.3 (5.4)	15.0 (6.7)	0.530
II	R	14 (8)[a]	13 (8) [a]	12.5 (8.8) [a]	0.921
	L	12.5 (5.8)	12.0 (5.8)	11.8 (6.7)	0.730
III	R	12.9 (5.3)	11.9 (5.2)	12.7 (6.3)	0.356
	L	13.5 (6.5) [a]	13 (6.5) [a]	15 (7) [a]	0.496
IV	R	15.2 (5.0)	14.9 (4.7)	15.6 (6.6)	0.770
	L	15.5 (6.5) [a]	14 (6) [a]	16.5 (7.5) [a]	0.175
V	R	12.7 (3.8)	13.3 (3.9)	14.0 (4.5)	0.102
	L	13.0 (3.9)	12.8 (3.9)	14.0 (5.2)	0.248

a: non-parametric data. Median (Interquartile range) is reported.

Table 2. Median (Interquartile range) of TRC asymmetry for five digits among patients with different malocclusion.

Digit	Class 1	Class 2	Class 3	p-value
I	2.5 (3)	3 (4)	2.25 (4.6)	0.899
II	2.5 (4)	3 (3.5)	2 (5)	0.169
III	2.5 (3.5)	2. (2.5)	2 (3)	0.143
IV	2 (3)	2.5 (3)	1.5 (2.6)	0.025
V	2 (2)	2.5 (2.5)	2 (3)	0.330

Table 3. Mean (standard deviation) for atd angle, a-b ridge count, and pattern dissimilarity score of patients with different malocclusions

Digit	Class 1	Class 2	Class 3	p-value
atd-R	40 (6)[a]	41 (8) [a]	40 (7) [a]	0.222
atd-L	40 (6) [a]	40 (8) [a]	40 (7) [a]	0.359
Atd-asymmetry	1 (1) [a]	1 (1) [a]	1 (1) [a]	0.875
ab-R	30.0 (6.5)	31.4 (7.5)	32.3 (6.4)	0.078
ab-L	30.5 (6.7)	32.1 (7.8)	33.1 (6.9)	0.046
ab-asymmetry	3 (4.6) [a]	3.5 (4.7) [a]	3 (3.5) [a]	0.996
Pattern dissimilarity score	1.5(1.2)	1.4(1.1)	1.3(1.2)	0.709

a: non-parametric data. Median (Interquartile range) is reported.

Table 4. Number and percentage of dermatoglyphic patterns in patients with different malocclusions

Pattern type	Classes; n (%)			
	Class 1	Class 2	Class 3	Total
Loop	852 (54.3)	681 (62)	268 (55.6)	1801 (57.2)
Arch	69 (4.4)	45 (4.1)	33 (6.8)	147 (4.7)
Whorl	505 (32.2)	279 (25.4)	126 (26.1)	910 (28.9)
Double whorl	143 (9.1)	94 (8.6)	55 (11.4)	292 (9.3)
Total	1569 (100)	1099 (100)	482 (100)	3150 (100)
p-value= 0.000				

4. Discussion

Genetic or chromosomal anomalies can be reflected as alterations in dermal ridges; therefore they can be used as an easily accessible tool in the study of genetically-influenced diseases. Dermatoglyphic investigation is cost effective, convenient, and requires no hospitalization (14). Many researchers have investigated dermatoglyphics in the fields of forensic medicine, genetics, and anthropology (16). Diagnosis of irregular fingerprints in patients with some congenital anomalies, such as trisomy 21 (16), breast cancer (17), autism (18), and skeletal abnormalities (19), has drawn attention to the field of medical dermatoglyphics. Epidermal ridges of the fingers and palms, as well as facial structures, form from the same embryonic tissues during the same embryonic period. Thus, this might indicate a possible association between dermatoglyphics and facial skeletal disorders, such as malocclusions (3). In this study, we found increased frequency of loops and whorls and decreased frequency of arches in all types of malocclusions. This finding is in contrast to the results of Reddy et al.'s study (13). Their results indicated that Class II div2 malocclusion was associated with increased frequency of arches and loops and decreased frequency of whorls, whereas in class III patients there was an increased frequency of arches and radial loops with decreased frequency of ulnar loops. Also, our results were not consistent with Trehan et al.'s study (20). They observed that class I and class III were associated with increased frequency of whorls and that both class I and class II div1 were associated with increased frequency of radial loop and arches. However, similar to the results of our study, Tikare et al. (14) did not find any association between dermatoglyphic patterns and malocclusion. They believed that variations in sample size might lead to contradictory results. Most previous studies have not mentioned clearly the protocol for recording fingerprint patterns, which can contribute to different results. A combination of hereditary and environmental conditions influences the abnormalities of fingerprint patterns. According to threshold theory, the abnormalities would occur only when the combined factors exceed a certain level. Therefore, etiologic factors that are responsible for the dermatoglyphic characteristics and malocclusion might not cross this threshold for the conditions to appear clinically (13). Similar to Tikare et al.'s study, we used Angle's classification of malocclusion. However, they believed that the use of a more accurate index for malocclusion may optimize the correlation between dermatoglyphics and malocclusion (14). However, to the best of our knowledge, similar previous studies have only investigated the association between fingerprint patterns and malocclusion. Our study was the only one that included some more variables, such as total ridge count, a-b ridge count, atd-angle, and their asymmetries between the right and left hands. Although we found some significant differences in TRC asymmetry of digit IV and left a-b ridge count between different malocclusions, most of the variables were not significantly different. Before coming to a final conclusion, additional studies are required that use larger sample sizes in other populations.

5. Conclusions

There were some slight differences in dermatoglyphic peculiarities of different malocclusions; however, most of the palm and fingerprint characteristics did not show any significant differences. Thus, based on our findings, evaluation of dermatoglyphic characteristics is not a reliable method for early diagnosis of skeletal malocclusions. Similar studies with larger sample sizes in different populations are still required.

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Conflict of Interest:

There is no conflict of interest to be declared.

Authors' contributions:

All authors contributed to this project and article equally. All authors read and approved the final manuscript.

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