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Original Research Article

Unravelling oral patterns: correlation of dactyloscopy and cheiloscopy with dental caries in 4-9 years old children: a pilot study

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ABSTRACT

Background: Genetic studies for early detection of caries susceptibility are gaining attention due to the availability of non-invasive, affordable, and effective tools. Cariogenesis results from a dynamic interaction between environmental and behavioural factors. This study aims to explore the correlation between dermatoglyphic patterns, specifically dactyloscopy (fingerprints) and cheiloscopy (lip prints), with dental caries in 4-9 years old children.
Methods: The study included 100 children aged 4-9 years who were divided into three groups based on their decayed, missing and filled teeth (DMFT/deft) index. Dactyloscopic and cheiloscopic patterns recorded and analyzed for their correlation with the prevalence of dental caries.
Results: The most common fingerprints patterns in the children with higher deft scores were loop (54%) pattern, followed by whorls (34%) and arches (12%). Branched pattern (63%) of lip was found in children with moderate to severe caries.
Conclusions: The study demonstrated that dermatoglyphics and cheiloscopic patterns are valuable in understanding the genetic basis of dental caries. In a developing country like India, these methods provide non-invasive, affordable, and efficient tools for predicting dental caries. Early identification through these techniques can support proactive oral health management and promote preventive care from an early age.

Keywords: Dermatoglyphics, Cheiloscopy, Dental caries

INTRODUCTION

According to renowned author Victor Hugo, "Life is a fingerprint that cannot be duplicated." Thus, we should use it to create the best impression possible. The foundation of fingerprint analysis, also known as dactyloscopy, is the individuality of each fingerprint. It is a well-established scientific fact that no two distinct individuals have the same fingerprint pattern. Fingerprints are generally divided into three fundamental groups: whorls (5%), loops (30-35%), and arches (60-65%). Even though a person may have the same pattern on all ten fingers, distinct digits frequently exhibit diverse patterns.[1] In addition to this, cheiloscopy employs lip traces to identify people. In his 1972 study of identical twins, McDonell concluded that because lip prints are epidermal derivatives formed early in intrauterine life, they are similar to thumbprints in uniqueness.[2] Congenital problems such as Down syndrome, Alzheimer's disease, multiple sclerosis, cleft lip and palate, periodontal disease, bruxism, malocclusion, and oral submucous fibrosis have been linked to dermatoglyphics in a number of studies.[3-10]

The world health organization has identified dental caries, one of the most common oral diseases, as one of the three main chronic and non-communicable diseases, along with cardiovascular and cancer.[11] Numerous environmental and genetic factors have been proposed as the cause of dental caries. Each factor's contribution to

the onset and advancement of dental caries varies from person to person. The genetic composition of an individual determines their susceptibility to dental caries.[12]

Understanding how these biometric characteristics interact with oral health parameters can help develop early detection methods and preventative measures for pediatric dentistry. When assessing a person's vulnerability to caries, dermatoglyphic and cheiloscopic patterns are taken into account because the ridges on fingers and palms, the palate, lips, alveolar bone, and enamel are all formed from the same embryonic tissues (ectoderm) during the same embryonic period (6-9) weeks in utero.[13]

This study was undertaken to establish a correlation between dermatoglyphic pattern, 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 applying non-invasive, inexpensive and efficient tools that aid in the early detection of dental caries, preventing the disease from developing to a more advanced level and resulting in further tooth loss.

Thus, the objectives of this study were to identify the prevalent lip and finger patterns in children and assess their potential relationship with dental caries. Specifically, it explores the association between dactyloscopy and dental caries as well as evaluates the correlation between cheiloscopy and the occurrence of dental caries, with the goal of determining whether these biometric traits can serve as predictive markers for oral health status.

METHODS

The present study was a cross-sectional, observational study conducted in the department of pediatric and preventive dentistry at Seema dental college and hospital Rishikesh over a period of 5th January 2024 to 5th April 2024, involving a sample size of 100 cooperative and healthy children aged between 4 to 9 years. The sample size was calculated using the formula

$N=Z^2p(1-p)/d^2$

Assuming a 95% confidence level, prevalence of 5% and a margin of error of 7%. The ethical clearance was obtained from the institutional ethical committee of Seema dental college and hospital Rishikesh. Following data collection, participants were divided into three groups based on their DMFT/deft scores, which were recorded using a mouth mirror and probe: Group I (DMFT 0-<4), group II (DMFT 4-<9) and group III (DMFT ≥9). Dactyloscopy (fingerprint) and cheiloscopy (lip print) patterns were then assessed and correlated with the prevalence of dental caries among the study participants.

Inclusion criteria

Cooperative children with positive Frankel's behavior rating scale with no medical conditions and systemic disorders falling between age group of 4-9 years were included.

Exclusion criteria

Uncooperative children, sspecially-abled children and children allergic to lipstick, ink pad or cellophane tape were excluded.

Armamentarium

Inkpad, wipes, cotton buds, herbal lipstick, transparent tape, magnifying glass were used.

Procedure for thumbprint recording

All fingers were cleaned and pressed on the blue ink stamp pad with gentle pressure followed by placing them on the A4 sheet to take their impressions (Figure 1).

Procedure for lip print recording

Lips were cleaned and lipstick (Lotus herbal) was dabbed evenly over the vermillion border and all other surfaces of lip. Participants were asked to rub both the lips to spread the applied lipstick uniformly. Lip prints were recorded on white transparent tape and after recording the print it was stuck to white A4 paper for permanent record. The prints were examined using a magnifying glass and analysis was done using Tsuchihashi and Suzuki's classification (Figure 2). The children appreciated the procedure and thought it was a pleasant pastime. After the procedure was completed, the children were given a reward.

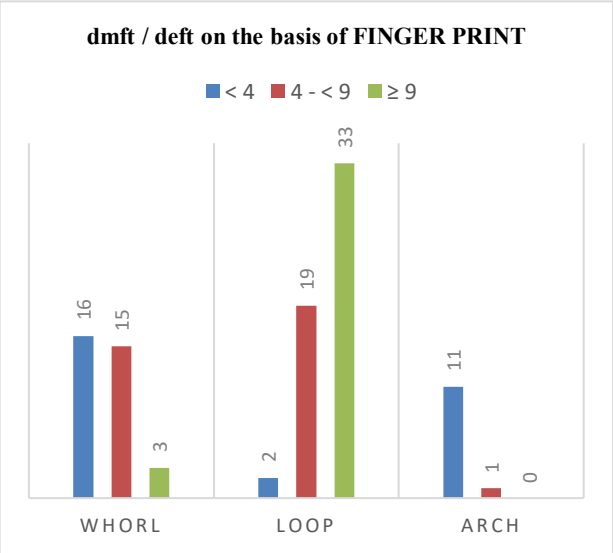

Figure 1: DMFT/deft distribution of study subjects on the basis of fingerprints.

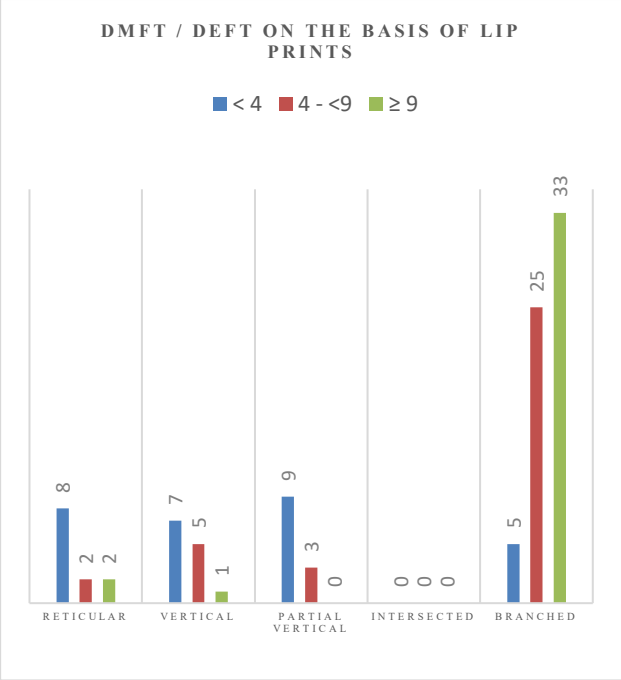

Figure 2: DMFT/deft distribution of study subjects on the basis of lip-prints.

Infection control

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

Data was compiled and statistically analysed using IBM SPSS statistics for windows, version 20.0 (IBM Corp., Armonk, NY). Descriptive statistics such as frequencies and percentages were used to summarize demographic data and response distributions. Paired t test analysis was employed to assess the effect at baseline and after intervention. A $p<0.05$ was considered statistically significant.

RESULTS

Demographic characteristics

The study included 100 subjects, with males constituting 62% and females 38%. The mean age was 6.74±1.8 years for males and 7.26±1.06 years for females.

Biological markers

Fingerprint patterns: Loops were most common (54%), followed by whorls (34%) and arches (12%).

Lip print patterns: Branched prints dominated (63%), while reticular (12%), vertical (13%), and partial vertical (12%) were less frequent. No intersected lip prints were observed.

Association between fingerprint patterns and dental caries

A significant association ($p<0.001$) was found between fingerprint types and caries levels: Whorl patterns were more frequently seen in children with low caries (16 out of 34 children with whorls were in the <4 group).

Loop patterns were strongly linked to high caries (33 out of 54 children with loops were in the ≥9 group).

Arch patterns were mainly associated with low caries (11 out of 12 children with arches fell in the <4 group).

Association between lip print patterns and dental caries

Lip print patterns also showed a statistically significant relationship with caries experience ($p<0.001$): Branched lip prints were more frequently associated with high caries (33 out of 63 children with branched prints were in the ≥9 group).

Other patterns-reticular, vertical, and partial vertical-were more commonly found among children with low to moderate caries.

Table 1: Descriptive details of the study subjects.

Variables		Percentage (%)
Gender	Male	62
	Female	38
Fingerprint	Whorl	34
	Loop	54
	Arch	12
Lip print	Reticular	12
	Vertical	13
	Partial vertical	12
	Intersected	0
	Branched	63
DMFT/deft	<4	29
	4-<9	35
	≥9	36

Table 2: Mean age of the study subjects on the basis of gender.

Gender	Mean age (in years)
Male	6.74±1.801
Female	7.26±1.057

Table 3: Correlation of fingerprint with DMFT/deft.

Variables		DMFT/deft			P value
		<4	4-<9	≥9	
Fingerprint	**Whorl**	16	15	3	0.000*
	Loop	2	19	33	
	Arch	11	1	0	

*Chi-square test. P≤0.05-statistically significant.

Table 4: Correlation of lip-print with DMFT/deft.

Variables		DMFT/deft			P value
		<4	4-<9	≥9	
Lip print	Reticular	8	2	2	0.000*
	Vertical	7	5	1	
	Partial vertical	9	3	0	
	Intersected	0	0	0	
	Branched	5	25	33	

*P≤0.05-statistically significant.

DISCUSSION

Dermatoglyphic patterns, which form during the fetal stage, are shaped by both genetic and environmental influences and may reflect inherited characteristics linked to oral health. Likewise, lip prints are unique to each individual and genetically determined, suggesting a potential association with the risk of developing dental caries. The onset of dental caries is multifactorial, influenced by various environmental and behavioural factors such as dietary habits, oral microbial flora, fluoride exposure, oral hygiene practices, salivary composition and flow rate, tooth alignment and morphology, as well as genetic predisposition and gene-environment interactions.[14]

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.[13]

Epithelium of fingers develops during same intrauterine period as the development of enamel and other craniofacial structures such as lips and palate; hence, both genetic and environmental factors affecting one can affect the other.[12] Thus, fingerprints and lip prints can be used for detecting and preventing caries at an early age.

Madhusudan et al conducted a study where they found out that branched pattern of lips prints was present in 50% of children with higher incidence of caries. In our study, branched pattern of lip was found in children with moderate to severe caries.[15]

In a related study, Agarwal et al discovered that the cheiloscopic, rugoscopic, and dermatoglyphic patterns were useful for examining the genetic foundation of dental caries.[13] The most common finger pattern they found was loop pattern followed by whorl pattern. Branched pattern of lip print was found to be the most prevalent. Similarly, in our study most common finger pattern found in children with higher DMFT score was loop pattern, followed by whorls.

In a study conducted by Singh et al they found out that whorls pattern of fingerprint are more prevalent in caries active children contradictory to our results.[16]

Navit et al conducted a study aimed at determining the association and correlation of dermatoglyphic patterns with early childhood caries and they found out that whorls pattern of fingerprint predict lower incidence of caries and these results are consistent with the findings of our study.[17]

Abhilash et al conducted a study to examine the role of dermatoglyphics in predicting an individual's susceptibility to dental caries.[18] Their findings revealed that individuals with whorl patterns had a higher susceptibility to dental caries, while those with loop patterns showed a lower risk. These results contrast with the conclusions of our study, which observed the opposite trend. The reason for this difference in results may be because of the different classifications used to analyse the fingerprints and may also be due to the higher number of participants that were considered during their studies.[13]

The development of dental caries is a complex, multifactorial process that is influenced by genetic factors, which are in turn affected by various physiological attributes. Several factors contributing to caries susceptibility-such as the timing of tooth eruption, tooth morphology, enamel integrity, salivary composition and flow, salivary gland function, immune response, and reduced bacterial clearance-have been found to be under genetic regulation. Genome-wide association studies have successfully identified specific genes involved in caries susceptibility, including those linked to pit and fissure or smooth surface caries. Notably, genes such as BCOR and BCORL1, both X-linked and sharing sequence similarity, have been implicated in the caries process.[13] However, further genetic studies are required to establish this fact.

Limitations

A larger sample size is required to enhance the validity and generalizability of the findings. Additionally, the use of different classification systems for analysing fingerprints and lip prints may yield varying results, potentially affecting the consistency and interpretation of outcomes.

CONCLUSION

The study revealed that among children with higher DMFT scores, the most common fingerprint pattern observed was the loop pattern, followed by whorls. Additionally, the branched lip print pattern was predominantly found in children with moderate to severe dental caries. These findings suggest that dermatoglyphic and cheiloscopic patterns may have a potential role in reflecting hereditary susceptibility to dental caries. The integration of such non-invasive genetically linked biometric indicators into pediatric oral health assessments can offer valuable insights for early diagnosis, personalized preventive strategies and potentially contribute to forensic identification frameworks. However, further in-depth studies with larger sample

sizes are essential to validate these associations and to better understand the genetic and developmental factors influencing these patterns.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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