Original Article

Relationship between Dermatoglyphics, Cheiloscopy, Rugoscopy, and Dental Caries: A Cross-sectional Study in Bengaluru, Karnataka

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Abstract

Introduction: Early detection of susceptibility to dental caries by studying its genetic basis by effectively utilizing noninvasive, less expensive, and effective tools is gaining popularity. Cariogenesis is affected by a combination of environmental and behavioral factors. **Aim:** The aim of this study was to compare the reliability of dermatoglyphic, cheiloscopic, and rugoscopic patterns for assessing the risk of dental caries in children. **Materials and Methods:** The study included 100 children aged 3–7 years who were divided into two groups based on their decayed, missing and filled teeth (DMFT/deft) index. Fingerprints, lip prints, and rugae patterns were recorded and analyzed. **Results:** The most common fingerprints patterns in the children with higher deft scores were loop pattern (52%), followed by whorls (32%) and arches (16%). The branched pattern of lip prints was found to be the most prevalent in all children irrespective of their caries status. Among palatal rugae shapes, wavy was found to be the most prevalent (54%) one in our study population, irrespective of the deft scores. Considering the palatal rugae unifications, it was found that converging type was significantly (P = 0.032) more prevalent in children with less deft scores (32%) compared to those with high deft caries (14%). **Conclusion:** Palatal rugae unifications have proved to be a good marker of dental caries. Among the various genes that may be playing a role in caries formation, BCOR and BCORL1 genes may also be playing a role in the development of palate and the rugae patterns and also in the development of enamel, which is known to be the most vulnerable dental tissue to dental caries.

Keywords: *Dental caries, dermatoglyphics, cheiloscopy, rugoscopy genetic markers*

Introduction

Dental caries is the most common disease in the field of dentistry. The etiology of dental caries has been advocated for various environmental and genetic factors. The level to which each factor contributes to the development and progression of caries is variable and changes on an individual basis.[1] It is the genetics that determines the susceptibility of an individual to develop caries.

The basis of considering dermatoglyphic pattern, rugae patterns, and cheiloscopic patterns in assessing the susceptibility of an individual to dental caries is that epidermal ridges of fingers and palms, as well as facial structures such as palate, lips, alveolar bone, and enamel, are formed from the same embryonic tissues (ectoderm) during the same embryonic period (6–9 weeks in utero).[2]

Dermatoglyphics includes the study of dermal ridge patterns of the hands and feet. It is considered for genetic correlation with dental caries as the epithelium of primary palate, and finger buds are both ectodermal in origin.[1] During epidermal development, certain mound shaped elevations of the mesenchymal tissue called the volar pads are formed, which are to a large extent responsible for the different types of configurations. As the formation and completion of these volar pads coincide with the development of facial structures, the genetic message contained in the genome is deciphered during this period and is also reflected by the change in dermatoglyphic patterns.[3] Hence, dermatoglyphics can be considered as an essential diagnostic tool for various forms of diseases such as dental caries, genetic disorders such as Downs syndrome, intellectual disability, head-and-neck oncology, cleft lip and palate cases, and many other systemic disorders.

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Lip prints are normal lines and fissures in the form of wrinkles and grooves present in the zone of transition of the human lip between the inner labial mucosa and outer skin. The grooves present on the human lips are unique to each person and can be used to determine identity. The study of these grooves or furrows present on the red part or the vermilion border of the human lips is known as cheiloscopy and it was first noted by anthropologists, R. Fischer who was the first to describe it in 1902.[4]

Palatal rugae, also called plicae palatinae transversae and rugae palatina, refer to the ridges on the anterior part of the palatal mucosa, each side of the median palatal raphe and behind the incisive papilla.[5,6] In human embryos, rugae are relatively prominent and occupy most of the length of the palatal shelves at the time of their elevation.[7] The palatine rugae are permanent and unique to each person and can establish identity through discrimination (via casts, tracings or digitized rugae patterns).

The present study was undertaken to establish a correlation between dermatoglyphic pattern, rugae patterns, and cheiloscopic patterns and dental caries, so as to enable early detection of susceptibility of an individual to dental caries by studying its genetic basis by effectively utilizing noninvasive, less expensive, and effective tools that help early prediction of dental caries, thereby limiting the disease from progressing to an advanced stage and preventing further tooth loss.

Thus, the objectives of this study were as follows:

i. To record the fingerprint, lip print, and palatal rugae patterns of children diagnosed with mild and severe dental caries
ii. To observe a prevalent and specific dermatoglyphic, cheiloscopic, and rugoscopic pattern in both groups
iii. To predict the efficacy of dermatoglyphic, cheiloscopic, and rugoscopic pattern in assessing the risk of susceptibility to caries
iv. To assess and compare among the three, which has the greatest efficacy in assessing the risk of susceptibility to dental caries.

Materials and Methods

The study was presented to the Ethical Clearance Committee of Amrith Educational and Cultural Society Maaruti College of Dental Sciences and Research Center and Ethical Committee Clearance certificate was obtained for conducting the study. (Ref. No. AECS/MDC/45A/2017-18; Dated 28/4/2017).

Source of data and study population

The participants for this study were chosen from different private schools of Bengaluru city.

Study design

The study was a cross-sectional study and a stratified random sampling method was used to include 100 children from various schools, in the age group of 3–7 years, from the urban Bangalore population. The participants were divided into two groups based on their DMFT/deft index which were examined using a mouth mirror and probe under a good source of light.

- Group A: 50 participants with DMFT score ≤2
- Group B: 50 participants with DMFT score >2.

Inclusion criteria

Cooperative and apparently healthy children between 3 and 7 years were included in this study.

Exclusion criteria

Uncooperative children, mentally or physically handicapped children, children with developmental anomalies, skin disorders, trauma or any pathology to the fingertips, lips and palate and those allergic to lipstick, ink pad, cellophane tape, and alginate were excluded from the study.

Procedure for thumbprint recording and interpretation

All fingers were cleaned and were pressed on the blue ink stamp pad with gentle pressure followed by placing them on the white bond paper to take their impressions. The prints were examined using a magnifying glass, classified, and analyzed by Cummins method of fingerprint identification into whorls, loops, and arches [Figure 1].

A loop is recognized as a series of ridges that enter the pattern area on one side of the digit, recurves abruptly and leaves the pattern area on the same side. A single triradius is present, which is located laterally on the fingertip, where the loop is closed.

A whorl differs from the loop in the aspect of a concentric arrangement of ridges, with two or more triradii in the latter.

Arches show the simplest ridge pattern, which is formed by the succession of one or more parallel ridges, which cross the finger from one side to the other without recurving. These patterns usually do not show the presence of triradii.

The procedure of Lip print recording and interpretation

The lips of the participants were cleaned and lipstick was dabbed evenly over the vermillion border of the lip and participants were asked to rub both the lips to spread the applied lipstick uniformly. After 1 min, the adhesive portion of the cellophane tape was placed over the lips and then

Figure 1: Cummins method of fingerprint identification

pressed comfortably toward the corners of the lips. The cellophane strip was then stuck to the white bond paper for a permanent record. The lip prints were then analyzed by Tsuchihashi and Suzuki's classification [Figure 2] using a magnifying glass into:

- Vertical: comprising of complete or incomplete longitudinal fissures/patterns
- Branched: branching Y-shaped pattern
- Intersected: criss-cross pattern
- Reticular: typical chequered pattern, fence-like.

The procedure of palatal rugae pattern recording and interpretation

Impressions of the upper arch of all participants under study were taken using alginate and casts were poured using dental stone. The rugae patterns were studied on the casts and classified based on the Thomas and Kotze classification [Figure 3].

The rugae were divided into four types based on their shape.

1. Curved: They had a crescent shape and curved gently
2. Wavy: If there was a slight curve at the origin or termination of curved rugae
3. Straight: They run directly from their origin to termination
4. Circular: Rugae that form a definite continuous ring.

Unification was said to have occurred when two rugae joined at their origin or termination:

1. Diverging: If two rugae had the same origin from the midline but immediately branched
2. Converging: Rugae with different origins from the midline, but joined on their lateral portions.

Infection control

Disposable mouth masks and gloves were used during the examination. Autoclaved clinical examination instruments were used for clinical examination.

The observations were recorded and statistical analysis was done.

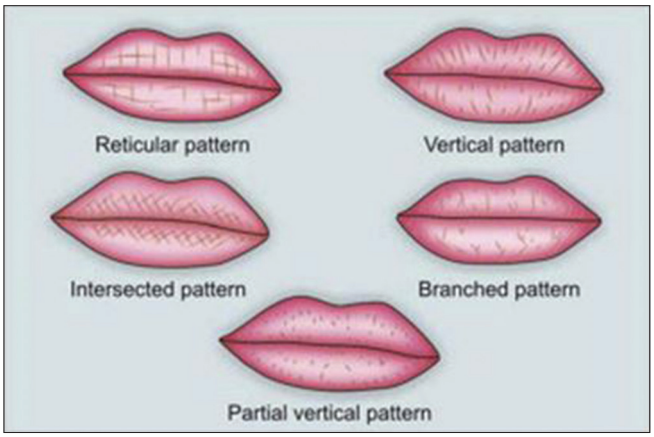

Figure 2: Tsuchihashi and Suzuki's classification of lip prints

Results

The present study was carried out to assess the correlation between various patterns of lip print, thumbprint, and palatal rugae patterns with dental caries.

A total of 100 children were included in the study out of which 50 were boys and 50 were girls.

The most common fingerprints pattern in the children with higher deft scores was loop pattern (52%), followed by whorls (32%) and arches (16%). In children with lower deft, whorls and loops were almost equally found [Table 1].

The branched pattern of lip prints was found to be the most prevalent in all children irrespective of their caries status [Table 2].

And also, among palatal rugae shapes, wavy was found to be the most prevalent (54%) one in our study population, irrespective of the deft scores [Table 3].

Considering the palatal rugae unifications, it was found that converging type was significantly (P = 0.032) more prevalent in children with less deft scores (32%) compared to those with high deft caries (14%) [Table 4].

Discussion

Cariogenesis is affected by a combination of environmental and behavioral factors, including dietary behaviors, bacterial flora, fluoride intake and exposures, oral hygiene, salivary composition and flow rate, tooth positional and morphological features, genetic predisposition, and gene-by-environment interactions.[8]

In dentistry, dental caries diagnosis can be easily done, but caries prediction is not an easy task.

Enamel is usually the first structure which gets affected by caries and therefore, preventing its occurrence is quite necessary.

The epithelium of fingers develops during the same intrauterine period as the development of enamel and other craniofacial structures such as lips and palate; hence, both

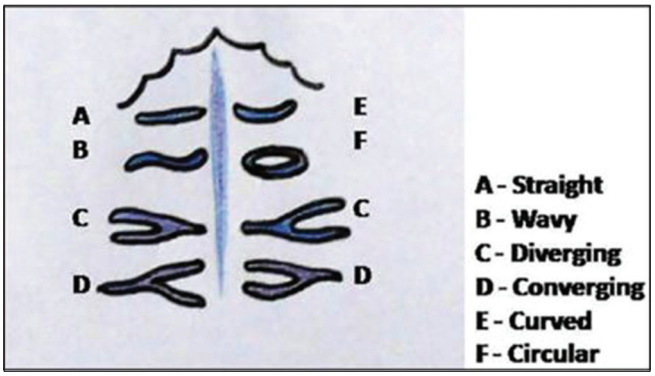

Figure 3: Thomas and Kotze classification of palatal rugae patterns

Table 1: Finger print analysis

	Group I	Group II	Total	Chi square test
Whorl	19 (38%)	16 (32%)	35 (35%)	*P*=0.234
Loop	18 (36%)	26 (52%)	44 (44%)	
Arch	13 (26%)	8 (16%)	21 (21%)	
Total	50 (100%)	50 (100%)	100 (100%)	

Table 2: Lip print analysis

	Group I	Group II	Total	Chi square test
Vertical	13 (26%)	10 (20%)	23 (23%)	*P*=0.788
Branched	21 (42%)	25 (50%)	46 (46%)	
Reticular	9 (18%)	7 (14%)	16 (16%)	
Intersected	7 (14%)	8 (16%)	15 (15%)	
Total	50 (100%)	50 (100%)	100 (100%)	

Table 3: Palatal RUGAE shape analysis

	Group I	Group II	Total	Chi square test
Wavy	26 (52%)	28 (56%)	54 (54%)	*P*=0.315
Straight	11 (22%)	14 (28%)	25 (25%)	
Curved	4 (8%)	5 (10%)	9 (9%)	
Circular	9 (18%)	3 (6%)	12 (12%)	
Total	50 (100)	50 (100)	100 (100)	

Table 4: Palatal RUGAE unification analysis

	Group I	Group II	Total	Chi square test
CON	16 (32%)	7 (14%)	23 (23%)	*P*=0.032
DIV	34 (68%)	43 (86%)	77 (77%)	
Total	50 (100%)	50 (100%)	100 (100%)	

genetic and environmental factors affecting one can affect the other.[1] Thus, fingerprints, lip prints, and palatal rugae patterns can be used for detecting and preventing caries at an early age.

In this study, there was no significant relationship between the loop pattern of fingerprints and higher incidence which was similar to the results of the study by Madhusudan *et al*.[9] And also, whorls and loops were almost equally found in those with a lower incidence of caries. This was, however, contradicting the studies by Navit *et al*.[10] concluding that whorls predict lower incidence of caries and also studies by Anitha *et al*.,[11] Sanghani *eta l*.,[1] Abhilash *et al*.,[12] and Singh *et al*.[13] stating that whorls are more prevalent in caries active children. The reason for this difference in results may be because of the different classifications used to analyze the fingerprints and may also be due to the higher number of participants that were considered during their studies.

The branched pattern of lip prints was seen in 50% of children with a higher incidence of caries in our study and this was in accordance with the study done by Madhusudan *et al*.[9] The uniqueness of the lip prints of an individual[4] indicate the role of genetics in the formation of the different patterns of the lip.

There have not been any studies in literature trying to correlate palatal rugae patterns with dental caries. In this study, no significant relation was found to exist between palatal rugae shapes and dental caries. However, a significant relationship was found between palatal rugae convergence and dental caries. The converging type of palatal rugae unifications was found to be more prevalent in those with the low incidence of dental caries.

The pathogenesis of the caries process is multifactorial and has genetic control and this control is also a consequence of various attributes. Some processes contributing to caries incidence including tooth eruption, tooth morphology, the structural integrity of the enamel, composition, and secretions of the salivary glands and salivary flow, host immune response and reduction in the clearance of the bacteria have shown to be genetically controlled. Bordoni concluded from his study that there is a "strong genetic component in primary teeth which affects the incidence of caries."[14]

Individuals with high resistance to dental caries had a specific immunoglobulin in saliva that provides immunity by lysing the cariogenic bacterial cells and this is inherited.

Among the various genes that may be playing a role in caries formation, successful identification was made through genome-wide association studies, those specific for pit and fissure or smooth surface caries, including BCOR and BCORL1 (2x-linked genes with sequence similarity).[8] The mutations of the BCOR gene prevent the production of any functional protein from the altered gene, which disrupts the normal development of the eyes and several other organs and tissues before birth, as seen in oculo-facio-cardio-dental syndrome having dental findings such as radiculomegaly of teeth, oligodontia, supernumerary teeth, malformed permanent teeth, malocclusion, root dilacerations, macrodontia, enamel defects, and also some facial anomalies including cleft palate. Thus, BCOR may be playing a role in the palatal development and the rugae patterns and also the development of enamel, which is known to be the most vulnerable dental tissue to dental caries. However, further genetic studies are required to establish this fact.

Conclusion

Through this study, we have found palatal rugae unifications to be a good marker of dental caries among dermatoglyphics, rugoscopy, and cheiloscopy.

The dermatoglyphics, cheiloscopic, and rugoscopic patterns utilized in the study were effective to study the genetic basis of dental caries. In a developing country like India, they can be noninvasive, inexpensive, and effective tools for predicting dental caries. This early detection can thus help in anticipation of oral health diseases and help to adopt preventive methods at a young age itself. Since they are still inexact sciences, further extensive research and

studies in this field have to be done to determine, ascertain, and to evaluate the significance of these variations in the dermatoglyphics, cheiloscopic, and rugoscopic features of patients with dental caries.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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