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Relationship Between Cheiloscopy, Rugoscopyand Dental Caries: A Cross-Sectional Study InLucknow, Uttar Pradesh

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Abstract
Dental caries continues to be one of the most common oral health challenges in children, with its development influenced by both genetic and environmental factors. Identifying reliable, non-invasive markers that can predict susceptibility at an early stage may significantly improve preventive care. This study explored whether lip print patterns (cheiloscopy) and palatal rugae patterns (rugoscopy)—both structures that share a common embryological origin with teeth—could be associated with dental caries in children. Thirty children between 3 and 7 years of age were examined, with their lip prints, palatal rugae patterns, and dental caries experience (def index) recorded and analyzed. Results revealed that children with branched lip prints and wavy or diverging rugae patterns showed higher def scores, indicating greater susceptibility to caries. These findings highlight that specific cheiloscopic and rugoscopic features may serve as practical markers for predicting caries risk. As inexpensive, non-invasive tools, they hold promise for early screening in pediatric populations, although larger studies are needed to validate their diagnostic value.

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I. Introduction

Dental caries is a complex condition resulting from the demineralization of tooth structure caused by bacterial acids metabolizing fermentable carbohydrates. Factors such as oral hygiene, diet, saliva flow, and genetics influence its development. Gaining insights into these factors is essential for crafting preventive strategies and improving oral health outcomes [1].

Lip prints consist of natural grooves and ridges located in the transition area between the inner labial mucosa and the external skin of the lips. These patterns, unique to every individual, have applications in identification. The scientific study of lip prints, termed cheiloscopy, was first introduced by R. Fischer in 1902. As a field, cheiloscopy has gained recognition for its forensic and personal identification potential due to the individuality of lip patterns, akin to fingerprints. Although primarily unrelated to oral health, there is growing interest in exploring connections between cheiloscopy and dental caries [2].

Rugae patterns and cheiloscopy are being considered in dental caries susceptibility studies due to their shared embryological origin. During embryonic development, structures like the lips, enamel, and palatal rugae emerge from the same ectodermal tissue between 6 and 9 weeks of gestation [3].

Cheiloscopy could supplement oral health evaluations by providing additional insights into caries susceptibility. Incorporating it into routine assessments might help identify individuals at higher risk for caries and enable tailored preventive approaches.

Palatal rugae are transverse ridges located on the anterior portion of the palatal mucosa, adjacent to the median palatal raphe, and behind the incisive papilla. These structures are unique to each person and remain stable throughout life, making them suitable for identification purposes through casts or pattern analysis [4,5]. Palatal rugae were first described by Winslow in 1753, with further classification systems developed over time, including those by Santorini in 1775 and Trobo Hermosa in 1932, who introduced the term "palatal rugoscopy" [7].

The stability and genetic nature of palatal rugae patterns suggest they may be linked to occlusal traits influenced by genetics. Environmental factors also contribute to their development [11]. Exploring these patterns as potential markers for early detection of dental caries could pave the way for non-invasive, cost-effective diagnostic tools, preventing disease progression and tooth loss.

This study aimed to investigate the correlation between lip print patterns, rugae patterns, and dental caries incidence.

II. Materials And Method

The study was conducted following approval from the Ethical Committee of Career Postgraduate Institute of Dental Sciences and Hospital. A total of 30 children, aged 3–7 years, were selected from the Outpatient Department (OPD) of Career Dental College, Lucknow. Lip prints and palatal rugae patterns were recorded, and participants were examined using a mouth mirror and probe to calculate the def score.

Inclusion criteria

Children aged 3–7 years who were cooperative and healthy.

Exclusion criteria

Uncooperative children.
Children with special needs.
Children with any trauma or pathology affecting the lips or rugae.
Children allergic to lipstick, cellophane tape, or alginate.

The procedure of Lip print recording and interpretation

After obtaining informed consent from the guardians, lip prints were collected from all 30 participants. The lips were cleaned, and lipstick was applied evenly to the vermillion border.

Participants were instructed to rub their lips together to ensure uniform application of lipstick. After one minute, a cellophane tape with an adhesive side was gently pressed onto the lips and comfortably extended toward the corners. The tape was then transferred onto white bond paper to create a permanent record.

The lip prints were analyzed according to the classification system by Tsuchihashi and Suzuki using a magnifying glass:
Vertical: Complete or incomplete longitudinal fissures.
Branched: Patterns resembling a Y-shape.
Intersected: Criss-cross patterns.
Reticular: A typical checkered or fence-like pattern [12].

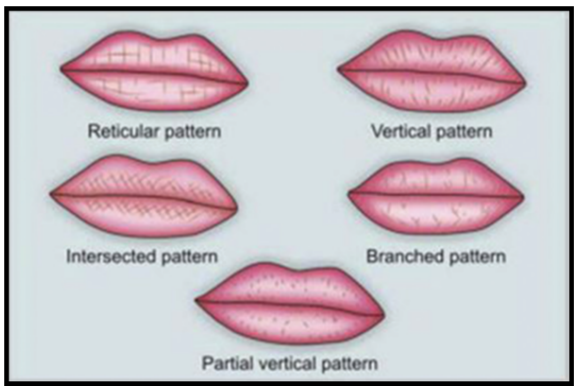


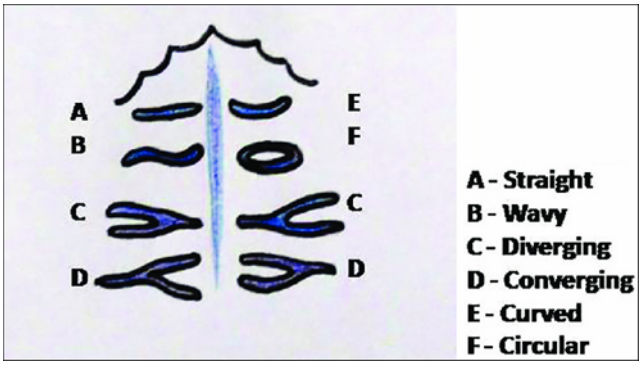
Figure 1: Tsuchihashi and Suzuki's classification of lip prints

The procedure of palatal rugae pattern recording and interpretation

After obtaining informed consent from the guardians, impressions of the upper arch were taken using alginate, and casts were prepared with dental stone. The shape and patterns of the palatal rugae were analyzed on these casts using the classification by Thomas and Kotze [5].

The rugae patterns were categorized based on their shapes as follows:
1. Curved: Crescent-shaped and gently curved.
2. Wavy: Rugae with a slight curve at the origin or termination.
3. Straight: Rugae running directly from their origin to termination.
4. Circular: Rugae forming a continuous ring.

Unification of Rugae
Unification was noted when two rugae joined either at their origin or termination:
1. Diverging: Two rugae originating from the midline but branching immediately.
2. Converging: Rugae with separate midline origins that joined at their lateral portions.



The def score was calculated, and correlations were established between the def scores, lip printpatterns, and rugae patterns.

III. Results

The present study was carried out to assess the correlation between various patterns of lip print, and palatal rugae patterns with dental caries. A total of 30 children were included in the study. The most common lip pattern observed in the children was branched in 14(47%), followed by vertical 8 (27%) and reticular in 4 (13%). Highest def scores was observed in branched followed by reticular and vertical. The result was statistically significant (p<0.001).

Table 1: Distribution of Study Participants based on lip print pattern

Characteristics	def Score Mean± SD (n=30)	P-value
Branched	8± 3.6	<0.004
Intersected	4± 2	
Partial vertical lines	3± 0	
Reticular	5.7± 0.9	
Vertical	4.1± 2.7	

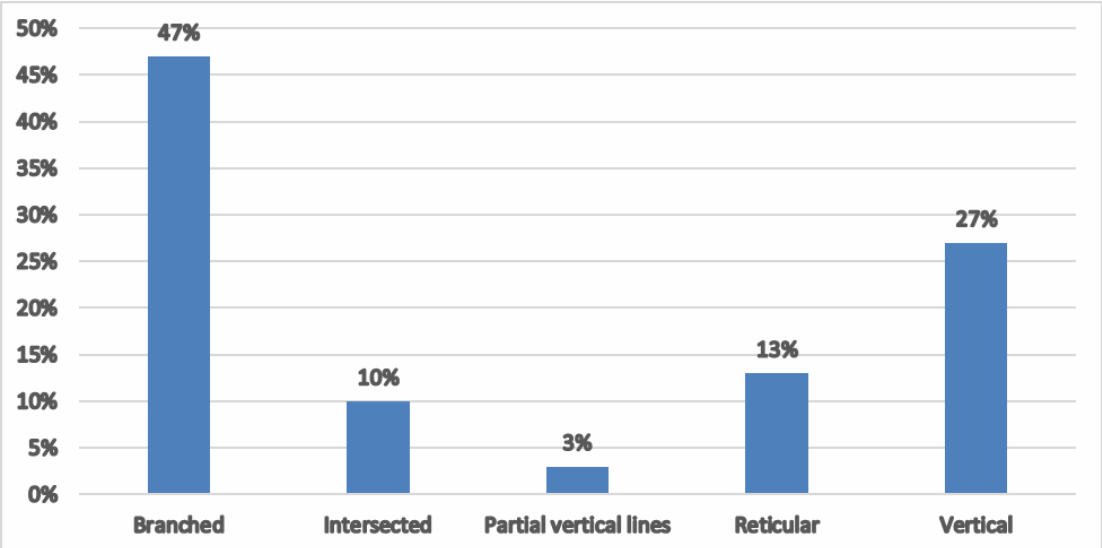


Figure 1: Distribution of Study Participants based on lip print pattern

Table 2: Comparison of DEF score based on lip print pattern

Characteristics	Value (n=30)
Branched	14 (47%)
Intersected	3 (10%)
Partial vertical lines	1 (3%)
Reticular	4 (13%)
Vertical	8 (27%)

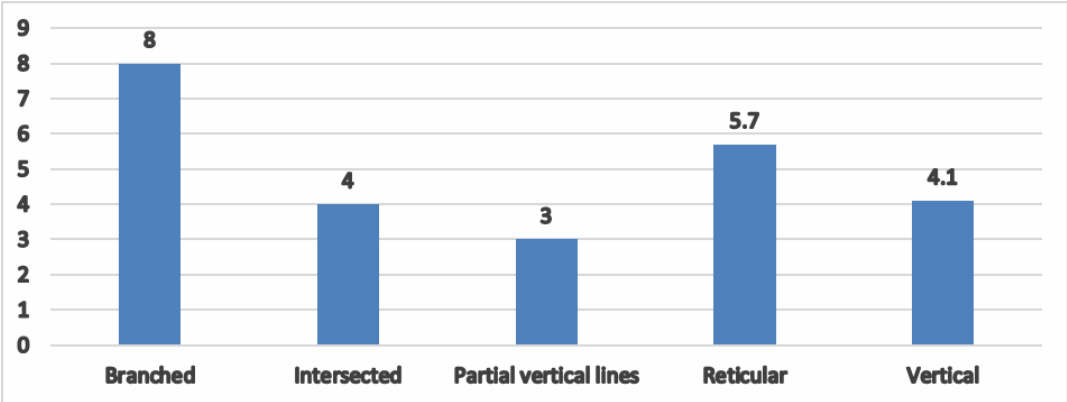


Figure 2: Comparison of DEF score based on lip print pattern

To assess the correlation between various patterns of rugae pattern, with dental caries. A total of 30 children were included in the study The most common rugae pattern in the children was wavy and diverging (53%), followed by wavy (13.33%) and wavy and converging (13.33%) [Table 1].

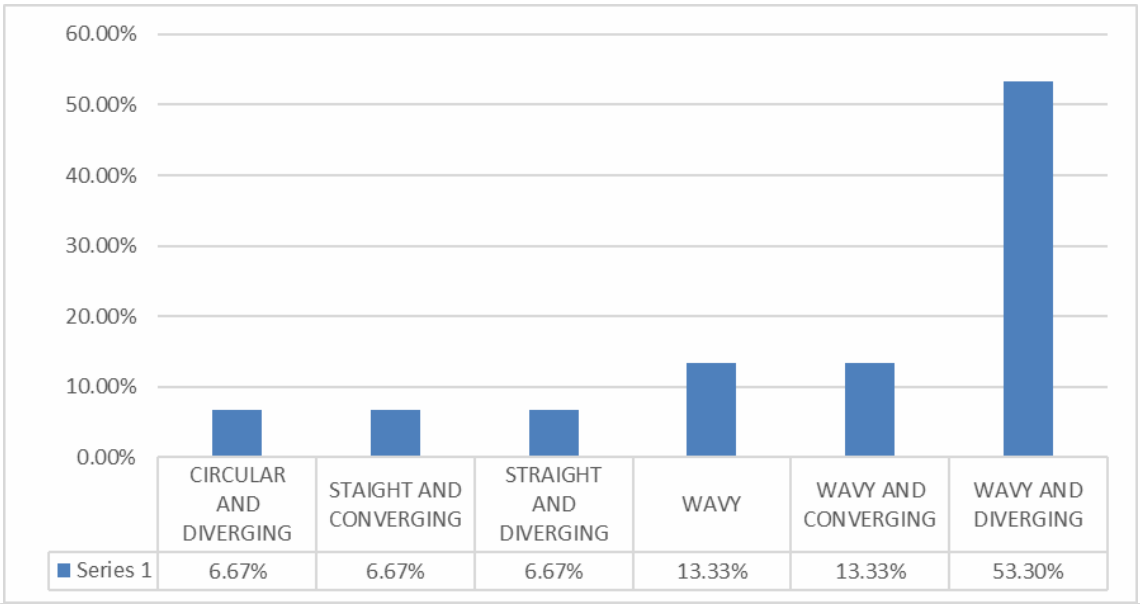
Highest def scores were observed in wavy and diverging, followed by straight and diverging and wavy. The result obtained were statistically significant ($p<0.001$).

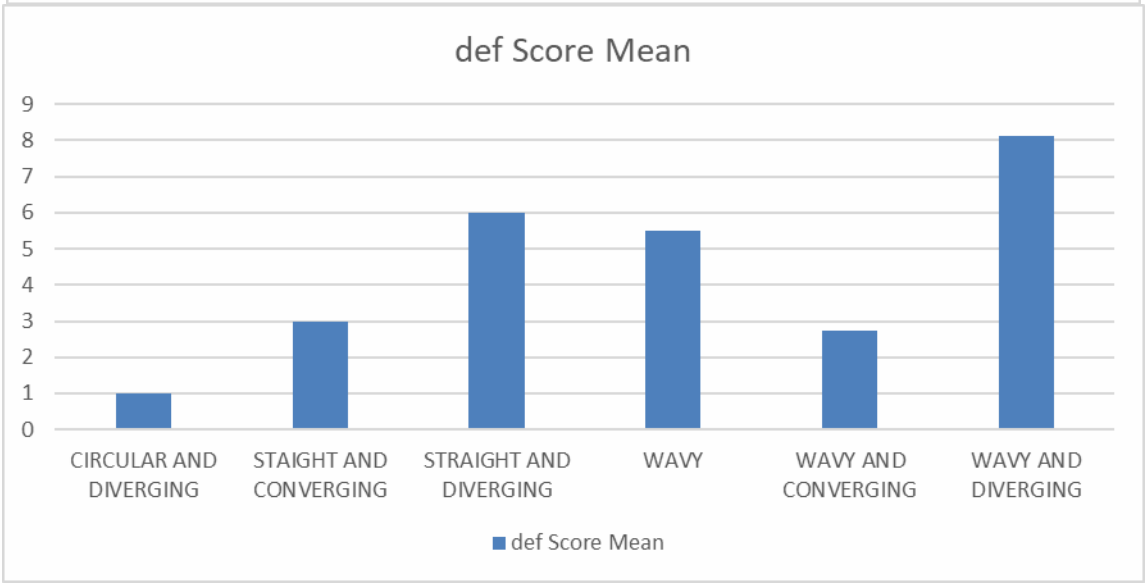
Table 1: Distribution of Study Participants based on shape and pattern of rugae

Characteristics	Value (n=30)
CIRCULAR AND DIVERGING	2 (6.67%)
STAIGHT AND CONVERGING	2 (6.67%)
STRAIGHT AND DIVERGING	2 (6.67%)
WAVY	4 (13.33%)
WAVY AND CONVERGING	4 (13.33%)
WAVY AND DIVERGING	16 (53.3%)

Table 2: Comparison of def score based on shape and pattern of rugae:

Characteristics	DEF Score Mean± SD (n=30)	P-value
CIRCULAR AND DIVERGING	1± 1.4	<0.002
STAIGHT AND CONVERGING	3± 0	
STRAIGHT AND DIVERGING	6± 1.4	
WAVY	5.5± 0.6	
WAVY AND CONVERGING	2.75± 1.0	
WAVY AND DIVERGING	8.12± 3.14	





IV. Discussion

Cariogenesis is influenced by a complex interplay of environmental and behavioral factors, including dietary habits, bacterial flora, fluoride exposure, oral hygiene, salivary composition and flow rate, tooth positioning and morphology, genetic predisposition, and gene-environment interactions. While the diagnosis of dental caries is straightforward, predicting caries remains a challenge [13].

Enamel is often the first structure to be affected by caries, making early preventive measures crucial. The embryological origin of the lips, palatal rugae, and teeth is intertwined, as they develop from the same ectodermal tissues during the 6th–9th week of intrauterine life [1]. According to Manisha Agarwal et al. [14], this shared developmental origin implies that both genetic and environmental factors influencing one structure could impact the others. Thus, palatal rugae patterns and lip prints (cheiloscopy) can serve as potential indicators for the early detection and prevention of dental caries.

The findings of the current study are in alignment with previous research. Madhusudan et al. (2015) [15] reported that a branched pattern of lip prints was observed in 50% of children with a higher incidence of caries. Similarly, this study found the branched lip pattern to be the most prevalent (47%) and significantly associated with higher caries incidence. These results are consistent with the studies by Agarwal et al. (2015) [14] and Madhusudan et al. (2015) [15].

Further support comes from research conducted by Sarika Balaganesh et al. (2021) [16] on a population sample from Tamil Nadu and Andhra Pradesh. Their study concluded that participants with branched lip patterns exhibited lower caries incidence compared to those with vertical or intersected patterns, reinforcing the findings of this study.

Regarding palatal rugae, a significant relationship was observed between certain rugae patterns and dental caries. This study found that the wavy and diverging unification patterns were more prevalent in participants with high caries incidence. The highest def scores were associated with wavy and diverging patterns, followed by straight and diverging and wavy patterns. These observations are consistent with findings from studies by Prabhu Subramani et al. (2022) and Cheeli et al. (2017) [17].

This study highlights a correlation between caries and the patterns observed in cheiloscopy and rugoscopy. The BCOR and BCORL1 genes, both X-linked and sharing sequence similarities, have been identified as key contributors to the formation of caries. These genes play a significant role in the development of pit and fissure or smooth surface caries. According to Zeng Z. et al. (2013), mutations in the BCOR hinder the creation of functional proteins, leading to oculo-facio-cardio-dental syndrome. This condition is associated with various dental abnormalities, including macrodontia, supernumerary teeth, radiculomegaly, oligodontia, malformed permanent teeth, root dilacerations, enamel defects, malocclusion and facial anomalies such as cleft palate. Further genetic research is needed to confirm the underlying causes and prevalence of dental caries [13].

V. Conclusion -

Through this study, we identified palatal rugae unifications and cheiloscopy as a reliable marker for dental caries.Thecheiloscopic, and rugoscopic patterns analyzed in this study proved effective in exploring the genetic basis of dental caries. These methods offer noninvasive, cost-effective, and practical tools for predicting dental caries. Early detection using these techniques can aid in anticipating oral health issues and adopting preventive measures at a young age. However, as these fields are still evolving, further extensive research is necessary to determine, confirm, and evaluate the significance of variations in cheiloscopic, and rugoscopic features among patients with dental caries.

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