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Research Article

A COMPARATIVE STUDY OF DERMATOGLYPHICS IN INDIVIDUALS WITH SKELETAL CLASS I, II AND III MALOCCLUSION

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ABSTRACT

Aim: To evaluate and compare the dermatoglyphic parameters of individuals with various classes of malocclusions. **Material and methodology:** A total of 120 pre- treatment lateral cephalograph between the age group of 15-28 years which were selected on the basis of type of malocclusion (skeletal Class I, II & III malocclusion). The participants were divided into four groups; Group 1: class I malocclusion; Group 2: class II division 1 malocclusion; Group 3: class II division 2 malocclusion; Group 4: class III malocclusion. The finger and palmar prints were obtained and they were analyzed for each type of pattern. **Results :** The ulnar loop was the most frequent and the central pocket loop was the least frequent fingerprint pattern. It revealed that ulnar loop pattern was more frequent in skeletal class I malocclusion**.** Statistically significant difference was observed in fingerprint pattern and skeletal malocclusion ($p<0.05$). No statistically significant difference was observed in total ridge count and skeletal malocclusion ($p>0.05$). Statistically significant difference was observed between the malocclusion groups regarding a-b ridge count and atd angle ($p<0.05$).**Conclusion:** The present study attempted in assessing the association between dermatoglyphic patterns and skeletal malocclusion. Analyzing dermal configurations may aid in indicating the type of developing malocclusion.

INTRODUCTION

The name "dermatoglyphics" comes from the Greek "glyphae," which means "carve," and "derma," which means skin. In 1926, Dr. Harold Cummins[1] first used the term "dermatoglyphics." Every fingerprint is distinct. Galton[2] divided patterns found on the fingertips into three primary categories based on the quantity of triradii observed. A simple arch is made up of several ridges that softly curve; it has no triradius and is not even really a pattern. A whorl has two or, in rare cases, three triradii, whereas a loop has just one. Loops are categorized as either ulnar or radial based on the way they face. Whereas the radial loop opens toward the radial margin, the ulnar loop opens toward the hand's ulnar margin. Even though a person may have the same pattern on all ten fingers, distinct digits frequently exhibit diverse patterns. The thumb and ring finger are most likely to have whorls, but the index finger is more likely to have radial loops and arches. An ulnar loop is the most common pattern on the little finger.

Anomalies in the look of fingers and palm prints can also result from hereditary and environmental causes that produce alterations in the lip, alveolus, and palate. The association between dermatoglyphics and malocclusion, such as sagittal skeletal discrepancies, has come to light recently due to the correlation between dermatoglyphics and oral clefts, periodontitis, and dental caries.[3]

AIM AND OBJECTIVES

Aim: To compare the dermatoglyphic parameters of individuals with various classes of malocclusions.

Objectives: To evaluate the fingerprint pattern i.e arches, whorls & loops in subjects with class I, class II div 1, class II div 2 and class III malocclusion and to evaluate the palm patterns i.e total ridge count, a-b ridge count and atd angle in subjects with class I, class II div 1, class II div 2 and class III malocclusion.

MATERIALS AND METHODS

The present study was done on 120 pre- treatment lateral cephalogram between the age group of 15-28 years which were selected on the basis of type of malocclusion (skeletal Class I,

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II & III malocclusion). All subject sample were from North Indian origin to minimize the variability from racial or geographical differences. Study samples were obtained from the patients who had reported to the department for comprehensive orthodontic fixed mechanotherapy. Written informed consent were obtained from each patient and were informed about the study and assured that the handprints will be used for study purpose only.

Selection criteria

1. Age group of 15-28 years.
2. All permanent teeth erupted in oral cavity excluding third molars.
3. No history of previous orthodontic treatment
4. History of trauma or surgical procedures performed in the orofacial region.
5. Skin diseases with wounds or scars on the fingers.
6. Congenital or acquired deformities of the fingers and palms or amputated fingers.
7. Malformation syndrome of maxilla and mandible, facial asymmetry and acquired skeletal defects.
8. History of thumb sucking, mouth breathing, tongue thrusting and lip biting.

Materials

1. Pre-treatment lateral cephalograph
2. Cephalometric tracing
3. Study models
4. Printing frame, each about 8 x 12 inches
5. Printer's ink
6. Small rubber roller
7. Paper with slightly glazed surface
8. Fine pointer
9. High power magnifying lens (10X)

Methodology

Dermatoglyphic pattern of all the 120 subjects were recorded by the ink and roller method as was suggested by Cummins and Midlo.[1]

Figure 1 Printing frame with small rubber roller
Figure 2 Hand placed on printing frame

Figure 3 Hand placed on glazed paper
Figure 4 Hand prints on glazed paper

Finger pattern analysis

Finger pattern configuration
It includes dermatoglyphic landmarks like whorls, loops and arches.

1. **Whorl (W)[4]:** It is distinguished by its concentric design, in which the majority of ridges make circuits around the core. A whorl has two tri-radii. Tri-radius is the point where three ridge system meet. (fig 5)

Figure 5 Whorl

2. **Loop(L)[4]:** It possesses only one tri-radius. The ridges curve around only one extremity of the pattern and flow to the margin of the digit. If the loop opens to the ulnar margin it is an ulnar loop (LU), and if so the radial margin it is the radial margin it is a radial loop (LR). (fig 6)

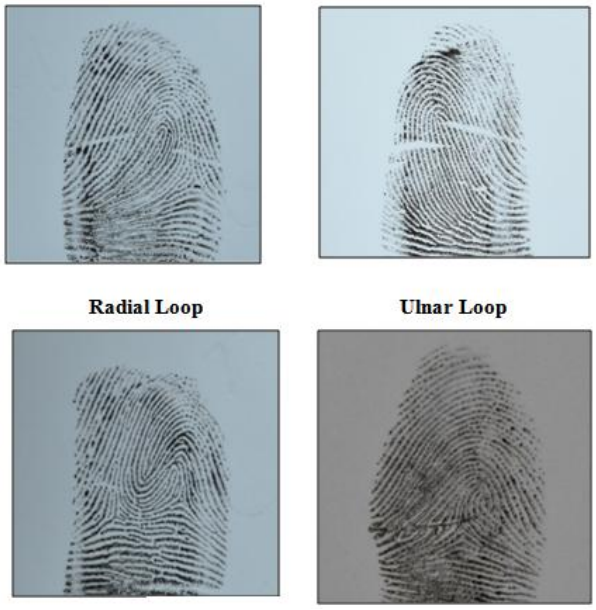


Figure 6 Types of Loop

Arch[4]: If an Arch the ridges pass from one margin of the digit to the other with a distally bowed sweep, which gives the name of the pattern type having no tri-radius. They may be simple or tented arches. (fig 7)

Simple arches **Tented arches**

Figure 7. Types of Arches

Palm print analysis

Palm pattern configuration

1. **Ridge Count**[4]**:** It is the no. of ridges between the tri-radius and the core. When two or more tri-radii are present, as in whorls, the one with the largest count is used. An arch has no tri-radii so its ridge count is 0. (fig 8)

Figure 8 Ridge Count

2. **Total Finger Ridge Count (TFRC)**[4]**:**

Single value for an individual will obtained as the sum of ridge count on all the ten fingers.

3. **A-B Ridge Count**[4]**:**

It is obtained by counting the number of ridges between tri-radii a & b.
All the ridge counts were done using a fine pointer and high power magnifying lens.

4. **ATD angle**[4]**:**

This angle is formed by lines drawn from the digital tri-radius 'a' to axial tri-radius and to'd'. The more distal is the position of axial tri-radius, the larger is the 'atd' angle. (Fig. 9)

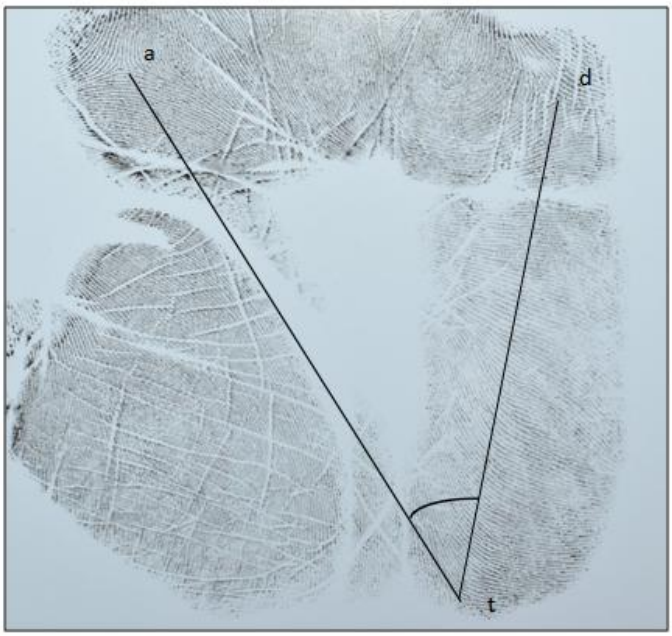


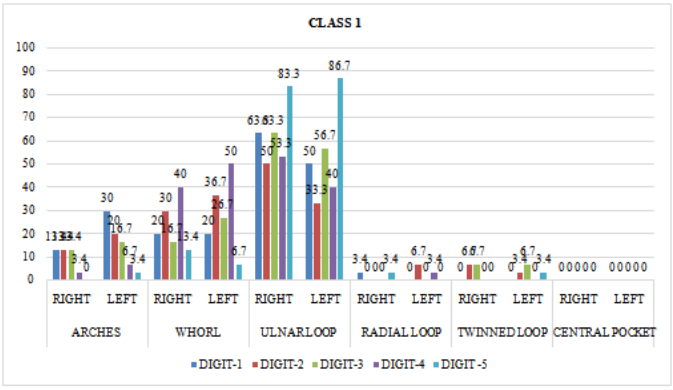
Figure 9 ATD angle; a- Digital tri-radius, t- Axial tri-radius

RESULTS

Data was analysed using the statistical package **SPSS 22.0** (SPSS Inc., Chicago, IL) and level of significance was set at **p<0.05**. **Descriptive statistics** was performed to assess the mean and standard deviation of the respective groups. **Inferential statistics** was done using **CHI SQUARE TEST** was used for checking the association between the groups. Mean comparison was done using **Kruskal Wallis test followed by Bonferroni post hoc test.**

TOTAL PERCENTAGE FREQUENCY OF PATTERNS IN DIFFERENT SKELETAL MALOCCLSIONS

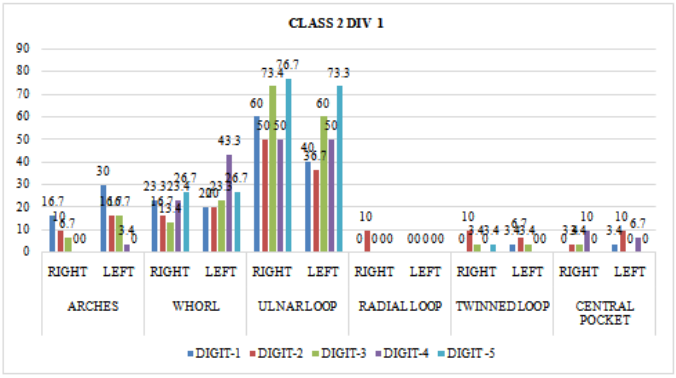
Skeletal Class I malocclusion



Graph I Percentage frequency of patterns in class I malocclusion

In class I malocclusion, ulnar loops were observed in maximum frequency in right hand (83.3%) and in left hand (86.7%) and radial loop were observed in maximum frequency in right hand (1.36%) and in left hand (2.02%). Central pocket loop shows minimum frequency in right and left hand (0%).

Skeletal Class II Div 1 malocclusion

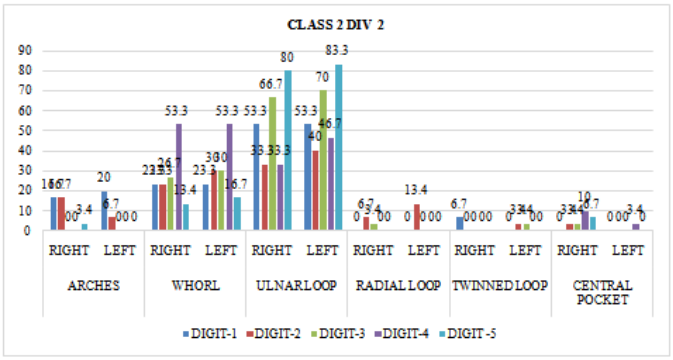


Graph II Percentage frequency of patterns in class II div 1 malocclusion

In class II div 1 malocclusion, ulnar loop were observed in maximum frequency in right hand (76.7%) and in left hand (73.3%). Radial loop shows minimum frequency in right hand (2%) and left hand (0%).

In class II div 1 malocclusion, ulnar loop were observed in maximum frequency in right hand (76.7%) and in left hand (73.3%). Radial loop shows minimum frequency in right hand (2%) and left hand (0%).

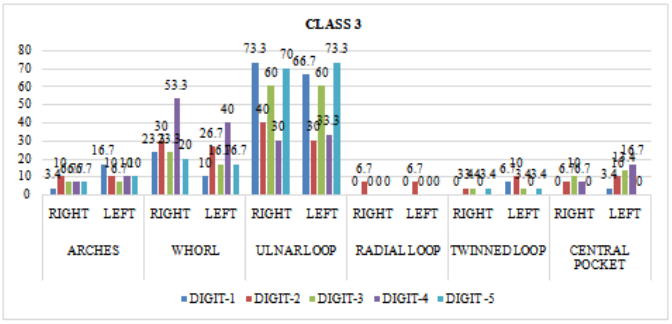
Skeletal Class II div 2 malocclusion



Graph III Percentage frequency of patterns in class II div 2 malocclusion

In class II div 2 malocclusion, ulnar loop were observed in maximum frequency in left hand (83.3%) and in right hand (80%). Central pocket loop shows minimum frequency in left hand (0.68%) and twinned loop shows minimum frequency in right hand (1.34%).

Skeletal Class III malocclusion



Graph IV- Percentage frequency of patterns in class III malocclusion

In Class III malocclusion, ulnar loop were observed in maximum frequency in right hand (73.3%) and in left hand (73.3%) and central pocket loop were observed in maximum frequency in right hand (10%) and in left hand (16.7%). Radial loop shows minimum frequency in both right and left hand (0%).

DISCUSSION

The study of ridge patterns was called "Samudra Shastra" in ancient India. On the fingertips, common ridge patterns are loops, whorls, and arches (Galton). Radial or Ulnar loops are possible. Tri radii, or the confluences of three ridge systems, are what distinguish these designs. A whorl has two or more tri radius, a loop has one, and an arch has none.[5]

Fingerprint pattern

In skeletal Class I malocclusion (right hand = 62.64%, left hand = 53.34%), skeletal Class II div 1 (right hand = 62%, left hand = 52%), Div 2 (right hand = 53.32%, left hand = 58.66%), and skeletal Class III malocclusion (right hand = 54.66%, left hand = 52.66%), ulnar loops were more noticeable than other finger print patterns in the current study. It was discovered that the outcomes were statistically significant. An earlier investigation by Kharbanda OPet al[4] in 1982 found that a rise in arches and ulnar loops at the expense of whorls on all digits, with the exception of digit 2, was linked to craniofacial skeletal Class III pattern (mandibular prognathism). Dermatoglyphics may be able to predict malocclusion, according to a 1997 study by Reddy et al.[6]In contrast to our findings, which showed that class III malocclusion was associated with an increased frequency of arches and radial loops and a decreased frequency of ulnar loops, their results suggested that craniofacial Class II division 2 pattern was associated with an increased frequency of arches and ulnar loops and a decreased frequency of whorls. According to Tiwari et al[7]in 2014 observation, the frequency of loops increased as the severity of malocclusion decreased, whereas the frequency of whorls decreased. According to Belludi et al[8]in 2021 study, skeletal class III malocclusion was shown to have a higher number of loops and a lower number of whorls and arches than class I malocclusion.In contrast to our study, which found that ulnar loops and whorls show increased frequency in class II malocclusion and that ulnar loops and central pocket loops show increased frequency in class III malocclusion, the previous study by Mohanakrishnan et al[9] in 2022 reported increased frequency of ulnar loop pattern in Skeletal Class II with mandibular deficiency group and it was least frequent in Skeletal Class III with mandibular excess group; there was also an increase in frequency of plain whorl pattern in Class III with mandibular excess group. Similar to our analysis, another study conducted in 2023 by Achalli et al[10] found a prominent loop pattern in skeletal class I malocclusion. However, contrary to our study, whorl pattern was more common in skeletal class III malocclusion.

Fewer studies, however, have noted that whorls occur more frequently than other finger patterns. In 2000, Trehan et al[11] noted that higher frequencies of whorls were linked to both Class I and Class III, and higher frequencies of radial loops and arches were linked to Class I and Class II division 1. In 2010, Tikare et al[12] found no statistically significant correlation between any class of malocclusion and the other finger print patterns, although there was a statistically significant correlation in the whorl patterns between class I and class II malocclusion.On the other hand, statistically significant differences were found in the arches, central pocket loop, ulnar loop, radial loop, and twinned loop in our investigation. While in our study whorl pattern, ulnar loop, radial loop, and twinned loop showed increased frequency in skeletal class II and whorl pattern and central pocket loop showed increased frequency in skeletal class III malocclusion, George et al[13]in 2017 observed increased distribution of whorl pattern in skeletal class II and increased distribution of loop pattern in skeletal class III.

Skeletal malocclusion and dermatoglyphics have also yielded non-significant results in earlier research. Reddy etal[14] in 2013 state that specific predictive patterns were not discovered to be connected to any group. Nonetheless, it was discovered that a few of the finger patterns were statistically significant, including the rise in twinned loops in class II malocclusions and the absence of radial loops in class III malocclusions. There was no statistically significant variation in the palmar print parameters. In 2015, Jindalet al[3] came to the conclusion that a fingerprint's pattern was not unique to a type of occlusion.Subjects with Class II malocclusion and those with class III malocclusion with simple arches showed a higher incidence of whorls. In a 2020 study, Harmeet Kauret al[15] evaluated the relationship between dermatoglyphics of people with varying skeletal growth and discovered no meaningful relationship between dermatoglyphics and distinct growth patterns. Nevertheless, dermatoglyphics and the types of

sagittal inconsistencies (class I, class II, and class III malocclusion) were linked to our research.

Total finger ridge count

Total finger ridge count (TFRC) has a mean value of 141.26 among Indian populations (ranging from 107.60 among Delhi's Jats to 183.60 among Car Nicobarese).Scheduled tribes have a lower value (140.59) than other ethnic groupings, such as the community (140.83), caste (140.91), and scheduled caste (142.60), but the variations between these groups are negligible. The Himalayan mountain complex (136.81), the Indus Ganga-Brahmaputra lowlands (145.20), the peninsular plateau (139.74), and the Islands natural region (167.97) have the highest values.

In our investigation, the class II div 2 malocclusion showed the highest TFRC (119.69±25.34), whereas the class I malocclusion showed the lowest TFRC (96.63±33.45). But there was no statistically significant difference between skeletal malocclusions and TFRC. These results are consistent with those of Kharbanda et al[4]in 1982, Reddy et al[14] in 2013, Eslami et al[16] in 2016, and Belludi et al[8] in 2021 who examined a variety of patients with skeletal malocclusion and found no statistically significant variation in TFRC between groups.

A substantial difference between the TFRC and malocclusion groups was observed by Jindal et al[3]in 2015. The subjects with class III malocclusion had the lowest mean TFRCs, followed by those with class I and class III malocclusion. In 2017 George et al[13] conducted another study which found that the skeletal Class II with maxillary surplus and the skeletal Class II with mandibular deficit groups had higher total ridge counts. Ridge count could be taken into consideration for predicting skeletal pattern, according to multinomial regression predicting skeletal pattern with respect to ridge count. In terms of TFRCs, Achalli et al[10] in2023 likewise observed a statistically significant difference between skeletal classes I, III, and IV with maxillary retrognathism and mandibular prognathism.

a-b ridge count

In contrast to previous studies by Kharbanda et al[4] in 1997, Reddy et al[14]in 2013, and Rajput et al[17]in 2014 that found no significant variation in a-b ridge count between the experimental groups, our study's Kruskal Wallis test revealed a statistically significant difference between the malocclusion groups regarding a-b ridge count ($P<0.05$) in both the right and left side. Similar findings were found in a subsequent study conducted by Belludi[8] in 2021, which showed no discernible variation in the mean a-b ridge count on the left and right hands of children in the skeletal class I and class III malocclusion groups.

Atd angle

In our investigation, the Kruskal Wallis test revealed a statistically significant difference ($p<0.05$) in the atd angle between the malocclusion groups on both the right and left sides. Comparing the class I control group to the experimental groups (class II, div. 1, div. 2, and class III), Reddy et al[6] in 1997 found similar results: on both the right and left hands, the mean value of the atd angle dropped. A statistically significant difference was found between the atd angle and skeletal class I and class III malocclusions in a further study conducted in 2023 by Achalli et al.[10]Our findings contradicted those of earlier research by Belludi et al[8] in 2021, Rajput et al[17] in 2014, Reddy et al[14] in 2013, and Eslami et al[16] in 2016, which found no statistically significant relationship between skeletal malocclusions and atd angle.

The current study was conducted on North Indian participants; more research should be done using specific DNA analysis and samples with a range of demographic and ethnic features to better explore the correlations examined here. Early identification of a person's genetic predisposition to malocclusion and its hereditary component may help design preventive and intervention measures. Conversely, dermatoglyphics can be extremely beneficial for the quick, simple, noninvasive, and affordable identification of individuals who are more likely to develop malocclusion as well as for prompt prevention, particularly in developing nations with sizable populations and constrained medical resources.[5]

Currently, malocclusion is observed in most people worldwide. Malocclusion is categorized as a "Handicapping Dentofacial Anomaly" by the World Health Organization (1987), which defines it as an anomaly that impairs function or results in disfigurement and necessitates treatment "if the disfigurement or functional defect was likely to be an obstacle to the patient's physical or emotional well-being."[18]

CONCLUSION

Statistically significant difference was observed in fingerprint pattern and skeletal malocclusion ($p<0.05$). No statistically significant difference was observed in digits and skeletal malocclusion ($p>0.05$). Statistically significant difference was observed between the malocclusion groups regarding a-b ridge count ($p<0.05$). Statistically significant difference was observed between the malocclusion groups regarding atd angle($p<0.05$).

Limitations

Malocclusions based on dermatoglyphics can be predicted with a fair degree of accuracy but it cannot be relied upon as the sole factor. This is due to the fact that numerous other factors such as ethnic and racial variations, congenital, environmental and other local factors can also influence the development of malocclusions. Further studies on large sample sizes, according to their racial and ethnic backgrounds, are warranted.

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