Assessment of the Relationship Between Dermatoglyphics and Spaced/Non-Spaced Dentition Among Children Aged 3-6 Years - A Cross-Sectional Study

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Background: Dermatoglyphics has been found to be valuable in predicting anomalies related to the orofacial region. ***Aim***: The current study aimed to evaluate the relation between fingerprints and spacing in primary dentition in children aged 3-6 years. ***Materials and Methods:*** A total of 320 children of age group 3-6 years were included in the study. Intraoral photographs were taken using a digital camera to assess spacing in the dentition. The ridge patterns of the left and right thumbs were recorded using a digital fingerprint scanner. ***Statistics:*** The correlation between dermatoglyphics and the incidence of spaced/ non-spaced dentition was assessed using the Shapiro-Wilk test. The Chi-square test was used to check the difference in proportions among several variables and to evaluate the data. ***Results*:** Subjects

belonging to non-spaced and spaced dentition had more loops ridge patterns followed by whorls patterns in both right and left thumb fingerprints. All the variables had statistically significant values, with a degree of divergence of specific dermatoglyphic patterns among the left-hand participants. ***Conclusion***: The study has shown that dermatoglyphic patterns could be used as a non-invasive anatomical tool for screening spacing in dentition and its correlation with malocclusion and guiding future research, concerning early diagnosis and instituting preventive and interceptive strategies.

Keywords: Dermatoglyphics, Spaced dentition, Non-spaced dentition, Primary dentition, Malocclusion

Introduction: Every child is different, and we can see this difference in their pattern of dentition too. It is well recognised that the occlusal relationship and spacing in the primary dentition play an important role in establishing the proper occlusal relationship in the permanent dentition[1].

Spacing in the primary dentition is a crucial aspect of dentition because it signals the favourable eruption of permanent teeth[2]. Primate spaces are most frequently seen distal to the canines in the mandible and mesial to the canines in the maxilla. (Korkhaus and Neumann 1931; Baume 1950). Interdental or incisor spaces refer to the secondary or developing spaces that are typically found between the incisors (Janiszewska-Olszowska et al. 2009; Han et al. 2017). When there are clear gaps between the primary incisors and the molars, the condition is known as generalised spacing (Abu Alhaija and Qudeimat 2003). The maxilla tends to have more spacing than the mandible, and boys tend to have more space than girls do. Dentists sometimes use the presence or absence of primary dentition spacing to presage tooth size variations in the permanent dentition arch. In addition, it is anecdotally believed that lack of spacing increases the risk of proximal caries lesions due to close contact with deciduous teeth.[2,3,4]

The occlusion and spacing in primary dentition can predict the occurrence of malocclusion in permanent dentition. Malocclusion is a problem that affects a considerable number of children across the globe, leading to a lot of psychological and social problems.[5]Since the overall prevalence of malocclusion is considerably high, a better-predicting tool to assess its development can reduce the required treatment needs. Even though various methods like assessing etiologic factors, cervical vertebrae measurements, facial profiles, terminal planes from primary dentition, and lip prints have been tried and published in the literature, a proper predicting tool is not yet there.

Dermatoglyphics has drawn attention as a potent tool for diagnosing psychiatric, physiological, and genetic disorders as well as in forensic medicine for identifying individuals.[6]The term "dermatoglyphics," which is derived from the Greek words "derma," which means skin, and "glyph," which means to carve, is the study of epidermal ridges and their arrangements on the fingers, palms, and soles.[7]The association of dermatoglyphics has been studied in precancerous and cancerous lesions in the oral cavity, dental caries, and dental anomalies such as malocclusion and cleft lip and palate.

Early detection can help the paediatric dentist to foresee oral health issues in children and start preventive and protective health measures at the earliest opportunity if such a relationship is established between fingerprints and spaced and non-spaced dentition in primary teeth due to both their roots in genetics. Therefore, this study aims to investigate whether there is a correlation between dermatoglyphic patterns and the frequency of spacing in primary dentition.

Material and Methods: 320 children between the ages of 3-6 were involved in this study attending the OPD of the Department of Paediatric and Preventive Dentistry. The procedures were well-explained and then performed on the children before conducting the study. The purposes of the study were explained to the parents/guardians and consent was given by them before the study. Assent was also taken from the children volunteering to participate in the study. Children with all primary teeth erupted were included in the study. Children with missing thumb digits, deleterious oral habits, children with conditions/abnormities that will not allow accurate recording of fingerprints and children with class II, III, and IV caries were excluded from the study. The study was undertaken following ethical approval from the Institutional Ethics Committee.

Every child was made to sit comfortably, and the intraoral photographs were taken with the help of a cheek retractor, occlusal mirror, and a digital camera (Fig. 1). The photographs taken were used to check for the non-spaced or spaced dentition in the subject. The photographs were analysed, and the data were tabulated. The print of the thumb digit was taken by pressing the thumb against the fingerprint sensor of the fingerprint scanner till a sharp image of the print appeared digitally on the computer screen (Fig.2). The fingerprints of both right and left thumbs were obtained. The type of ridge pattern from the fingerprints was determined and categorized into arches, loops, or whorls. The digital fingerprint scanner was wiped with the help of a disinfectant on cotton and dried between the scans (Fig. 3). In this manner 320 patients provided a total of 640 digital fingerprints. These dermatoglyphic patterns were examined and information was tabulated.

Figures

Figure 1: Intraoral photograph of the patient being taken to check for spacing inthe dentition.

Figure 2: Digital fingerprint of the patient being recorded using the digital fingerprint scanner.

Figure 3: Digital fingerprint scanner

Statistical Analysis: The data were analysed using SPSS version 27.0. Descriptive and analytical statistics were done. Normality was assessed using the Shapiro-Wilk test. Categorical data and its differences in proportions among several variables were compared with the Chi-square test. A p-value of <0.05 is considered statistically significant.

Result: A cross-sectional study was undertaken to comprise 320 children aged 3-6 years of age to assess the relationship between dermatoglyphics and spaced/non-spaced dentition in Faridabad city.

Table 1 and Table 2 show the distribution of the study subjects according to age and gender. The study population comprised 58.1% males and 41.9% females. The majority of the population was 6 years of age.

Graph 1 shows the distribution of fingerprint patterns among right-hand thumbprints and left-hand thumbprints. The majority of the thumbprints were 61.6%, 66.6% of loops on the right and left-hand side followed by 35%, 30% of whorls on the right and the left side and arches were found to be the least in number, i.e., 3.4% on both right and left sides.

Graph 2 indicates the distribution of spacing in teeth among the study population. Spaced dentition was found in 77.2% of the children while only 22.8% had non-spaced dentition.

Graph 3 presents the distribution of spaced dentition according to gender in the study population. More number of males was found with both spaced and non-spaced dentition.

Spaced dentition was found in 60.3% of males while non-spaced dentition was found in 50.7% of males. This difference between the proportion of males and females among both dentition types was not statistically significant (p-value= 0.177).

Table 3 exhibits the distribution of fingerprint patterns in the right thumb according to gender. In the right thumb, 63.4% of whorls and 56.9% of loops were found to be more in males while 72.7% of arches were found to be more in females. This difference between the proportion of males and females and the thumbprint pattern was not statistically significant for the right thumb (p-value= 0.058).

Table 4 shows the distribution of fingerprint patterns in the left thumb according to gender. It indicated that in the left thumb, 62% of loops and 53.1% of whorls were found to be more in males while 72.7% of arches were found to be more in females. This occurrence of more arches, i.e., 72.7% in females as compared to males was statistically significant (p=0.037).

Graph 4 demonstrates the comparison of fingerprint patterns according to dentition type in the right thumb. There was a significant difference in the thumbprint pattern and spacing in the dentition. 61.1% of loops were found to be more in spaced dentition, 63% of loops in non-spaced dentition followed by 38.5% of whorls in spaced dentition and 23.3% in non-spaced dentition in the right thumb. Loops and arches were more in non-spaced dentition while whorls were found to be more in the spaced dentition.

This occurrence of more loops and arches in non-spaced dentition as compared to spaced dentition was found to be statistically significant (p=0.0001).

Graph 5 depicts the comparison of fingerprint patterns according to dentition type in the left thumb. There was a significant difference in the thumbprint pattern and spacing in the dentition. 66.4% of loops were found to be more in-spaced dentition and 67.1% of loops in non-spaced dentition followed by 32.4% of whorls in spaced dentition and 21.9% of whorls in non-spaced dentition in the left thumb. Loops and arches were more in non-spaced dentition while whorls were found to be more in the spaced dentition.

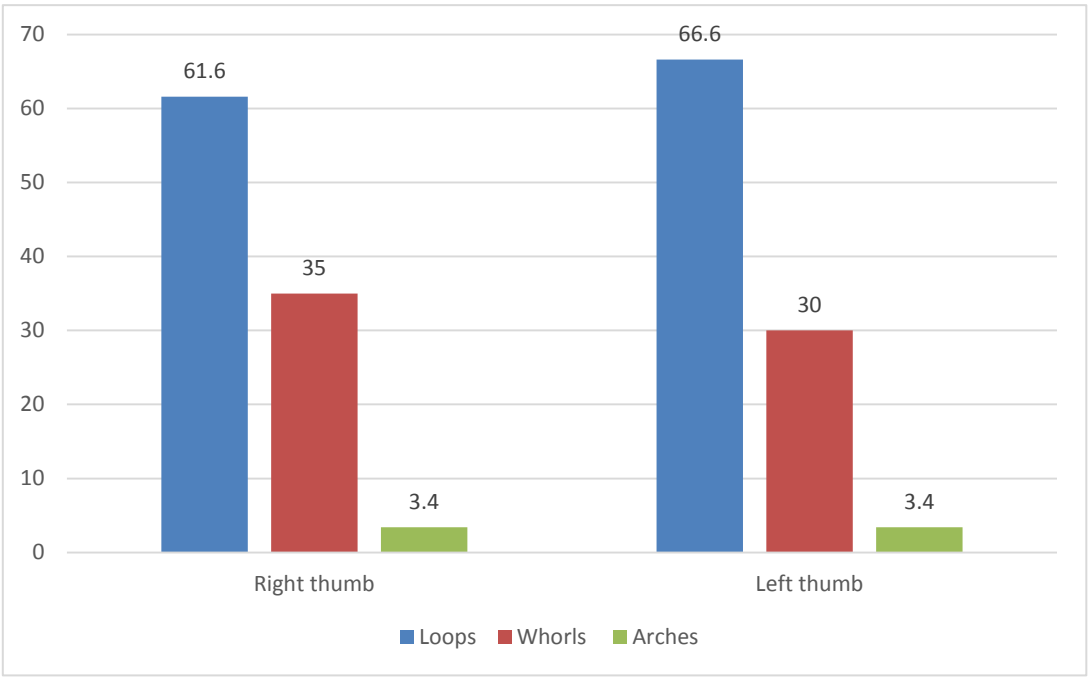
This occurrence of more loops and arches in non-spaced dentition as compared to spaced dentition was found to be statistically significant (p=0.0001).

Table 1: Distribution of study population according to age

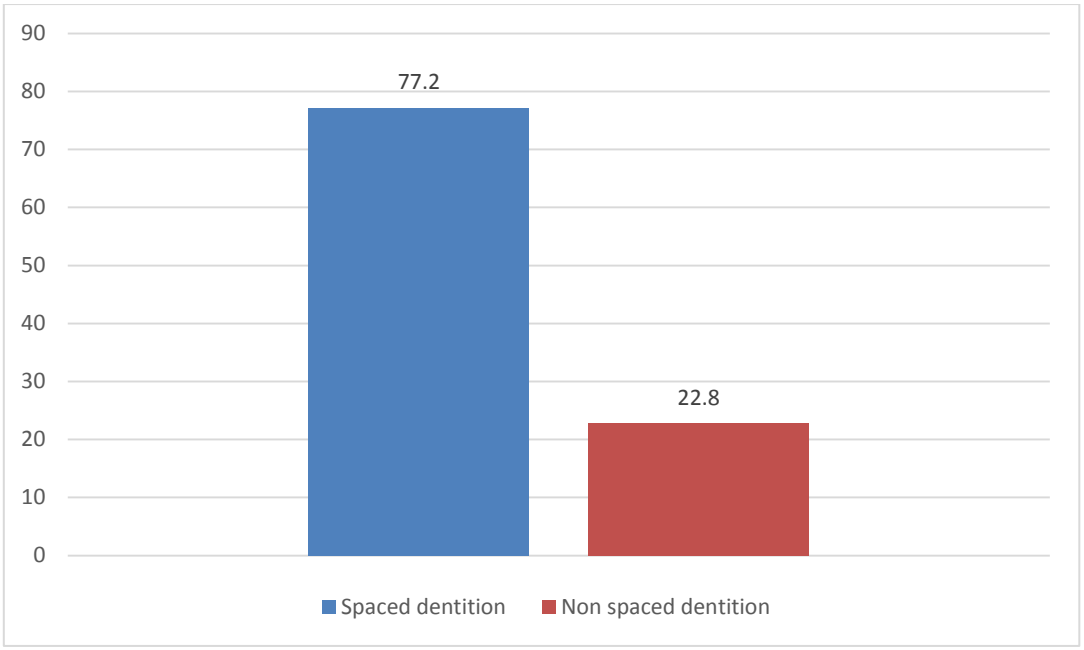
Age	N	%
3 years	15	4.7
4 years	48	15.0
5 years	95	29.7
6 years	162	50.6
Total	320	100.0
Mean age (Mean ± S.D.)	5.26 ± 0.88	

Table 2: Distribution of study population according to gender

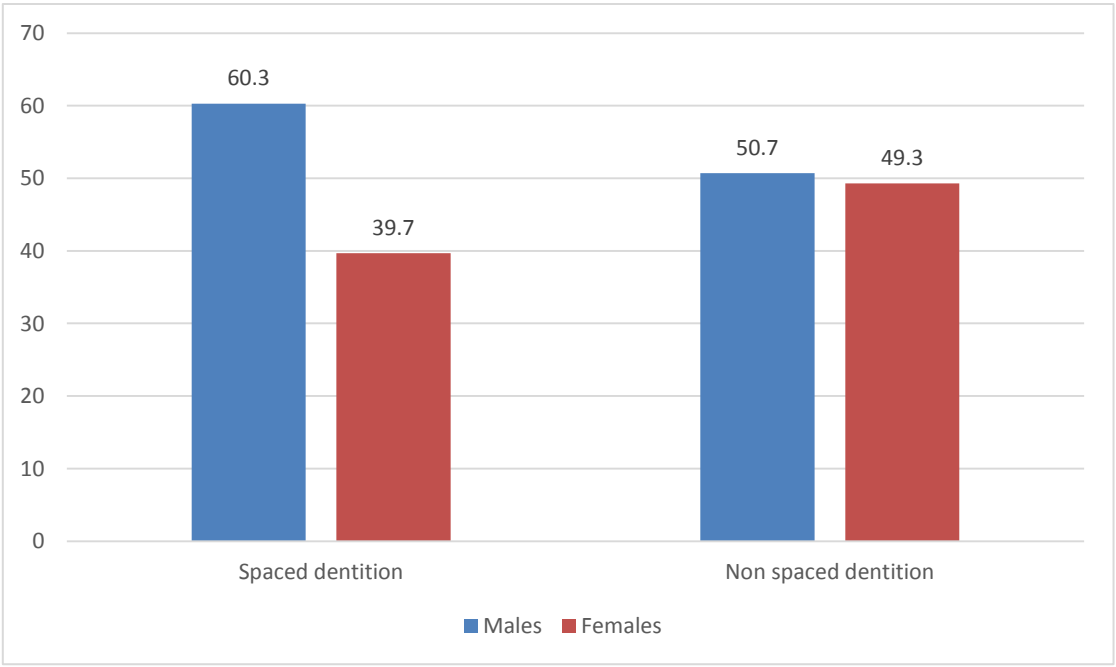
Gender	N	%
Males	186	58.1
Females	134	41.9
Total	320	100.0



Graph 1: Distribution of fingerprint pattern of right and left thumbs



Graph 2: Distribution of spacing in teeth among the study population.



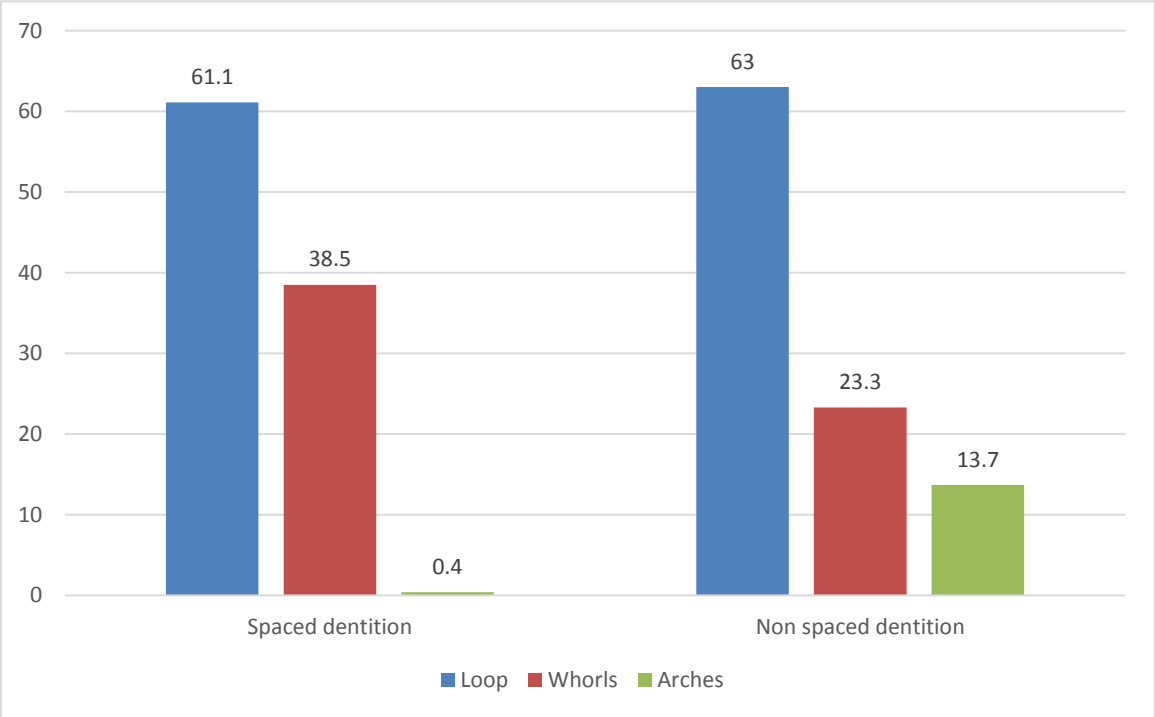
Graph 3: Distribution of spaced dentition according to gender

Table 3: Distribution of fingerprint pattern in right thumb according to gender

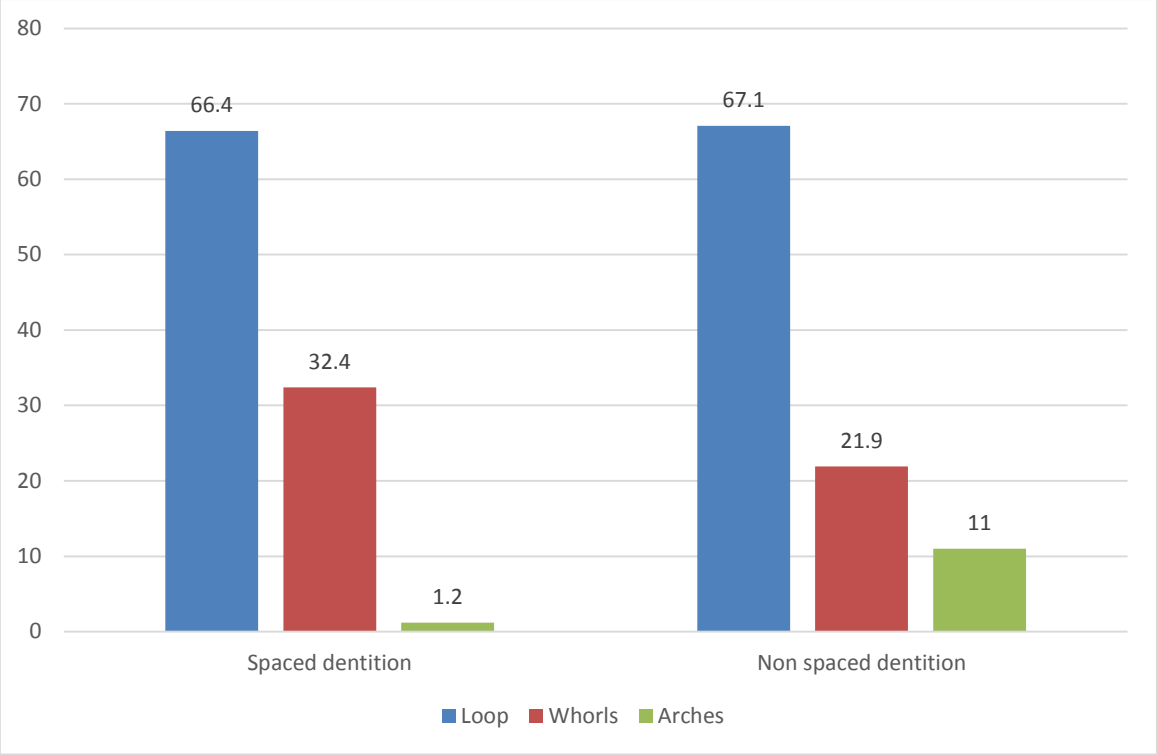
Thumbprint pattern	Males		Females		Total
	N	%	N	%	N (%)
Loop	112	56.9	85	43.1	197 (100.0)
Whorls	71	63.4	41	36.6	112 (100.0)
Arches	3	27.3	8	72.7	11 (100.0)
Total	186	58.1	134	41.9	320 (100.0)

Table 4: Distribution of fingerprint pattern in left thumb according to gender

Thumbprint pattern	Males		Females		Total
	N	%	N	%	N (%)
Loop	132	62.0	81	38.0	213 (100.0)
Whorls	51	53.1	45	46.9	96 (100.0)
Arches	3	27.3	8	72.7	11 (100.0)
Total	186	58.1	134	41.9	320 (100.0)



Graph 4: Comparison of fingerprint pattern according to dentition type in right thumb



Graph 5: Comparison of fingerprint pattern according to dentition type in left thumb

Discussion: Dermatoglyphics is the designation for the scientific analysis and study of the skin ridge patterns on the fingers, toes, palms of hands, and soles of feet. Dermatoglyphics can be sourced back to 1892, when Sir Francis Galton, the kin of Charles Darwin and one of the most innovative scientists of his time, released his study on fingerprints. Dr Harold Cummins renamed the study as Dermatoglyphics.[8]

Dermatoglyphic pattern development is governed by genetics. This is obvious from the dermatoglyphic similarities between related people. Numerous illnesses are known to be brought on by faulty genes. Any irregularity in the parents' genetic makeup is passed down to the offspring and manifests as a dermatoglyphic pattern.[9]

The dermal pattern and cornified layer of epithelium affect the ridge pattern. The dermis expands upward in the epidermal hollows known as dermal papillae as a result of cell growth in the lower zone of the epidermis, which appears as regularly spaced thickenings in the dermis. Following this, the elevations which are known as epidermal ridges, are generated by them on the skin's surface and they start to emerge.[8]

There are three basic fingerprint patterns according to Sir Francis Galton- Arches, Loops and Whorls.[10]

a. Arches: Five per cent of fingerprint patterns contain arches. The ridges follow patterns from one side to the next without turning around. Normal arch patterns don't consist of deltas.

b. Loops: About 60 to 70 per cent of fingerprints contain loops. Each side of the imprint has one or more ridges that penetrate, recurve, touch, or cross the line that connects the delta to the core before ending on or towards the side from which they started.

c. Whorls: About 25 to 35 per cent of fingerprint patterns contain them. Some of the ridges complete at least one whorl of circuits. Any fingerprint pattern having two or more deltas is referred to as a whorl pattern.

Figure 5: Ridge patterns on the distal phalanges of the fingertips (a) arches (b) loops (c) whorls

Every human being is unique and exhibits its characteristic pattern. All structures developing at the same time will be impacted by any factor that is present throughout the period of genetic expression.[11] The ridges on the fingers and palms, as well as the lips, alveoli, and palate, are all formed from the same embryonic tissue, the ectoderm, during the 24th week of intrauterine life.[12] So, throughout this time, the genetic expression of each of these structures—whether normal or abnormal—can be deciphered, and the dermatoglyphic patterns that are created at the same developmental time reflect this.

In this present study, biometrics was employed to record the bilateral thumbprints of the subjects. The fingerprints thus obtained were of high quality and the clarity of digital fingerprints was so accurate and had the benefit of allowing digital magnification of prints. Loveday et al has mentioned biometric analysis are one of the inexpensive and quick methods of capturing fingerprints digitally providing an easy and friendly method of capturing fingerprints in children[13].The various other methods to obtain fingerprints are the ink method,

transparent adhesive tape method, and photographic method in which less accuracy was reported.[14]

In our study, the distribution of fingerprint patterns in the right and left thumb according to gender indicated that in the right thumb, 63.4% of whorls and 56.9% of loops were found to be more in males while 72.7% of arches were found to be more in females which were not statistically significant (p-value= 0.058). Whereas in the left thumb, 62% of loops and 53.1% of whorls were found to be more in males while 72.7% of arches were found to be more in females. This occurrence of more arches, i.e., 72.7% in females as compared to males was statistically significant (p=0.037).This is according to the study conducted by Shrestha I, and Malla BK (2019).[15]

The results of our study showcased that the loops and arches pattern of fingerprints were more prominent in non-spaced dentition compared to the spaced dentition in both right and left thumbs. Loops in non-spaced dentition were 63% and 67.1% in right and left thumbs respectively. Arches in non-spaced dentition were 13.7% and 11% in right and left thumbs respectively. The prominence of loops and arches in non-spaced dentition compared to spaced dentition was found to be statistically significant in children. This study found a statistically significant correlation between fingerprint patterns and spaced/non-spaced dentition in children which is in accordance with the studies conducted by Preetha S et al[16], Ravinder V et al[17]and Deepti A et al.[18]

Preetha S et al[16]demonstrated the association between dermatoglyphics and malocclusion risk in subjects. It was concluded that the population with malocclusion had more whorl pattern prevalence compared to the normal population. Ravindra V et al [17] showed the correlation between dermatoglyphic patterns and terminal planes in children with primary dentition. He discovered that the most common dermatoglyphic pattern was the ulnar loop pattern. The distal step was associated with the existence of a whorl pattern in the right and left middle fingers as well as a larger overall number of finger ridges in the left hand in comparison to the right hand. The absence of an arc pattern on the left hand's ring finger was linked to the flush terminal plane. Deepti A et al[18] explored a plausible role between dental caries, malocclusion and dermatoglyphics in children aged 6 to 12 years. It was found that there was a significant correlation seen between the ulnar loop pattern and malocclusion, with a higher occurrence of the ulnar loop pattern in individuals with malocclusion.

It is possible to analyse the genetics of spacing in dentition and malocclusion using dermatoglyphic patterns. The findings of this research offer some understanding of distinct fingerprint patterns for dentition with and without spacing in the dentition. The study's

exclusive focus on genetic factors is one of its weaknesses. The possibility of local and environmental factors, which might also have a big impact on malocclusion, was not taken into account. To make a more precise prediction, additional research with a bigger sample size and participation from various ethnic groups is necessary.

Conclusion: Within the limitations of the present study, dermatoglyphics can be used as potential non-invasive anatomical tools for screening spacing in dentition and its correlation with malocclusion and guiding future research, concerning early diagnosis, instituting preventive and interceptive strategies, and can render more effective treatment modalities.

Clinical significance: The assessment of the relationship between dermatoglyphics and spaced/non-spaced dentition among children can have clinical significance in identifying developmental abnormalities, predicting dental problems, and aiding in treatment planning and monitoring.

It was determined, within the constraints of the current study, that dermatoglyphic patterns can assist in foretelling future malocclusions at an earlier stage to support space management and preventative orthodontic treatments.

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