Dermatoglyphic patterns and salivary pH in subjects with and without dental caries: A cross-sectional study

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Abstract

Background: Dermatoglyphic patterns, which are regularly used in judicial and legal investigations, can be valuable in the diagnosis of many diseases associated with genetic disorders. Dental caries although of infectious origin, may have a genetic predisposition. Hence, we evaluated the correlation between dental caries and dermatoglyphic patterns among subjects with and without dental caries and evaluated its association with environmental factors such as salivary pH. **Materials and Methods:** Totally, 76 female students within the age group of 18-23 years were clinically examined, and their decayed, missing, filled teeth (DMFT) score and oral hygiene index-simplified were recorded. Based on their DMFT score, they were divided into following three groups; group I (*n* = 16, DMFT score = 0), group II (*n* = 30, DMFT score <5), and group III (*n* = 30, DMFT score ≥5). Their fingerprint patterns and salivary pH were recorded and analyzed using descriptive statistics. **Results:** Dermatoglyphic pattern distribution in caries-free group showed more ulnar loops than high caries group (group III) while high caries group showed more whorl patterns. Presence of whorl with double loop, whorl within a loop was associated with high DMFT score. The total finger ridge count was lower in caries group. The mean salivary pH was higher in caries-free group than high caries group. Thus, we conclude that dermatoglyphic patterns may be potential diagnostic tool for detecting patients prone to develop dental caries.

Key words: Dental caries, dermatoglyphics, salivary pH

INTRODUCTION

Dermatoglyphic patterns are patterns of dermal ridges present on the fingers, palm, toes and the soles of human.[1,2] Dermal ridges are largely genetically determined but are subjected to alteration when combined genetic and local environmental modifications exceed certain threshold level during the critical period of ridge differentiation.[3] Dermatoglyphic patterns are also assessed to predict the genetic and related disorders such as Down's syndrome, Alzeihmer's disease, multiple sclerosis, congenital spinal cord anomalies,[4,5] cleft lip, cleft palate,[6] periodontal diseases, bruxism, malocclusion[7] and oral submucous fibrosis.[8,9]

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Dental caries is an infectious disease of multifactorial cause with genetic susceptibility being one of the etiological factors.[10] The application of dermatoglyphic patterns to dental diseases, such as dental caries, is rationalized due to the similarities of environmental and genetic factors between teeth and skin during their development. During embryogenesis, the ridged skin and teeth develop from the same layer (ectoderm) and at the same time (around the 6th to 7th week of the embryonic period). Hence, suggesting that the genetic information contained in the genome is dissipated during this period, and any disturbance affecting tooth development and structure will be simultaneously reflected through change in dermatoglyphic patterns.[6,11,12]

The present study was hence designed to evaluate the correlation between dermatoglyphic patterns and dental caries by analyzing the fingerprint patterns of subjects with and without dental caries. The salivary pH of the individuals was also recorded to assess any possible correlation.

MATERIALS AND METHODS

This descriptive cross-sectional study was conducted on randomly selected 76 female students (age group of 18-23 years) studying at Vivekanandha Dental College for Women, Tiruchengode, Tamil Nadu, India. The purpose of the study was explained to the subjects, and informed consent was obtained from them. Nonwilling subjects and subjects who were not able to record their palmar prints, e.g., those who had trauma to fingertips, subjects with skin disorders, etc., were excluded from the study. Case history was recorded from each of them, which included the evaluation of their caries status by decayed, missing, filled teeth (DMFT) index, and evaluation of their oral hygiene by oral hygiene index-simplified (OHI-S). Autoclaved instruments (odontoscope [mouth mirror], shepherd probe [no. 23] and sterile cotton) were employed for dental examination under natural diffused light. The 76 subjects were then divided into three groups based on their DMFT score. Of the 76 subjects examined, 60 were with dental caries and 16 subjects were totally free of dental caries. In these 60 students with dental caries, 30 of them had their DMFT index <5 and 30 of them had DMFT index ≥5. Thus, the following three groups were included in the study, Group I (n = 16), DMFT score = 0; Group II (n = 30), DMFT score <5 and Group III (n = 30), DMFT score ≥5.

From all of these 76 subjects, palm and fingerprints were recorded, and their salivary pH was measured as described below.

Method of recording finger and palm prints (Modification of Cummins and Midlo method)

Hands of the study subjects were cleaned using antiseptic lotion, and water to remove sweat, oil or dirt from the palmar surface and allowed to dry. In the recording of dermatoglyphics, ink was used in other studies, but we preferred kajal since being solid in consistency; kajal would not spread in paper, thereby recorded finger and palm prints would be with improved clarity. Also, kajal could be easily removed from subject's hand by applying oil, unlike ink. Kajal was applied over the dried palmar surface of both the hands and the impression was recorded by pressing the hands on A4 size white sheet. Two sheets per individual (one for the right hand and the other for left) were used. If the prints were not clearly demarcated, then the procedure was repeated on another paper. Following verification of a satisfactory record of palm impression, the applied kajal was removed by applying oil and subsequently washing with soap and water. Thus from 76 subjects, 760 fingerprints (10 per individual) were recorded and analyzed using magnifying lens (×10 magnification), divider, scale and compass as follows.

Analysis of fingerprint patterns

Predominantly three dermatoglyphic patterns were observed in fingertips, namely:[1]

1. Whorl pattern,
2. Loop pattern and
3. Arch pattern. Additionally, we also analyzed.
4. Triradius, and
5. Total finger ridge count (TFRC) in the subjects.

Whorl pattern

About 35% of the world's population has this whorl pattern and here ridges form circle or spiral patterns. This pattern has four subtypes - clockwise spiral whorl [Figure 1:1.1], anticlockwise spiral whorl [Figure 1:1.2], whorl with double loop [Figure 1:1.3], whorl within a loop [Figure 1:1.4].

Loop pattern

About 60% of the world population has this fingerprint pattern. Here, ridges start on one side, rise toward the center and return back to the side they started from. If this loop faces the ulnar bone (or little finger), it is called

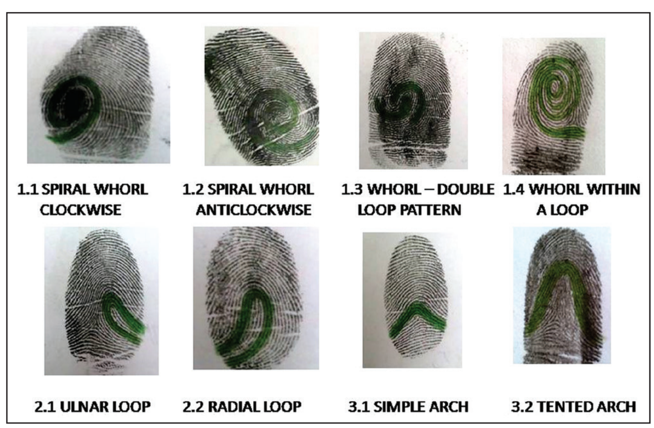

Figure 1: Whorl pattern, loop pattern, arch pattern and their subtypes

ulnar loop (UL) [Figure 1:2.1] and if it faces radial bone (or thumb), it is called radial loop [Figure 1:2.2].

Arch pattern

This pattern constitutes about 5% of the world population normally; and the ridges here start on one side, rise toward the center and then leave on the other side. The subtypes are (1) simple arch [Figure 1:3.1], and (2) tented arch [Figure 1:3.2].

Triradius

It is a triangular region formed by three ridges that forms angle of 120° with each other [Figure 2:4.1]. Normally, loop pattern has one triradius, on the opposite side of loop opening, and whorl pattern has two triradius, one on either side of the whorl pattern.

Total finger ridge count

It is estimated for each finger by counting total number of ridges present from center/core to triradius in each pattern [Figure 2:4.2].

Recording of salivary pH

Unstimulated saliva was collected in a sterile container 2 hours after food intake to record the salivary pH. The pH meter (Deluxe pH meter, 101) was employed for recording salivary pH accurately.

For the analysis of fingerprint patterns, two examiners were involved, and the collected data were subjected to statistical analyses using Statistical Package for Social Science (SPSS) version 16.0 (SPSS Inc.,Chicago, USA). Test of proportion and Chi-square test were employed to find the correlation between analyzed dermatoglyphic patterns and dental caries in all the three groups. $P < 0.05$ was considered as statistically significant.

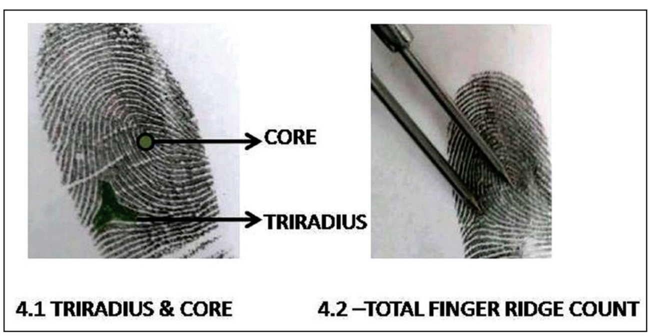

Figure 2: Triradius and total finger ridge count

RESULTS

In all the three groups analyzed, the oral hygiene status based on OHI-S was good to fair. The predominant dermatoglyphic pattern observed in all the three study groups were UL pattern followed by whorl pattern and arch pattern, however with varying proportions [Table 1]. The distribution in caries-free subjects showed 60% of UL followed by 36.9% of whorls, while in group with DMFT ≥5, the percentage of UL were comparatively lower (50.7%) and the whorl pattern was comparatively higher (44.7%). The difference between these two groups in the distribution of UL and whorl pattern was statistically significant ($P < 0.05$). In the group with DMFT score <5, the UL pattern was 54.9%, and the whorl pattern was 36.9%; however, no statistically significant difference was observed in pattern distribution between this group and other two groups. The TFRC was also lower in caries group than the control group. The mean salivary pH was 6.9 ± 1.1 in caries-free group, 6.9 ± 1.2 in persons with DMFT <5 and was slightly lower (6.7 ± 1.4) in subjects with DMFT score ≥5.

DISCUSSION

The morphology of primary and secondary dermatoglyphic ridges during initial period of embryogenesis, appear as a smooth ridge of tissue and thereafter peg like structures (the dermal papillae, characteristic of the definitive dermal ridges) are progressively formed.[2] After being laid down, these epidermal ridges remain unchanged, except for an increase in size with aging. The dermatoglyphic patterns

Table 1: Distribution of various dermatoglyphical patterns and salivary pH in the study groups

Parameters analyzed	Subtypes of fingerprints	DMFT = 0 (*n* = 16) (%)	DMFT <5 (*n* = 30) (%)	DMFT ≥5 (*n* = 30) (%)
Loop		60	54.9	50.7
	Ulnar loop	56.9	52.6	47.7
	Radial loop	3.1	2.3	3
Whorl		36.9	36.9	44.7
	Spiral whorl	30	27	28.7
	Whorl within a loop	2.5	8.3	8.3
	Whorl with double loop	4.4	1.6	7.7
Arch		3.1	8.2	4.6
	Simple arch	2.5	5.6	3
	Tented arch	0.6	2.6	1.6
Mean salivary pH		6.9±1.1	6.9±1.2	6.7±1.4

DMFT: Decayed, missing, filled teeth

are highly distinctive among different individuals.[13,14] Thus, it is one of the best available worldwide recognized biometric analyzers for person identification and good tools in preventive medicine, especially for detecting intrauterine anomalies, syndromes, genetic predisposition of diseases like breast carcinoma, type I diabetes mellitus, etc.[1]

Dental caries is a highly prevalent multifactorial disease with multiple interlinked etiopathological components, of which genetic predisposition, environmental and host factors are considered important. As the epithelium of primary palate, tooth bud and finger buds are of same ectodermal origin and develop at the same site and time,[6,7,11,12,15] we streamlined the association of genetic susceptibility for an individual to have dental caries with their finger and palmar patterns. A few studies have evaluated such associations previously.[11,14-18]

Most of these previous studies[11,14,15,17] involved children within 3-6 years of age and wherein, the influence of the genetic component would be more than environmental component in the causation of dental caries. In our analysis, we included subjects within 18-23 years of age, wherein environmental factors also act predominantly along with genetic factors in the causation of dental caries. Thus, to control the possible environmental factors, the subjects with good to fair oral hygiene were included, and salivary pH was also recorded. Also, three groups, differentiated based on the severity of dental caries, were individually analyzed, to endorse the role of the genetic component.

On dermatoglyphical analysis, UL pattern, followed by whorl pattern and arch pattern were most commonly observed and radial loop, simple arch and tented arch patterns were least commonly observed in all the study groups. In the caries-free group, UL was significantly higher than in high caries group (group III) and whorl pattern was significantly lower than in high caries group, which is consistent with previous studies.[11,15-17] Group II (with DMFT <5) did not differ significantly from the other two groups, thus inferring that dental caries in these subjects might be caused by environmental factors, rather than by genetic susceptibility.

Among the whorl patterns observed, spiral whorl was more (75%) in caries-free controls, whereas high caries group along with spiral whorl, also showed whorl with double loop, whorl within a loop at a greater proportion than in control group. Similar observations were also reported previously[16] where only spiral whorl was exclusively observed in the caries-free individuals. Thus, the occurrence of whorl with double loop and whorl within a loop should be suspected for more genetic susceptibility toward development of dental caries.

Interestingly, previous study results found that radial loop patterns[16] were observed only on the 2nd, 4th and 5th fingers of both the hands in caries subjects, whereas radial loops in the caries-free subjects were observed on their left 2nd, and right 2, 3, 4 fingers.[17] Our study found radial loop in all the three groups. In the control group (DMFT = 0), radial loops were observed on left - 2, 3, 4, 5 fingers and on right - 2nd finger. In the caries group (group III), right 2nd, 4th finger and left - 2nd finger showed radial loop. No radial loop was observed in the little finger of any persons. However, the reliability on radial loop for determining the dental caries susceptibility needs further studies with larger sample inclusion.

Madan *et al*.,[11] in addition had given few observations, to improve the application of dermatoglyphics for prediction of dental caries in males and females that males with arches in the thumb finger were less susceptible to dental caries. Also, presence of whorls in the third digit or ring finger in the left hand of males and right hand of females favored high DMFT score.[11]

The TFRC were more in control subjects than in the high caries subjects and also the salivary pH was comparatively lower in group III than in caries-free group I persons, as analyzed in other studies.[11,18] On the application of dermatoglyphic patterns individually, a person with UL in all their ten fingers, even at unfavorable salivary pH (5.5) remained caries-free. Similarly, a person with spiral whorl in his nine fingers remained caries-free, at favorable salivary pH of 7. Thus, the multifactorial etiology of dental caries is disprovable, and all the factors should be in the mind of a clinician while applying any diagnostic techniques.

We conclude that the genetic component plays an important role in the presence of caries in persons with high DMFT score and absence of caries in caries-free persons, which can be evaluated eminently through dermatoglyphics. Specifically, caries-free individuals showed increased frequency of UL, whereas subjects with high caries score had more percentage of whorl patterns. Presence of whorl within a loop, whorl with double loop favored high caries score than spiral whorl alone. The TFRC was lower in high caries individuals and mean salivary pH was lower in high caries persons than caries-free subjects. Nevertheless, larger scale studies are warranted to confirm our findings before applying dermatoglyphics to predict individual prone to dental caries development in clinical practice.

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