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A Comparative Evaluation between Dermatoglyphic Patterns and the Permanent Molar Relationships – An Attempt to Predict the Future Malocclusions

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Abstract

Background: Due to the similar duration of development, finding the dermatoglyphic patterns to predict malocclusions can help a pediatric dentist to attempt any necessary preventive and interceptive orthodontic therapies. **Aim:** To assess the correlation between different dermatoglyphic patterns with the permanent molar relationships. **Materials and Methods:** 300 children who are 14-16 years old with completely erupted 2nd permanent molars up to occlusal table were recruited and the pattern of molar terminal plane was recorded in the proforma. Finger prints of these subjects were recorded with ink and roller method. Forensic analyst analysed the prints and classified based on the classification given by Galton and also calculated the finger ridge count as given by Cummins and Midlo Statistical analysis used: Chi-Square test was applied to compare proportions between all the groups and also for gender comparison. Fisher's exact test was used when any expected cell frequency of less than five were obtained. Paired t-Test and McNemar's test were applied to compare values between right and left hand. **Results:** Class I children showed absence of arch pattern in thumb and little finger of left hand; and higher total finger ridge count in right hand when compared to left hand. Children with Class II molar relationship had a significant association with presence of arch pattern in thumb finger of left hand; and presence of whorl pattern in both left and right ring fingers. Class III had a significant association with presence of loop pattern in left thumb finger and little finger; absence of arch pattern in thumb of right hand. **Conclusion:** Dermatoglyphics can be a useful non-invasive analytical tool to predict malocclusions in permanent dentition and sometimes, to identify an individual. Further studies with larger sample size are required to provide an insight into its significant correlations.

Keywords: Angle's Classification, Dermatoglyphics, Malocclusion

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1. Introduction

According to Angle "occlusion is the normal relation of the occlusal inclined planes of the teeth when the jaws are closed"[1]. Malocclusion is when the teeth are in abnormal position in relationship to the basal bone of the alveolar process[2]. Malocclusion can lead to psychological and social problems[3]. Since the overall prevalence of malocclusion is considerably high, identifying a factor which can predict its development can help in reducing the treatment needs required. Various methods have been tried like assessing etiologic factors[4], cervical vertebrae

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measurements[5], facial profiles[6], terminal planes from primary dentition[7] and lip prints[8]. Dermatoglyphics, which comes from two Greek words derma meaning skin; glyphe meaning carve,[9] refers to the study of the intricate dermal ridge configuration on the skin covering, the palmar and plantar surfaces of the hands and feet[10]. Finding patterns to predict malocclusions can help a pediatric dentist to attempt any necessary preventive and interceptive orthodontic therapies. So this study was aimed to assess the correlation between different dermatoglyphic patterns with the Angle's classification of molar relationship.

2. Materials and Methods

This study was conducted among 300 children aged 14-16 years attending the out-patient department of the Department of Pediatric and Preventive Dentistry. Ethical clearance was obtained from Institutional Review Board. Study purpose and procedures were explained to the parents and only those who gave consent to participate were included in the study. Children with complete permanent dentition which had developed to occlusion except the 3rd molars were included in the study. Uncooperative children, retained deciduous teeth or root stumps, previous history of orthodontic treatment, previous history of burn or chemical injury or lesions on distalphalanges of hands and different molar relationships on either side of the same subject were excluded from the study. Children were taught multiple times to bite incentric occlusion and two calibrated examiners were trained to assess the molar relationship based on the classification given by Angle (1899)[1] as Class I, Class II, Class III. The assessment was done using a mouth mirror and recorded in the proforma. Using SPSS software version 22.0, with 95% power and with limitations of 5% error, the sample size was calculated as 82 per group with a total of 246 subjects. A total of 100 children were taken for each molar relationship to standardize the number of children under each group.

The ink and roller method, suggested by Cummins and Midlo,[11] was preferred to record the fingerprints. Children were asked to wash their hands using soap to remove any dirt and sebaceous secretions on the palms. A small amount of Black printer's ink was dispensed on the inking slab and and was evenly spread to a thin dull finish using a roller. The bulb of each distal phalange of all the ten digits in both hands were placed at right angles to the in kings lab and rolled over the ink until the bulb faced opposite side. Children were asked to transfer the fingerprint to a bonded white paper by rolling in the same manner with minimal pressure. (Figure 1) Each print was checked for clarity and if any smudging of the print was noticed, the print was repeated once again. The collected fingerprints were analysed using a magnifying glass by a forensic specialist who was trained to analyse the prints. The analyst was blinded about the age, gender and molar relation of the children. The analyst read the fingerprints based on the basic classification given by Galton (1892)[12] asarch, loop and whorl (Figure 2) and further sub-classified as simple arch, tented arch, ulnar loop, radial loop, simple whorl, double loop whorl and central pocket whorl.

The total finger ridge count was calculated based on the method given by Cummins and Midlo[11]. The approximate center of each pattern (core) and corresponding confluence of three ridge systems that form angles of approximately 120° with one another (triradii/delta) were identified. A straight line was drawn passing through these two points. The ridge count was calculated by counting the number of ridges that intersect this line (Figure 3). In this study, the highest of the two ridge counts (in case of whorl pattern) of each finger was taken as the finger ridge count for that finger. The finger ridge counts were summed for each hand separately and for both hands together to obtain the total finger ridge count.

3. Statistical Analysis

The data values were tabulated and subjected to statistical analysis. Chi-Square test was applied to compare proportions between all the groups and also for gender comparison. Fisher's exact test was used when any

Figure 1: Method to record fingerprints as described by Cummins and Midlo.

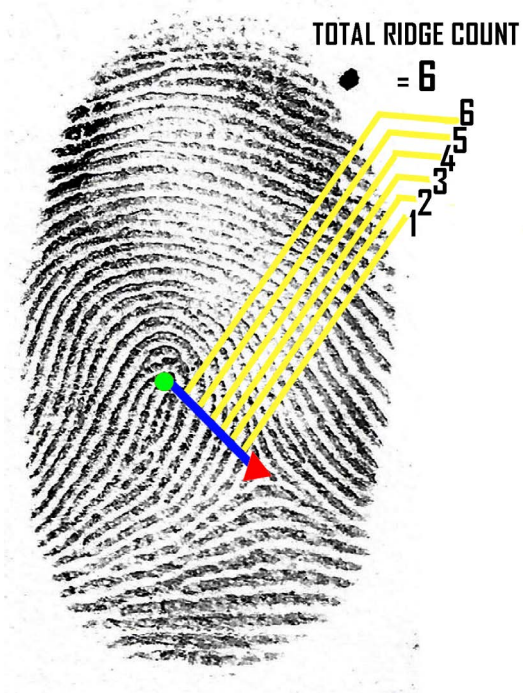

Figure 2: The 3 basic patterns in dermatoglyphics. a) Arch, b) Loop, c) Whorl

expected cell frequency of less than five were obtained. Paired T-Test and McNemar's test were applied to compare values between right and left hand. SPSS version 22.0 was used to analyse the data. Ap-value of <0.05 is considered as statistically significant.

4. Results

The mean age group of children was 15.31 ± 0.67 years. Among the children having Class I, 30% were females and 70% were males. For the children having Class II, 55% were females and 45% were males. In children having Class III, 51% were females and 49% were males.

Ulnar loop pattern was the most predominant pattern equally distributed in all the children. For children having Class I, the left hand showed an increase in loop pattern and decrease in arch pattern in the thumb finger; and a decrease in arch pattern in little finger, which were statistically significant (p = 0.012 and 0.013 respectively). In specific patterns there was a significant increase in ulnar loop pattern in the left little finger (p = 0.001) for children with Class I. The right hand showed a significant

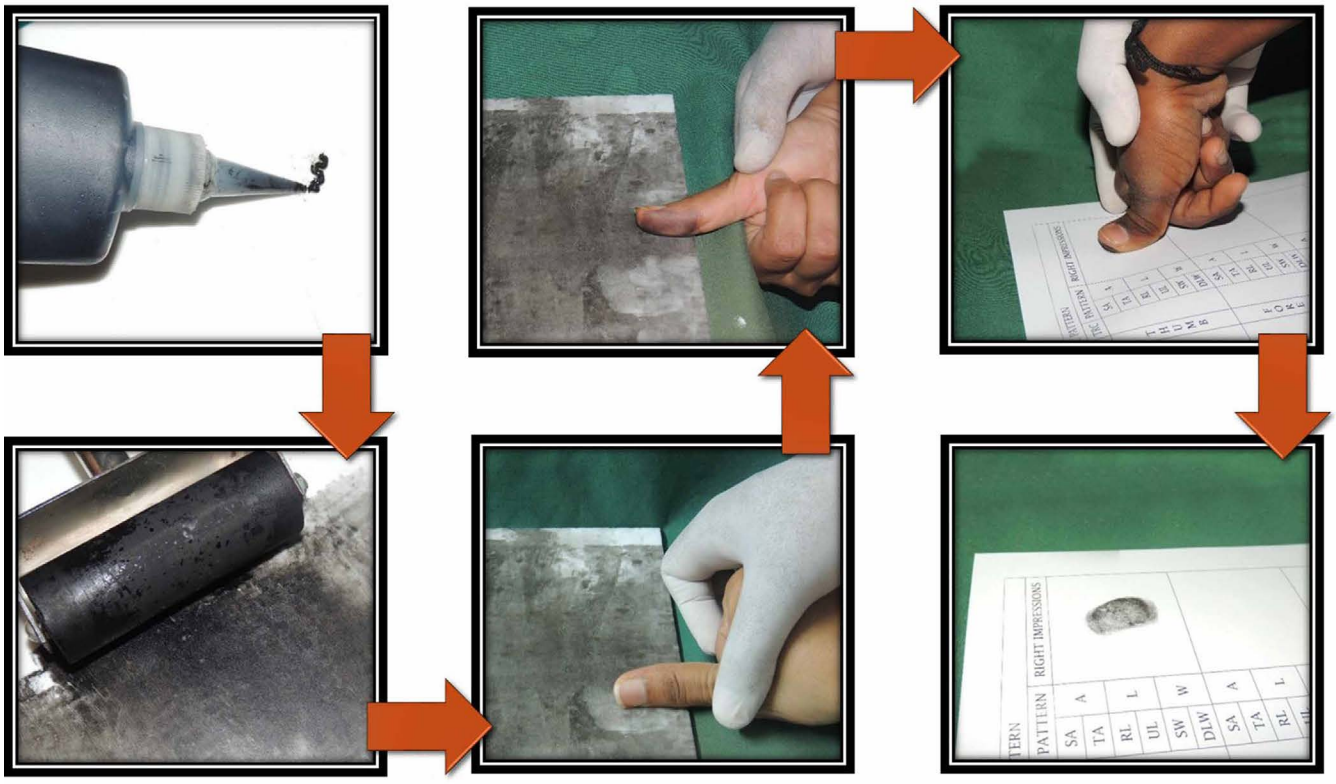

Figure 3: Method to calculate total ridge count. Green circle is the core. Red triangle is the delta. Count the number of ridges that intersect the line (blue) joining the core ad delta to get the finger ridge count.

increase in loop pattern in thumb finger (p = 0.015); and a reduction in arch pattern in ring finger and absence of arch pattern in little finger were noted, which were not statistically significant (p = 0.940 and 0.327 respectively). In the children having Class II, the left hand showed a significant increase in arch pattern in thumb finger (p = 0.012) and in loop pattern in little finger (p = 0.013). An increase in whorl pattern was also noticed in left ring finger, which was not statistically significant (p = 0.512). In specific patterns, an increase in simple whorl and/or central pocket whorl in the left little finger was noted with statistical significance (p = 0.001) in children with Class II. The right hand of children with Class II shows a significant rise in loop pattern in the thumb finger (p = 0.015). There was also a significant reduction in arch pattern in right middle, ring and little finger which was not statistically significant (p = 0.419, 0.940, 0.327 respectively). In the children with Class III, there was a significant increase in loop pattern in the thumb finger (p = 0.012) and little finger (p = 0.013) of the left hand. There was also an increase in whorl pattern in left ring finger, which was not statistically significant (p = 0.512). In specific patterns, a significant increase in ulnar loop pattern in the little finger was noticed (p = 0.001). The right hand showed significant decrease in arch pattern in thumb finger (p = 0.015); and also in middle, ring and little finger, which was not statistically significant (p = 0.419, 0.940, 0.327 respectively). The significant relations are provided in Table 1. Figure 4 depicts the dermatoglyphic patterns of 3 random patients (one under each class of molar relation).

Comparison between the left and right hands showed that children with Class II molar relationship showed combined absence of whorl pattern in left middle finger and arch pattern in right middle finger or combined absence of arch pattern in left middle finger and whorl pattern in right middle fingers (p = 0.003); absence of whorl pattern in left ring finger along with absence of arch pattern in right ring finger; and also presence of whorl pattern in both left and right ring fingers (p = 0.023); and presence of arch pattern in left and right little finger (p = 0.012). Absence of arch pattern in left middle finger along with absence of whorl pattern in right middle finger for children with Class III was significant (p = 0.016). There were no significant differences among the specific patterns between different terminal planes when compared between the left and right hands. The significant relations are provided in Table 2. Based on gender, no significant correlation was noticed for any of the patterns in all the 3 molar relationships.

The mean total finger ridge count in the left hand, right hand and both hands showed significantly higher count in Class I when compared with other classes (p = 0.032, <0.001, 0.003 for Class I, II, III respectively). The left hand showed a significantly higher finger ridge count in thumb and ring finger for Class I (p = 0.005 and 0.002 respectively). In the right hand, a significant increase in finger ridge count was noticed in thumb, fore, middle and ring finger for Class I (p = 0.001, 0.040, 0.016 and 0.025 respectively).

On comparison between the hands, children with Class I had a significantly higher finger ridge count in right thumb, index and middle finger when compared to their counterparts (p = 0.001, 0.011, 0.041 respectively). They also had a higher total finger ridge count in right hand when compared to left hand, which was also statistically significant (p = 0.001). On comparison based on gender, there was an increase in finger ridge count in right thumb among males with Class I molar relationship, which was statistically significant (p = 0.048). There was a significant increase in finger ridge count in right ring finger among females with Class II molar relationship (p = 0.014). The significant relations are provided in Table 3.

5. Discussion

Every human is unique and distinct in that they exhibit their own characteristic pattern. These patterns can be exhibited as dermal ridges that are formed in the palm and distal digits of hands. Any factor which is active during the time period of genetic expression, is bound to affect all structures developing at the same time period[13]. The epidermal ridges of the fingers and palm and the facial structures like lip, alveolus and palate originate during the same embryonic period, i.e. the 24th week of intra uterine life, concurrently[14] and also from the same embryonic tissue, i.e. the ectoderm. Thus genome in the genetic message whether its normal or abnormal is expected to be deciphered during this period and is

Table 1. Significant correlations in the patterns for each molar relation

Molar relation	Finger	Pattern	p-value
Class I	Left thumb	Increase in loop and decrease in arch	0.012
	Left little	Decrease in arch	0.013
		Increase in ulnar loop	0.001
	Right thumb	Increase in loop	0.015
Class II	Left thumb	Increase in arch	0.012
	Left little	Increase in loop	0.013
		Increase in simple whorl and/or central pocket whorl	0.001
	Right thumb	Increase in loop	0.015
Class III	Left thumb	Increase in loop	0.012
	Left little	Increase in loop	0.013
		Increase in ulnar loop	0.001
	Right thumb	Decrease in arch	0.015

Table 2. Significant correlations on comparison of patterns between left and right hands for each molar relation

Molar relation	Left finger	Right finger	p-value
Class II	Middle – absence of whorl	Middle – absence of arch	0.003
	Middle – absence of arch	Middle – absence of whorl	
	Ring – absence of whorl	Ring – absence of arch	0.023
	Ring – presence of whorl	Ring – presence of whorl	
	Little – presence of arch	Little – presence of arch	0.012
Class III	Middle – absence of arch	Middle – absence of whorl	0.016

Table 3. Significant correlations in the ridge counts for each molar relation

Molar relation	Finger / Hand	Ridge count	p-value
Class I	Left hand	Higher mean total ridge count	0.032
	Right hand	Higher mean total ridge count	<0.001
		Higher total ridge count than left	0.001
	Left and Right hand	Higher mean total ridge count	0.003
	Left thumb	Higher finger ridge count	0.005
	Left ring	Higher finger ridge count	0002
	Right thumb	Higher finger ridge count	0.001
		Higher finger ridge count than left	0.001
		Males – higher finger ridge count	0.048
	Right index	Higher finger ridge count	0.040
		Higher finger ridge count than left	0.011
	Right middle	Higher finger ridge count	0.016
		Higher finger ridge count than left	0.041
	Right ring	Higher finger ridge count	0.025
Class II	Right ring	Females – higher finger ridge count	0.014

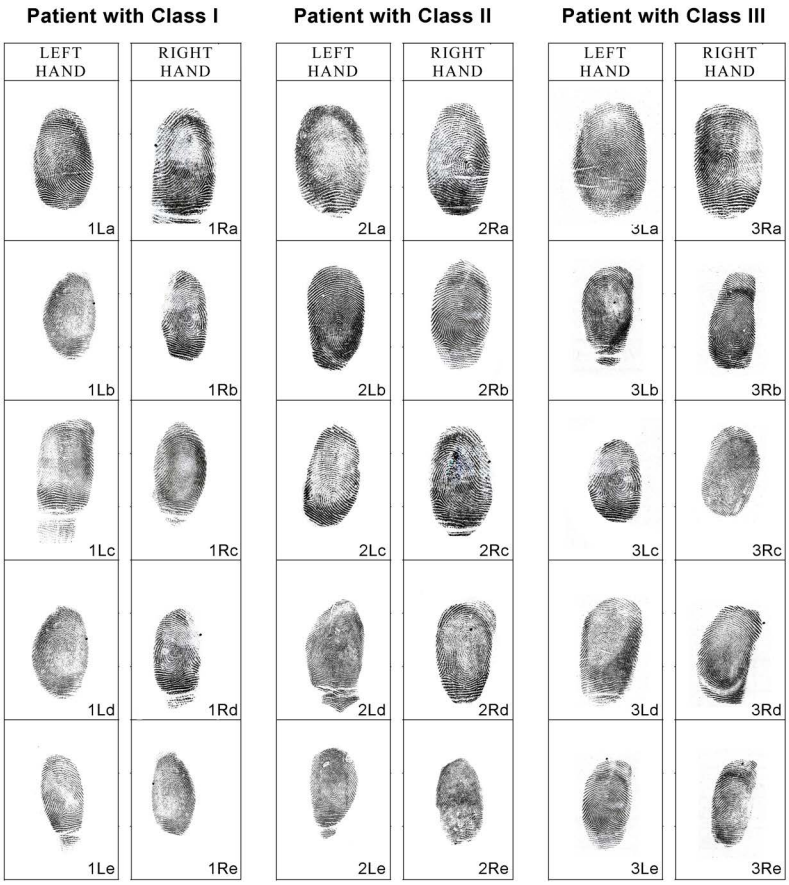

Figure 4: Image showing dermatoglyphic patterns of 3 random patients (one under each class of molar relation). Patient with Class I molar relation had absence of arch pattern in left thumb (1La) and little finger (1Le). Patient with Class II molar relation had arch pattern in left thumb finger (2La), whorl pattern in both left (2Ld) and right ring fingers (2Rd), whorl pattern in left little finger (2Le). Patient with Class III molar relation had loop pattern in left thumb (3La) and littl Class e finger (3Le), absence of arch pattern in right thumb finger (3Ra).

reflected in dermatoglyphic patterns that are formed at the same period of development.

In the present study, ulnar loop pattern was found to be equally distributed in all the children. This was in accordance with BR Reddy *et al*[13], Eslami *et al*[15] and Deepti *et al*[16] studies who had reported the same predominance, but contradictory to the study done by Tikare *et al*[17] who showed a predominant whorl pattern. Children with Class I molar relationship had an absence of arch in thumb and little finger of left hand. On the other hand, for Class I molar relationship, Sumedha *et al*[18] had reported an increased whorl pattern and Deepti *et al*[16] had reported loop pattern in middle and ring finger of both hands. Children who had Class II molar relationship showed presence of arch pattern in thumb finger of left hand and presence of whorl pattern in both left and right ring finger. This was contradictory to the study by Kaur *et al*[19] who had reported whorl pattern in thumb finger and Divyashree *et al*[20] who concluded ulnar loop pattern in right hand. Class III molar relationship showed significant relationship with presence of loop pattern in left thumb and little finger which was contradicting to the study by Reddy *et al*[13] who showed absence of radial loop pattern. The total finger ridge count in the present study is the highest for Class I malocclusion while the study done by Jindal *et al*[21] reported that Class III had a significantly lower total finger ridge count.

The current study showed that children with Class I had absence of arch pattern in thumb and little fingers of left hand; increased total finger ridge count in both hands, individually and combined; increased ridge count in thumb and ring finger of both hands, middle and

index finger of right hand; higher finger ridge count in right thumb, index and middle fingers when compared to their counterparts; increase in finger ridge count in right thumb among males; and higher total finger ridge count in right hand when compared to left hand. Class II molar relation in children was seen along with presence of arch pattern in thumb finger of left hand; presence of simple whorl pattern and/or central pocket whorl pattern in little finger of left hand; combined absence of whorl pattern in left middle finger and arch pattern in right middle finger; combined absence of arch pattern in left middle finger and whorl pattern in right middle finger; absence of whorl pattern in left ring finger along with absence of arch pattern in right ring finger; presence of whorl pattern in both left and right ring fingers; presence of arch pattern in left and right little fingers; and increase in finger ridge count in right ring finger among females. Children with Class III was correlated to presence of loop pattern in left thumb finger and little finger; presence of ulnar loop pattern in little finger; absence of arch pattern in thumb finger of right hand; and absence of arch pattern in left middle finger along with absence of whorl pattern in right middle finger.

One of the limitations of the study is that this study covers only the genetic factors, but the environmental and local factors which also play significant role in determining malocclusion were not considered[22]. The threshold theory states that only when the combined factors exceed a certain level, can these abnormalities be expected to appear. The aetiological factors responsible for the manifestation of dermatoglyphic patterns and malocclusion might not cross this threshold for these conditions to manifest clinically[23]. The other limitations include asymmetry analysis of malocclusion was not considered in the present study; further studies with larger sample size involving multiple ethnic groups are required to provide a more accurate prediction.

These results could help the dental practitioner to establish necessary measures during the primary and mixed dentition period itself so as to ensure no loss of space occurs due to reasons of dental caries or premature extraction of primary teeth. Identifying individual's malocclusion through their dermatoglyphic pattern could help even in identifying an individual in mass disasters based on their orthodontic treatment history, provided all their past dental history were recorded in a database.

6. Conclusion

Within the limitations of the current study, dermatoglyphic patterns can be considered as an aid in predicting malocclusions at an earlier stage, which could eventually help us in providing preventive orthodontic treatment, space management and sometimes even in identifying the individual.

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