Association between dermatoglyphic patterns and growth patterns of subjects with skeletal class I relation: A cross sectional study [version 1; peer review: 2 approved]

Keerthan Shashidhar1, Kuttappa M N2, U S Krishna Nayak1, Neevan D'Souza2, Mahabalesh Shetty3, Sonika Achalli4

1Orthodontics and Dentofacial Orthopedics, A B Shetty Memorial Institute of Dental Sciences; Nitte (Deemed to be University), Mangalore, Karnataka, 575018, India
2Department of Biostatistics, K.S Hegde Medical Academy, Nitte (Deemed to be University), Mangalore, Karnataka, 575018, India
3Department of Forensic Medicine, K.S Hegde Medical Academy, Nitte (Deemed to be University), Mangalore, Karnataka, 575018, India
4Oral Medicine and Radiology, A B Shetty Memorial Institute of Dental Sciences; Nitte (Deemed to be University), Mangalore, Karnataka, 575018, India

Abstract

Background: To assess the relationship between dermatoglyphic patterns and various growth patterns of the mandible.

Methods: Patients with Class I Skeletal relation were selected after clinical diagnosis followed by digitally tracing the cephalogram. The patients were subdivided into three groups of mandibular divergence patterns ie Average, Horizontal and Vertical. 90 samples ie 30 in each group were selected for the study. The fingerprints of all the selected subjects were then extracted digitally and analysed for the most dominant pattern in each hand.

Results: For the left hand, there was a statistically significant (P<0.05) association between fingerprint pattern and growth pattern when Horizontal growers were compared to Average and Vertical Growers. For the right hand, there was a statistically significant (P<0.05) association between fingerprint pattern and growth pattern when Horizontal growers were compared to Average Growers. A significant association (P<0.05) between fingerprint pattern and growth pattern was also found when average growers were compared to vertical growers.

Conclusions: Horizontal growers had 80% frequency of appearance of whorls in their left hand and 67% in their right hand. Horizontal growers could easily be differentiated from the average and vertical growers because of the dominance of whorl pattern in their hands. Composite and arch pattern were more frequent in vertical growers when compared to horizontal and average growers.
Introduction
The craniofacial growth determines the type of shape of the head, shape of the face and the presence or absence of any anomalies in the head and face region. Many factors influence the craniofacial growth which ultimately maps the face of an individual.

One of the factors that contributes a large role in determining the final outcome of the face is genetics. The human mandible continues to grow even after the maxilla attains its final position. It is because of this reason that the mandibular growth pattern cannot be easily predicted. Facial growth relative to a cranial base line proceeds along a vector composed of variable amounts of horizontal (forward) growth or vertical (downward) growth. These growth patterns of the mandible are each associated with varied treatment modalities in the orthodontic field. The rotations of the mandible can occur for a variety of reasons, but there is undeniably an intrinsically determinant factor ie the genes that play a role in the establishment of the pattern of growth of the lower jaw.

Recently, a lot of interest has been shown towards dermatoglyphics in the dental fraternity. It has also been reported that dermatoglyphics is associated with a number of medical conditions. The interest of dermatoglyphics in medicine was generated when abnormal dermal patterns were observed in Down’s syndrome. Today, dermatoglyphic patterns have been shown to be related to oral clefts, dental arch forms, dental caries, carcinoma of the breast, Type 2 diabetes, hypertension and head and neck cancer.

Since dermatoglyphic patterns develop intrauterine (12th–24th week) during the same period as the development of the mandible (14th–29th week) and genetics plays a determining factor in their development, it can be hypothesized that they bear relationship with each other. Since it is said that the dermal configurations remain constant throughout life except for overall size, fingerprint patterns and other details of dermal ridges could offer distinct advantages wherein, they could be used as a screening tool, which is easily accessible, economical and may serve as non-invasive marker to detect early malocclusion.

In the field of orthodontics, many studies have been conducted to assess the relationship between dermatoglyphic patterns and sagittal malocclusion. However, currently, only two studies have focused on the relationship between dermatoglyphic patterns and growth patterns of individuals. Both these studies had low sample sizes and had not clearly defined the parameters of the study.

Hence, the objective of this study was to assess the relationship of dermatoglyphic patterns with diverging growth patterns of individuals with Class I Skeletal Relationship with the hypothesis that there was a relationship between dermatoglyphic patterns and diverging growth patterns.

Methods
This cross-sectional study was conducted in A B Shetty Memorial Institute of Dental Sciences, Karnataka, India after obtaining ethical clearance from the institutional ethical committee (Ethical Clearance No. ABSM/ETH/2020-18/092).

Systemically healthy dental patients with no missing teeth (except third molars) between the ages of 20 and 35 years who attended the department of orthodontics and dentofacial orthopaedics at A B Shetty Dental College from December 2020 until December 2021 without any history of previous orthodontic treatment were recruited for the study. Nonprobability convenience sampling was used to select the samples that fit into the inclusion criteria. A detailed case history was taken of each patient to rule out patients with history of habits, or history of any surgical procedures on the digits of the hand and face. Patients with Class I Skeletal relation were selected after clinical diagnosis followed by digitally tracing the cephalogram. Based on the Cephalometric values, the patients were subdivided into three groups of mandibular divergence patterns ie Average, Horizontal and Vertical. 111 samples were selected for this study, of which 21 samples were eliminated due to conflicting cephalometric values. Finally, 90 samples ie 30 in each group were selected for the study. Fingerprints of the subjects were recorded digitally for each finger and then analysed. All subjects signed a written consent form indicating their approval to participate in this study. This human observational study manuscript conforms to STROBE guidelines for cross-sectional studies.

Cephalometric evaluation
Angles Class I malocclusion was diagnosed by assessing the ANB angle (2±2), the Beta Angle (27-35) and the Wits Analysis (0±1).

The growth pattern for an individual was diagnosed by assessing the FMA angle, the SNGoGn Angle and the Jarabacks ratio. For the Average group the FMA ranged from 25±5, the SNGoGn ranged from 32±4 and the Jarabacks ratio ranged from 62-65. These values were used as the norms to diagnose the Average group of mandibular divergence.
Any values below the range of FMA, SNGoGn and above the Jarabacks ratio would be classified as Horizontal Growth Pattern. Any values above the norms of FMA, SNGoGn and below the Jarabacks ratio would be classified as Vertical Growth Pattern.

Each cephalogram was traced digitally on the One Ceph software twice by the same author to avoid any error in measurements.

**Figure 1.** Index of subjects data as seen in the ‘Fingerprince’ application.

**Figure 2.** Data of a sample patient as seen in the ‘Fingerprince’ application after collection of fingerprints.
Dermatoglyphics

The DG patterns of patients were recorded for all 10 digits of the hands using a digital fingerprint scanner MFS100 (Mantra Tech v54/v54OTG). The subject was asked to wash his/her hand with soap and water, followed by which his/her hand was allowed to be air dried. Once the fingers were dry, the fingers were scanned using the digital scanner. A custom designed application for this study called ‘Fingerprince’ (Designed in Arizona, United States of America) (Figures 1, 2) was used to store and analyse the fingerprint of the subjects. The application also helped store the patient’s case history as well as the cephalometric values. Henry’s classification was used to classify the fingerprints into loops, whorl, arch and composite patterns (Figure 3).

Figure 3. Henry’s classification of dermatoglyphic patterns.
Loops consisted of radial loops and ulnar loops. Whorls consisted of Plain Whorl, Double loop whorl, accidental whorl and central pocket whorl. Arches consisted of plain arches and tented arches. Composite patterns consisted of central pocket loop whorl, lateral pocket loops and accidental loops. In cases where there was no dominant fingerprint pattern, it was classified as a Tie between the 2 patterns.

**Statistical analysis**

The results were evaluated using Version 20 of the Statistical package for social sciences (SPSS INC, Chicago, Illinois, USA). Fisher’s Exact test was used to find the association between growth pattern and dermatoglyphic patterns, where P<0.001 was considered significant.

**Results**

The results of the Left hand are shown in Tables 1-4 and the results of the Right hand are shown in Tables 5-8.

**Left hand**

With respect to the left hand, average growers had the loop pattern as the most dominant pattern with a frequency percentage of 93.3%, followed by composite pattern with a frequency percentage of 3.3% and there were 3.3% of the population that showed a tie between two patterns (Table 1).

Horizontal growers had the whorl pattern as the most dominant pattern with a frequency percentage of 80%, followed by loop pattern with a frequency percentage of 16.7% and there were 3.3% of the population that showed a tie between two

### Table 1. Overall comparison for between groups (Left hand).

| Growth pattern | Left dominant | Total |
|----------------|---------------|-------|
|                | Arch | C | Loop | Tie | Whorl |
| Average        | 0    | 1 | 28   | 1   | 0     | 30 |
| % within Growth pattern | 0.0% | 3.3% | 93.3% | 3.3% | 0.0% | 100.0% |
| Horizontal     | 0    | 0 | 5    | 1   | 24    | 30 |
| % within Growth pattern | 0.0% | 0.0% | 16.7% | 3.3% | 80.0% | 100.0% |
| Vertical       | 1    | 2 | 21   | 3   | 3     | 30 |
| % within Growth pattern | 3.3% | 6.7% | 70.0% | 10.0% | 10.0% | 100.0% |

### Table 2. The Fisher’s exact test between the average and horizontal groups (Left hand).

| Dermatoglyphic patterns | C | Loop | Tie | Whorl | Total |
|-------------------------|---|------|-----|-------|-------|
| Growth pattern          |   |      |     |       |       |
| Average                 | 1 | 28   | 1   | 0     | 30    |
| % within Growth pattern | 3.3% | 93.3% | 3.3% | 0.0% | 100.0% |
| Horizontal              | 0 | 5    | 1   | 24    | 30    |
| % within Growth pattern | 0.0% | 16.7% | 3.3% | 80.0% | 100.0% |

Fishers value: 47.855; P value: 0.000.
It shows a value of 47.855 and a P value of <0.05, indicating an association between the Growth patterns and Fingerprint patterns (P<0.05).

### Table 3. The Fisher’s exact test between the average and vertical groups (Left hand).

| Dermatoglyphic patterns | Arch | C | Loop | Tie | Whorl | Total |
|-------------------------|------|---|------|-----|-------|-------|
| Growth pattern          |      |   |      |     |       |       |
| Average                 | 0    | 1 | 28   | 1   | 0     | 30    |
| % within Growth pattern | 0.0% | 3.3% | 93.3% | 3.3% | 0.0% | 100.0% |
| Vertical                | 1    | 2 | 21   | 3   | 3     | 30    |
| % within Growth pattern | 3.3% | 6.7% | 70.0% | 10.0% | 10.0% | 100.0% |

Fishers value: 5.875; P value: 0.142.
It shows a value of 5.875 and a P value of 0.142, indicating no association between the Growth patterns and Fingerprint patterns (P>0.05).
patterns (Table 1). The exceptional dominance of the whorl pattern in the horizontal group is striking since the average and vertical groups have only 1/8th the amount of whorls than the horizontal group.

Vertical growers had the loop pattern as the most dominant pattern with a frequency percentage of 70%, followed by whorl pattern with a frequency percentage of 10%, followed by the composite pattern with a frequency percentage of 6.7% and lastly the arch pattern with a frequency percentage of 3%. In this group there were 10% of the population that showed a tie between two patterns (Table 1). The higher incidence of presence of composite pattern and arch pattern in the vertical group was an important finding.

### Table 4. The Fisher’s exact test between the horizontal and vertical groups (Left hand).

| Dermatoglyphic patterns | Arch | C | Loop | Tie | Whorl | Total |
|-------------------------|------|---|------|-----|-------|-------|
| Growth pattern          |      |   |      |     |       |       |
| Horizontal              |      |   |      |     |       |       |
| Count                   | 0    | 0 | 5    | 1   | 24    | 30    |
| % within Growth pattern | 0.0% | 0.0% | 16.7% | 3.3% | 80.0% | 100.0% |
| Vertical                |      |   |      |     |       |       |
| Count                   | 1    | 2 | 21   | 3   | 3     | 30    |
| % within Growth pattern | 3.3% | 6.7% | 70.0% | 10.0% | 10.0% | 100.0% |

Fishers value: 31.355; P value: .000.
It shows a value of 31.355 and a P value < 0.05, indicating an association between the Growth patterns and Fingerprint patterns (P<0.05).

### Table 5. Overall comparison for between groups (Right hand).

| Growth pattern | Right dominant | Total |
|----------------|---------------|-------|
|                | Arch | C | Loop | Tie | Whorl |      |
| Average        |      |   |      |     |       |       |
| Count          | 0    | 0 | 28   | 2   | 0     | 30    |
| % within Growth pattern | 0.0% | 0.0% | 93.3% | 6.7% | 0.0% | 100.0% |
| Horizontal     |      |   |      |     |       |       |
| Count          | 0    | 0 | 8    | 2   | 20    | 30    |
| % within Growth pattern | 0.0% | 0.0% | 26.7% | 6.7% | 66.7% | 100.0% |
| Vertical       |      |   |      |     |       |       |
| Count          | 1    | 0 | 21   | 6   | 3     | 30    |
| % within Growth pattern | 3.3% | 0.0% | 66.7% | 20.0% | 10.0% | 100.0% |

### Table 6. The Fisher’s exact test between the average and horizontal groups (Right hand).

| Dermatoglyphic pattern | Arch | C | Loop | Tie | Whorl | Total |
|------------------------|------|---|------|-----|-------|-------|
| Growth pattern         |      |   |      |     |       |       |
| Average                |      |   |      |     |       |       |
| Count                  | 0    | 0 | 28   | 2   | 0     | 30    |
| % within Growth pattern | 0.0% | 0.0% | 93.3% | 6.7% | 0.0% | 100.0% |
| Horizontal             |      |   |      |     |       |       |
| Count                  | 0    | 0 | 8    | 2   | 20    | 30    |
| % within Growth pattern | 0.0% | 0.0% | 26.7% | 6.7% | 66.7% | 100.0% |

Fishers value: 35.815; P value: 0.000.
It shows a value of 35.815 and a P value of < 0.05, indicating an association between the Growth patterns and Fingerprint patterns (P<0.05).

### Table 7. The Fisher’s exact test between the average and vertical groups (Right hand).

| Dermatoglyphic pattern | Arch | C | Loop | Tie | Whorl | Total |
|------------------------|------|---|------|-----|-------|-------|
| Growth pattern         |      |   |      |     |       |       |
| Average                |      |   |      |     |       |       |
| Count                  | 0    | 0 | 28   | 2   | 0     | 30    |
| % within Growth pattern | 0.0% | 0.0% | 93.3% | 6.7% | 0.0% | 100.0% |
| Vertical               |      |   |      |     |       |       |
| Count                  | 1    | 0 | 20   | 6   | 3     | 30    |
| % within Growth pattern | 3.3% | 0.0% | 66.7% | 20.0% | 10.0% | 100.0% |

Fishers value: 6.752; P value: 0.031.
It shows a value of 6.752 and a P value of 0.031, indicating an association between the Growth patterns and Fingerprint patterns (P<0.05).
Upon intergroup comparison between the average group and the horizontal group (Table 2), there was a statistically significant association between fingerprints and growth patterns ($P<0.05$).

Comparison between average group and vertical group (Table 3) showed no statistically significant association between fingerprints and growth patterns ($P>0.05$).

Comparison between the horizontal group and the vertical group (Table 4) showed a statistically significant association between fingerprints and growth patterns ($P<0.05$).

**Right hand**

With respect to the right hand, average growers had the loop pattern as the most dominant pattern with a frequency percentage of 93.3%. There were 6.7% of the population that showed a tie between two patterns (Table 5).

Horizontal growers had the whorl pattern as the most dominant pattern with a frequency percentage of 66.6%, followed by loop pattern with a frequency percentage of 26.7% and there were 6.7% of the population that showed a tie between two patterns (Table 5). Although reduced when compared to the left hand, the frequency of the whorl pattern in the horizontal group is still striking since the average and vertical groups have only 1/6th the amount of whorls than the horizontal group.

Vertical growers had the loop pattern as the most dominant pattern with a frequency percentage of 66.7%, followed by whorl pattern with a frequency percentage of 10%, followed by the composite pattern with a frequency percentage of 6.7% and lastly the arch pattern with a frequency percentage of 3.3%. In this group there were 20% of the population that showed a tie between two patterns (Table 5). The higher incidence of presence of composite pattern and arch pattern in the vertical group.

Upon intergroup comparison between the average group and the horizontal group (Table 6), there was a statistically significant association between fingerprints and growth patterns ($P<0.05$).

Comparison between average group and vertical group (Table 7) also showed a statistically significant association between fingerprints and growth patterns ($P<0.05$).

Comparison between the horizontal group and the vertical group (Table 8) showed a statistically significant association between fingerprints and growth patterns ($P<0.05$).

A point to be remembered is that we only chose the most dominant pattern in each hand (Appearing at least three times in each hand). Therefore, even though none of the growth patterns had a dominant composite pattern in the right hand, it does not mean that the composite pattern did not appear in the right hand.

**Discussion**

Being able to predict what one’s facial pattern would be like by assessing their fingerprints may seem far-fetched. But the results of this study prove otherwise. Dermatoglyphics has shown to be positively associated with cleft lip and palate. Some authors also claim that they are able to predict dental malocclusion as well. However, all studies so far seem to have conflicting results. While one may say that the loop pattern is dominant in class I malocclusion, another may say that it is the whorl pattern. Sagittal skeletal relations have also been studied. The results here also seem to be contrasting. While one author says that Arches are the most common pattern in skeletal class I relation, others say it is the loop pattern.

Only two studies have tried to find a relation between growth patterns and dermatoglyphics.

---

**Table 8. The Fisher’s exact test between horizontal and vertical groups (Right hand).**

| Dermatoglyphic pattern | Arch | C | Loop | Tie | Whorl | Total |
|------------------------|------|---|------|-----|-------|-------|
| **Growth pattern**     |      |   |      |     |       |       |
| Horizontal             | Count| 0 | 0    | 8   | 2     | 20    |
|                        | % within Growth pattern | 0.0% | 0.0% | 26.7% | 6.7% | 66.7% | 100.0% |
| Vertical               | Count| 1 | 0    | 20  | 6     | 3     |
|                        | % within Growth pattern | 3.3% | 0%    | 66.7% | 20% | 10% | 100.0% |

Fishers Value: 21.294; P value: 0.001. It shows a value of 21.294 and a P value of 0.001, indicating an association between the Growth patterns and Fingerprint patterns ($p<0.05$).
While Nivedita Sahoo found that there was an increased incidence of whorls in the horizontal group and loops in the vertical group (which is similar to the results found in the present study), the study failed to have a detailed inclusion criteria for the selection of subjects. The skeletal relation of the subjects hadn’t been mentioned and the average group pattern had not been studied. Both of these shortcomings have been addressed in the present study.

A recent study by Harmeet et al. showed a higher presence of loops in skeletal class I subjects but concluded saying that there was no statistically significant association between dermatoglyphics and various growth pattern. However, a point to be noted is that their sample size consisted of only 15 subjects in each of the three groups, while the present study had double the sample size of their study.

While both the studies mentioned above used the ink method to extract the fingerprints, we used the digital method to extract the fingerprints. We found this method to have an easier mode of operation, better ease of convenience and higher accuracy than the ink method/lipstick method. A recent study by Loveday et al. has proven that the digital method of collecting fingerprints was the easiest and the most user friendly methods when compared to the ink/lipstick method. The present study also involved the use of a custom made software called ‘Fingerprince’ which helped store the Case history of the subjects and their fingerprints.

The present study included subjects with purely class I skeletal relation, with the sole objective of finding out if there was any relation of dermatoglyphics with the normal skeletal relation. However, we did categorize the Skeletal Class I relation into three categories ie the average, horizontal and vertical growth pattern groups. The present study shows that the loop pattern was dominant in both the average and the vertical growth pattern group. But it contradicts other studies in the Class I Horizontal Group. Despite having a Class I skeletal relation, more than 73% of the horizontal growers had the whorl pattern as a dominant pattern making it a very important discovery.

This shows that horizontal growers could easily be identified by seeing which pattern was dominant in both their hands. The present study showed that horizontal growers had 80% frequency of appearance of whorls in their left hand and 67% in their right hand.

This could mean that when a child is born, and if he/she has a dominance of whorl pattern on their fingers, we could predict that the child may have a horizontal growth pattern.

Another important discovery was the increased incidence of finding arches and composite patterns in the vertical growers when compared to the average and horizontal group. Although it was a clinical difference and not a statistically significant difference found while assessing the subjects, it does help in understanding the relationship of dermatoglyphics with growth patterns. We also observed that the average growth pattern had 93% frequency of appearance of loops and a negligible percentage of whorls and composite pattern.

While we can confirm and say that horizontal group of patients can easily be differentiated from average and vertical growers, the same cannot be said for average and vertical growers.

A higher sample size will be required to see if the difference between the average and vertical groups are statistically significant.

The results of this study have drastic implications in treatment planning and diagnosis. For example, if we are able to identify a child with prints that show a dominance of whorl pattern, we can predict that the child may have a horizontal growth pattern. This can be easily intercepted using cervical headgears or anterior bite planes to bring about an average growth pattern. Since orthodontic treatment modalities change according to the growth pattern, even vertical growers can be intercepted to try and achieve an average growth pattern.

A problem we faced was the conflicting cephalometric values that made a subject borderline class I/II, or Average-Horizontal, Average to Vertical. The authors took a decision to eliminate such samples and therefore reduced the samples from 111 to 90. Hence the samples had True Class I Skeletal Relation, true average growth pattern, true horizontal growth pattern and true vertical growth pattern (Table 9).

Although the sample size was higher than other studies, we do feel that a drawback of the present study was the low sample size. A higher sample size with a target population of a specific area would help us understand the demographic and/or ethnic variation of the dermatoglyphics (if any) and also help validate the findings of the present study. While this study focused on finding the dominant pattern in each hand, it would be interesting to note if there was any particular finger
which showed a consistent pattern for each growth pattern. Having found interesting results for this study, the above mentioned drawbacks can increase the scope of research in this field.

While all the current methods to predict the growth of the mandible are cumbersome, technique sensitive and manual, predicting the growth pattern by analysing the fingerprints seems to be the most easiest, cost-effective, non-invasive method and can be done anytime and anywhere. The only prerequisite would be to have knowledge of the different types of dermatoglyphic patterns.

**Conclusion**

The following conclusions can be made from this study

1) Horizontal growers had the highest incidence of whorl pattern as the dominant pattern in both the left and right hands when compared to average growers and horizontal growers.

2) Average growers had the highest incidence of loop pattern as the dominant pattern in both the left and right hands when compared to average growers and horizontal growers.

3) The presence of Arch pattern and composite patterns (although not dominant) was more common in vertical growers than the horizontal and average growers.

**Data availability**

**Underlying data**

The images of the fingerprints cannot be shared because of ethical issues since it can be tied to the identity of a person. However, the interpretation of the data is available in Excel format.

Open Science Framework: Association between dermatoglyphic patterns and growth patterns of subjects with skeletal class I relation: A Cross Sectional Study, [https://doi.org/10.17605/OSF.IO/5VFKJ](https://doi.org/10.17605/OSF.IO/5VFKJ).

Data are available under the terms of the Creative Commons Attribution 4.0 International license (CC-BY 4.0).

**Acknowledgements**

We would like to thank Dr. Saritha’ D Souza (Head of Department of Criminology and Forensic Science, School of Social Work, Roshni Nilaya, Mangalore) for her timely guidance during the course of this study. We would like to express great gratitude to Mr. Neville Nazerane for helping develop the ‘Fingerprince’ application. We would also like to acknowledge the support of Dr. Tarona Azem Subba in proofreading this manuscript. Lastly, we would like to thank Mangala.S.S, Raju Shashidhar and Nidhi.S.S for their constant support through the course of this study.

---

**Table 9. Average values for all parameters in all 3 groups.**

| Parameter       | Average Growth pattern | Horizontal Growth pattern | Vertical Growth pattern |
|-----------------|------------------------|---------------------------|------------------------|
| ANB (Degrees)   | 2.4                    | 2.6                       | 3.1                    |
| WITS (mm)       | 0.4                    | 0.3                       | 0.02                   |
| BETA (Degrees)  | 32.1                   | 30.7                      | 32.6                   |
| FMA (Degrees)   | 27.8                   | 23.4                      | 33.1                   |
| SNGoGn (Degrees)| 31.7                   | 23.8                      | 37.1                   |
| Jarabacks (%)   | 64.3                   | 71                        | 60.5                   |
References

1. Isaacson JR, Isaacson RJ, Speidel TM, et al.: Extreme variation in vertical facial growth and associated variation in skeletal and dental relations. Angle Orthod. 1971 Jul 1; 41(3): 219–219, 229. PubMed Abstract
2. Cakan DG, Ulkur F, Taner TU: The genetic basis of facial skeletal characteristics and its relation with orthodontics. Eur. J. Dent. 2012 Jul; 06(03): 340–345. Publisher Full Text
3. Cummins H: Dermatoglyphic stigmata in mongoloid imbeciles. Anat. Rec. 1939; 73: 407–415. Publisher Full Text
4. Mathew L, Hegde AM, Rai K: Dermatoglyphic peculiarities in children with oral clefts. J. Indian Soc. Pedod. Prev. Dent. 2005 Oct 1; 23(4): 179–182. PubMed Abstract | Publisher Full Text
5. Sachdeva S, Tripathi A, Kapoor P: Dermatoglyphic assessment in subjects with different dental arch forms: an appraisal. J. Indian. Prosthodont. Soc. 2014 Sep; 14(3): 281–288. PubMed Abstract | Publisher Full Text
6. Fathima L, Mohan R, Prashanthy MR: Does Dermatoglyphics An Essential Tool for Predicting Dental Caries?-A Systematic Review. Indian J. Forensic Med. Toxicol. 2021 Jan 1; 15(1).
7. Inggarash R, Zakyah AD, Hayati L, et al.: Dermatoglyphy in Breast Cancer Patients: A Systematic Review, Bioscience Medicina: Journal of Biomedicine and Translational Research. 2021 Jun 23; 5(11): 1014–1029. Publisher Full Text
8. Mooneshkumar CD, Anand S, Shilpa RH, et al.: Dermatoglyphics and Cheiloscopy patterns in hypertensive and type 2 Diabetes mellitus patients: An observational study. J. Family Med. Prim. Care 2021 Mar; 10(3): 1177–1182. PubMed Abstract | Publisher Full Text
9. Kaur V, Kaur TP, Sharma M, et al.: Dermatoglyphics, the hidden potential in dentistry A review. J. Adv. Med. Dent. Sci. Res. 2018 Oct; 6: 110–113.
10. Muhlethill JJ, Smith DW: The genesis of dermatoglyphics. J. Pediatr; 1969; 75: 579–589. PubMed Abstract | Publisher Full Text
11. Walker NF: Inkless methods of finger, palm and sole printing. J. Pediatr. 1957; 50: 27–29. PubMed Abstract | Publisher Full Text
12. Sahoo N: A comparative study of dermatoglyphics in subjects with hypodivergent and hyperdivergent growth patterns. J. Int. Soc. Prev. Community Dent. 2018 Nov 8(6): 540–545. PubMed Abstract | Publisher Full Text
13. Kaur H, Tikku T, Khanna R, et al.: Assessment of correlation between dermatoglyphics of individuals with different skeletal growth. Int. J. Orthod. Rehabil. 2020 Apr 1; 11(2): 69. Publisher Full Text
14. Vignesh R, Rekha CV, Annamalai S, et al.: A Comparative Evaluation between Dermatoglyphic Patterns and the Permanent Molar Relationships- An Attempt to Predict the Future Malocclusions. J. Forensic Dent. Sci. 2020 Apr 1: 23–30.
15. Tikare S, Rajesh G, Prasad KV, et al.: Dermatoglyphics—a marker for malocclusion? Int. Dent. J. 2010 Aug; 60(4): 300–304. PubMed Abstract
16. Charles A, Ramani P, Sherlin HJ, et al.: Evaluation of dermatoglyphic patterns using digital scanner technique in skeletal malocclusion: A descriptive study. Indian J. Dent. Res. 2018 Nov 1; 29(6): 711–715. PubMed Abstract | Publisher Full Text
17. Achalli S, Patla M, Nayak HJ, et al.: Assessment of dermatoglyphic patterns in malocclusion. J. Dent. Indones. 2016; 25(2): 104–107. Publisher Full Text
18. Eslami N, Jahanbin A, Ezzati A, et al.: Can dermatoglyphics be used as a marker for predicting future malocclusions? Electron. Physician 2016 Feb; 8(2): 1927–1932. PubMed Abstract | Publisher Full Text
19. Oghenemawwe LE, Gloria O: Analysis of Dermatoglyphic Features: Comparison of the Ink, Lipstick and Improvise Digital Methods. Asian J. Adv. Res. Rep. 2020; 14(3): 6–16.
Masanobu Abe  
Division for Health Service Promotion, The University of Tokyo, Tokyo, Japan

Authors assessed the relationship between dermatoglyphic patterns and various growth patterns of the mandible and they found close association between dermatoglyphic patterns and diverging growth patterns of the mandible. The results suggest that mandibular development may be predicted by other physical characteristics. The research is substantial and the manuscript is well written. The results would contribute to the future development of orthodontics.

- The sample size and statistical tests are appropriate for this analysis.
- The results are well summarized.
- The discussion is well written. However, following issues (#1 and #2) need to be discussed.
  - #1: The authors found interesting results regarding the relationship between skin pattern and mandibular growth patterns, possibly the scientific mechanisms for the relationship need to be discussed.
  - #2: The authors state that one of the factors influencing final outcome of the face is genetics in the Introduction. It would be interesting whether facial finish and skin pattern formation are directly related, involving the same genes (e.g., growth-related genes), or whether they are indirect events. I would appreciate discussion on this point.

- The conclusion is appropriate, but authors have to describe the limitations of their study.
- The references are considered to be adequate.

Is the work clearly and accurately presented and does it cite the current literature?  
Yes

Is the study design appropriate and is the work technically sound?
Are sufficient details of methods and analysis provided to allow replication by others? 
Yes

If applicable, is the statistical analysis and its interpretation appropriate? 
Yes

Are all the source data underlying the results available to ensure full reproducibility? 
Yes

Are the conclusions drawn adequately supported by the results? 
Yes

**Competing Interests:** No competing interests were disclosed.

**Reviewer Expertise:** Oral Malignancies, Malocclusion, Periodontal diseases

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.

---

Reviewer Report 20 June 2022

https://doi.org/10.5256/f1000research.133883.r139572

© 2022 Sivamurthy G. This is an open access peer review report distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

---

Gautham Sivamurthy

Department of Orthodontics, School of Dentistry, University of Dundee, Dundee, Scotland, UK

Interesting piece of work which would add to the evidence base in this field. Work clearly presented with appropriate study design used and useful to our clinical practice as many a times it is difficult to predict growth pattern of the mandible.

- Good sample size for analysis, which could have been strengthened with a sample size calculation.

- Robust Cephalometric evaluation done - possible typo 'Angles Class I malocclusion was diagnosed by assessing the ANB angle (2±2).....', which should have been 'Skeletal Class I....'

- Good information regarding methodology to replicate the study, along appropriate use of software to analyse cephalograms and finger prints. Possibly information on intraexaminer reliability on cephalogram tracing could have been included.

- Appropriate statistical test employed. - but a very low p value (<0.001) has been used to test significance? - possible typo maybe and meant to be <0.05?
Results well discussed and appropriate data provided in the tables. By 'tie' does the authors mean 'correlation'? If so, authors to consider use of this word instead?

Conclusion drawn adequately, but since the population studied is presumably from south India and Class I skeletal, hence the authors should consider including this in the conclusion statement?

Adequate references used - could reference number 9 kindly be checked as article relates to dentistry and reference quoted is to support correlation between dermatoglyphics and cancer?

Overall a well conducted study and well written article which is appropriate for indexing.

Is the work clearly and accurately presented and does it cite the current literature?
Yes

Is the study design appropriate and is the work technically sound?
Yes

Are sufficient details of methods and analysis provided to allow replication by others?
Yes

If applicable, is the statistical analysis and its interpretation appropriate?
Yes

Are all the source data underlying the results available to ensure full reproducibility?
Yes

Are the conclusions drawn adequately supported by the results?
Yes

**Competing Interests:** 2nd and 3rd authors were previous colleagues of mine during 2005-2007. I confirm I am able to review this article impartially.

**Reviewer Expertise:** Clinical trials in orthodontics assessin growht modification appliances for Class II skeletal patterns, arch wire materials and deep bite correction, cephalometrics and its clinical use.

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard.
The benefits of publishing with F1000Research:

- Your article is published within days, with no editorial bias
- You can publish traditional articles, null/negative results, case reports, data notes and more
- The peer review process is transparent and collaborative
- Your article is indexed in PubMed after passing peer review
- Dedicated customer support at every stage

For pre-submission enquiries, contact research@f1000.com