Original Article

Dermatoglyphics: A New Diagnostic Tool in Detection of Dental Caries in Children with Special Health-care Needs

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Abstract

Introduction: Dermatoglyphics is the scientific study of dermal ridge configurations on palmar and plantar surfaces of the hands and feet. Dermal ridges and primary palate, both are formed during 6th–7th week of intrauterine life; therefore, hereditary and environmental factors causing changes in fingerprint patterns may also lead to dental anomalies. **Objective:** The aim of the study was to evaluate and compare the correlation between dermatoglyphic peculiarities and caries experience in special children. **Materials and Methods:** A total of 300 children aged 6–16 years were selected using simple random sampling technique. Their fingerprints were recorded with duplicating ink and caries experience was assessed using International Caries Detection and Assessment System criteria. **Results:** Chi-square test revealed a significant statistical association between the whorl and loop patterns in caries and caries-free groups. The frequency of whorls was found to be more in caries group and frequency of loops more in caries-free group. **Conclusion:** Dermatoglyphics could be an effective method as an early and noninvasive and early predictor of dental caries in special children so as to initiate the preventive oral health measures at an early age.

Keywords: Dental caries, dermatoglyphics, special children

Introduction

The study of the human hand has always been fascinating,[1] as the human skin is the largest and delicate organ of the human body that can perform many vital functions in life. The palms of the hands and the soles of the feet are covered with two totally distinct classes of marks. The most conspicuous features are the creases or folds of the skin which interest the followers of palmistry.[2] These folds or creases could be an indicator of certain congenital abnormalities. Scientifically, the term palmistry means dermatoglyphics.[3] The term "dermatoglyphics" is coined by Cummins and Midlo in 1926. It is derived from the Greek word "Derma" meaning skin and "glyphic" meaning carvings.[4] Dermatoglyphics deals with the study of the epidermal ridges and their configurations on the volar surfaces of fingers, palms, and soles. The volar pads are mound-shaped elevations on each finger above the proximal end on the distal metacarpal bone. The size and position of these pads are responsible for the ridge patterns to an extent.[4] Toward the end of the 19th century, Sir Francis Galton, a British anthropologist, began his observations of fingerprints as a mean of identification and put forth a rule called "proof of no change," which states that an individual's dermatoglyphics remain unchanged throughout his/her lifetime.[3,4] Dermal ridge differentiation takes place in the early stages of fetal development. The ridges are influenced by blood vessel–nerve pairs at the border between the dermis and epidermis during prenatal development. These ridge patterns will get influenced by factors such as inadequate oxygen supply, unusual distribution of sweat glands, and alterations of epithelial growths during the prenatal development.

The ridged skin is considered to be a sensitive indicator of intrauterine dental anomalies because it originates from the same fetal volar pads as that of the teeth and they originate from the same ectodermal layer in the 6th–7th week of embryonic life. Hence, when an intrauterine dermal damage occurs, a tooth anomaly can be expected.[2]

The resulting ridge configurations are genetically determined and influenced or modified by environmental forces.[4] In a

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similar way, development of dermal ridges and congenital deafness seems to be interlinked as they develop at around the same time.[4]

Herschel was the first to experiment with fingerprints in India.[5] Schaumann and Alter's (1976) published the book "dermatoglyphics in medical disorders." Atasu M was the first ones to introduce dermatoglyphics into dentistry.[5]

The possible genetical influence on dental caries is also proved by many researchers. Hans Muhlemann presented a philosophical view when considering the scientific evidence about caries (and periodontal diseases) in humans from the genetic point of view and he concluded that "dental caries is a polyfactorial entity.[6] Could caries not therefore also have a polygenic heritability? One gene could influence the resistance of enamel by determining its chemistry or its morphology; another gene could control the composition of saliva, which could influence partly the oral flora; a third gene could determine eating habits; a fourth could influence one's characteristic personal view of or approach to oral hygiene at home.[1,7]

Hence, the study of this is considered as a window of congenital abnormalities and is a sensitive indicator of intrauterine dental anomalies. A very extensive and comprehensive National Health Survey conducted in 2004 throughout India has shown dental caries prevalence as 63.1%.[6]

Dental treatment is the greatest health need of these children because of their inability to maintain proper oral hygiene. Thus, when combined with other clinical and investigative features, dermatoglyphics can serve to strengthen as a diagnostic tool in children with special health-care needs as it is an invasive and simple procedure without much of their cooperation.

Hence, the purpose of the present study was to find out the correlation between dermatoglyphic patterns and caries in children with special health-care needs which is helpful in diagnosing one's caries experience and managing accordingly.

Materials and Methods

The present study was a cross-sectional study conducted on 6–16-year-old group children which included normal healthy children, and visually impaired, deaf and mute, and mentally challenged children without any systemic disturbances in Tirupati city, Andhra Pradesh, India. Ethical clearance was obtained from members of Ethical Committee, CKS Theja Dental College. Study design and benefits were explained to the parents and participants of the study and informed consent was taken from the parents and the head of the institutions and the principal of the selected schools. The participants included in the study were in the age group of 6–16 years and they were selected from three special homes for visually impaired, deaf-mute, and mentally challenged children. Moreover, normal healthy children were selected from a school. Children having caries were included in the study. Children with skin disorders, trauma to the fingertips, and uncooperative children were excluded from the study, and also children whose parents did not give consent were excluded from the study. Simple random sampling was used. The selected children were divided into two groups (case group and control group) with 300 samples in each group. The case group was again subdivided into three groups with Group A: visually impaired, Group B: deaf and mute, and Group C: mentally challenged. Each group had 50 caries and 50 caries-free children. Control group was subdivided into two groups with 150 caries and 150 caries-free children.

Dermatoglyphic patterns of the digits of both hands were recorded using the Cummins and Mildo method.[8] Children were asked to scrub their palms were scrubbed thoroughly using soap solution and were allowed to dry. The digits were then pressed firmly on an ink pad with the little finger first followed by the ring finger, middle finger, index finger, and finally, the thumb for each participant. Prints were obtained on bond paper by applying stable and adequate pressure. The dermatoglyphic patterns were then analyzed to determine the loops, arches, and whorls using a magnifying glass. The caries experience of the children was recorded using the International Caries Detection and Assessment System (ICDAS) criteria (2015).[6] Examination was carried out in daylight using mouth mirror and Community Periodontal Index for treatment need (CPITN) probe for all the experimental samples.

They were analyzed with the help of hand-magnifying glass by single examiner by seeing the pattern of ridges. Based on the ridge configuration, three basic types of ridge patterns were encountered: (1) whorl pattern [Figure 1], (2) loop pattern [Figure 2], and (3) arch pattern [Figure 3].

The caries experience of the children was recorded using the ICDAS criteria (2015).[6] The examination was carried out in daylight using mouth mirror and CPITN probe for all the experimental samples.

Statistical analysis

The data collected were subjected to statistical analysis. Chi-square test was used to determine the comparisons between caries and the caries-free groups among special and normal children using SPSS Software version 13 (IBM).

Figure 1: Whorl pattern – impression and diagrammatic representation.

Figure 2: Loop pattern – impression and diagrammatic representation.

Figure 3: Arch pattern – impression and diagrammatic representation.

Results

The results showed a significant change in the dermatoglyphic pattern between caries and the caries-free group in deaf and mute, blind, and mentally retarded children. The frequency of whorls was found to be more in caries group and the frequency of loops more in caries-free group. No statistically significant difference was observed between caries and caries-free group with respect to loops and whorls in between subject and control groups.

Table 1 shows that a comparison between the normal versus special children, suggesting caries group has more prevalence of whorls and caries-free group has more whorls from the above.

Table 2 it is observed that caries sample shows a significant increase in the percentage of whorls (P = 0. 00) compared with noncaries group.

Table 3 shows a comparison between the subject groups, i.e., blind, deaf and dumb, and mentally retarded groups. Here also, caries group showed significant increase in whorls in the caries-free group showed increase in loops which was similar to that of the control group showing P = 0.002.

Table 1: Comparison of total normal versus special children

	Normal children, *n* (%)	Special children, *n* (%)	Total, *n* (%)	χ^2	*P*
Loops	117 (39.0)	112 (37.3)	229 (38.2)	0.371	0.831
Whorls	116 (38.7)	115 (38.3)	231 (38.5)		
Loops and whorls	67 (22.3)	73 (24.3)	140 (23.3)		
Total	300 (100.0)	300 (100.0)	600 (100.0)		

Table 2: Comparison of total caries versus carries free

	Caries, *n* (%)	Caries free, *n* (%)	Total, *n* (%)	χ^2	*P*
Loops	81 (27.0)	148 (49.3)	229 (38.2)	32.691	0.000
Wherls	141 (47.0)	90 (30.0)	231 (38.5)		
Loops and wherls	78 (26.0)	62 (20.7)	140 (23.3)		
Total	300 (100.0)	300 (100.0)	600 (100.0)		

Discussion

Development is the progress toward maturity. In intrauterine period, these processes are dependent on both genetic and environmental determinants.[7] The development of dermatoglyphic patterns begins with the appearance of fetal pads in the 6th week of gestation and ends with the appearance of finished patterns on the surface of the skin in the 24th week of gestation.[2] From this stage onward, they are unaffected by the environment, and this explains their unique role, as an ideal marker for individual identification.[2]

The diagnostic value of dermatoglyphic pattern in chromosomal and genetic disorders was first suggested by Czech doctor Jan Purkinjie.[7] He suggested that the dermatoglyphic patterns might have both genetic and diagnostic importance. Danuta Loesch[7] noted that the diagnostic application of dermatoglyphics should be confined to chromosomal anomalies and disorders of limb growth because in other diseases, any deviations from normal are too small to be of value for diagnostic discrimination. Dental caries demonstrates the graded continuous variation pattern, where sharp distinction between the average and higher afflictions is not possible. Only two extreme differences such as "no caries" and caries on "ten or more teeth" may be expected to demonstrate noticeable variations.[7]

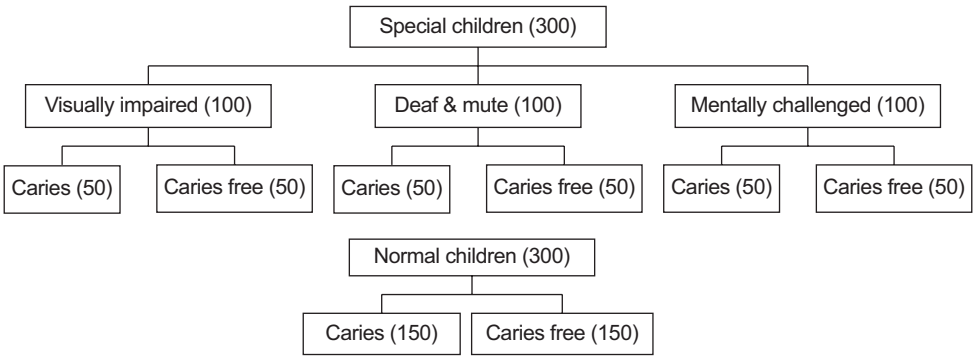
The basis of considering dermatoglyphic patterns as genetic marker for dental caries is that the primary palate develops during 6th–13th week of intrauterine life.[5] Epithelium of primary palate as well as finger buds develops from the same site and is of ectodermal origin. The other point which needs to be mentioned is epithelium of finger buds as well as enamel has ectodermal origin, and both develop at the same time of intrauterine life.[5,9,10]

Similarly, development of dermal ridges and congenital deafness seems to be interlinked as they develop at around the same time. It is estimated that about 50% of cases of

Table 3: Comparison blind, deaf and dumb, and mentally retarded

	Blind, *n* (%)	Deaf and dumb, *n* (%)	MR, *n* (%)	Total, *n* (%)	χ^2	*P*
Loops	33 (33.0)	32 (32.0)	47 (47w.0)	112.000 (0.373)	17.547	0.002
Whorls	45 (45.0)	31 (31.0)	39 (39.0)	115.000 (0.383)		
Loops and whorls	22 (22.0)	37 (37.0)	14 (14.0)	73.000 (0.243)		
Total	100 (100.0)	100 (100.0)	100 (100.0)	300.000 (1.000)		

MR: Mentally retarded



Flowchart 1: Sample Distribution

childhood hearing impairment of moderate to profound degree are genetically determined.[11] Studies have also shown that caries has been high in the deaf and mute children,[12-14] and also the caries levels are high in children with mental retardation as the dental treatment is the greatest unattended health need of these children.

A study done by Metin Atasu among normal healthy children in Turkey has stated that frequency of whorls was high in caries group which is similar to that of the results obtained in the present study.[15]

Ashwani rao *et al*.[16] reported that dental caries susceptibility of an individual increases with an increase in the incidence of whorl pattern. Padma *et al*.[8] in their study also found the frequency of whorls to be more in the caries group and the frequency of loops to be more in the caries-free group. The results obtained in the present study are in line with these results with regard to the normal healthy children.

Similarly, a study done by Sharma and Somani in Ghaziabad among 3–6-year-old children showed decreased frequency of loops in caries group compared to caries-free group, and the results obtained in the present study are similar to that of the above-mentioned study.[5]

A study was conducted by Sharma *et al*., to compare the dermatoglyphic patterns in established congenitally deaf cases with that of control healthy individuals.[11] It was found that increased frequency of whorls was noticed in deaf and mute caries group which is in line with the results of the present study which also stated that frequency of whorls was higher in caries group.

Padma *et al*. in their study evaluated the dermatoglyphic peculiarities and caries experience of deaf and mute children and found an increased frequency of whorl pattern in caries group, and the frequency of loops was more in caries-free group[8] which is in line with the results of the present study.

A study done by Sharma *et al*. showed dermatoglyphic patterns in established congenitally deaf cases with that of control healthy individuals and found that the frequency of whorls was more in deaf and mute caries group as observed in the present study.[11]

A study done by Al-Qahtani and Wyne examined caries experience in 11–12-year-old visually impaired children, deaf, and mentally challenged children and showed that caries prevalence was high in them with increased frequency of whorls in caries group are in line with the results of the current study.[13]

In contrast to the results of the present study, a study conducted by Asif *et al*. conducted a study to evaluate the dermatoglyphic pattern among deaf and mute children affected with caries and children without caries and concluded that the frequency of arches was found to be more in both caries and caries-free group. Fingerprints of caries-free females and females with caries showed more of arch followed by loops. In caries-free males, a common pattern was arch, and in males with caries, the pattern seen was arches followed by loops.[17]

A study conducted by Anjana *et al*. evaluated the dermatoglyphic features in children belonging to primary mental retardation and stated that there are increase ulnar loops on fingertips, decrease in whorl on fingertip which is in line with the present study.[18]

The present study showed that there is an increased frequency of whorls in caries group and increased frequency of loops in

the caries-free group, in all the subjects including deaf and mute, visually impaired, and mentally challenged children and also similar results found in normal healthy control group individuals.

Conclusion

There is a definite correlation between dermatoglyphics and dental caries. A statistically significant correlation was found in relation to the increased frequency of the whorls in caries group in children with special health-care needs as well as in normal healthy individuals. It can serve to strengthen the diagnostic impression of the disease right from an early age and preventive oral health measures can be obtained. In addition, the oral hygiene habits of individuals with disabilities can be improved by close monitoring and periodic dental checkups. This result suggests that more systematic larger samples consisting of the different genetic population are required to verify the conclusion. Dermatoglyphic pattern variation may be an important tool in identification of people at risk of developing dental caries, which will enable an early detection and prevention of the disease.

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Conflicts of interest

There are no conflicts of interest.

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