

RESEARCH ARTICLE

ASSOCIATION OF CHEILOSCOPY, DACTYLOSCOPY, AND PALATAL RUGOSCOPY WITH PERMANENT MOLAR RELATIONSHIP IN CHILDREN

Tejashri Das¹, Parminder Singh Dua², Ritu Mangla³, Divya Vyas⁴ and Neha Rajput⁵

- 1. MDS, Post Graduate Student, Department of Pedodontics and Preventive Dentistry. Himachal Institute of Dental Sciences, Himachal Pradesh.
- 2. MDS, Professor and Head of the department, Department of Pediatric and Preventive Dentistry, Himachal Institute of Dental Sciences, Himachal Pradesh.
- 3. MDS, Senior Professor, Department of Pediatric and Preventive Dentistry, Himachal Institute of Dental Sciences, Himachal Pradesh.
- 4. MDS, Reader, Department of Pediatric and Preventive Dentistry, Himachal Institute of Dental Sciences, Himachal Pradesh.
- 5. MDS, Senior Lecturer, Department of Pediatric and Preventive Dentistry, Himachal Institute of Dental Sciences, Himachal Pradesh.

Manuscript Info

Manuscript History Received: 31 May 2024 Final Accepted: 30 June 2024 Published: July 2024

.....

Key words:-

Cheiloscopy, Dactyloscopy, Palatal Rugoscopy, Suzuki and Tsuchihashi (1971) Classification, Thomas and Kotze classification, Michael and Kucken Method, Angle's Classification, Malocclusion

Abstract

Background: To record and study the correlation of the predominance of recorded cheiloscopic, dactyloscopic and palatal rugoscopic patterns with molar relationship in 8-15 years of children in order to determine if there exists any association between them.

.....

Material and Methods: 505 children of age group 8-15 years of old with completely erupted 2nd permanent molars upto occlusal table were recruited and angle's molar relation was recorded in the proforma. Lip prints of these subjects were recorded with lipstick-cellophane method and middle 10mm of lower lip was analysed for the lip print pattern as suggested by Sivapathasundharam et al. The patterns were classified based on Tsuchihashi and Suzuki classification. The patent prints of finger were recorded in the performa and analysed according to Michael Kucknas method. The palatal rugae was obtained by photographs and alginate impression of the upper arch for each patient and were defined using a sharp graphite pencil under adequate light and magnification and were recorded according to the classification given by Thomas and Kotze classification.

Results: In cheiloscopic patterns: Type I pattern was found to be the most predominant cheiloscopic pattern in class I and class III molar relation whereas Type II pattern in class II molar relation. The composite patterns showed the most prominent dactyloscopic patterns in class I and class II molar relation and loop patterns were found as the most prominent in class III molar relation. In case of rugoscopic pattern in class 1 and class 3 molar relation group, the curve pattern showed the most prominent and wavy pattern in class 2 molar relation. No statistical significance was found in all the three parameters.

Conclusions:co -relation of the lip, finger and palatal rugae patterns with molar relation might aid in the early diagnosis and interception of

malocclusion among paediatric patients as it is easily accessible, economical and non-invasive marker for the aforementioned conditions.Further investigations, may be required on the relationship between cheiloscopic, dactyloscopy and rugoscopic patterns with malocclusion in order to substantiate the findings presented herein.

Copy Right, IJAR, 2024,. All rights reserved.

Introduction:-

The impact of oral health on one's quality of life is termed as oral health related quality of life ⁽²⁾. As in childhood, the propensities of adulthood are reflected; similarly, the type of occlusal characteristics in primary dentition predicts the occlusal relationship of the succedaneous dentition ⁽³⁾. The well aligned teeth or the type of occlusal characteristics contributes to the health of the oral cavity and stomatognathic system thereby influencing the personality of the individual ⁽¹⁾whereas in mal aligned teeth/malocclusion it produces detrimental effects on overall aesthetics and decreases a person's self-esteem.

In Pediatric orthodontics point of view, diagnosis of the type of malocclusion is the most important aspect before proceeding towards the correction. Malocclusion is mostly influenced by the genetic and environmental factors ⁽²⁾, found in various ethnic, gender and age groups in varied percentages. Therefore, to predict the malocclusions, different methods like extra oral x-rays i.e., cephalometric analysis, CT cone beam, dental cast analysis are used.Whereas,clinical assessment includes evaluation of interarch molar relationship, canine and incisor relationship and facial profile. Amongst all, interarch molar relationship, given by Edward H. Angle in 1899, is the most common clinical predictor of assessing malocclusion.

Nowadays, lip prints, finger prints and prints of palatal rugae patterns are some of the techniques that are not only use for forensic investigation but can also be used for dental record purposes as every human being is distinct and discernible in that they exhibit their own pattern of characteristics.

Lip prints, whose study is known as Cheiloscopy is derived from the Greek word (cheilos = lips and Skopein = see), was first described by an anthropologist R. Fischer in 1902. In the period 1968-71 two Japanese scientist Y.Tsuchihashi and T. Suzuki proved that the lip prints are unique for each human being and can be used for identification of a person and have also named the lip print pattern as "sulci labiorum rubrorum" ⁽⁴⁾. Lip prints remain the same throughout the life and can be identified as early as the 6th week of intrauterine life.

The science of using fingerprints to uniquely identify an individual is known as dactyloscopy whereas the study of skin markings or the patterns on fingers, hand and feet and its application is known as dermatoglyphics. Theterm Dermatoglyphics (dermi = skin and glyphe = curve) was coined by Cummins and Midlo in 1926 ⁽⁴⁾. The dermal ridges take their origin from fetal volar pads that appear in the 6th -7th week of embryonic life and are completed by the 12th– 14th week of gestation. Finger prints are unique in all individuals and remain unchanged over the lifetime and are considered to be highly sensitive indicators.

Similar to dermal ridges, palatine rugae are also unique to each person and can establish identity through discrimination (via casts, tracings or digitized rugae patterns).Palatal rugae are irregular fibrous connective tissue folds located on anterior third of palate on either side of mid palatine raphae and are called as plica palatine ⁽⁶⁾ or "rugae palatine." A Spanish investigator named Trobo Hermosa proposed the term "palatal Rugoscopy" in 1932.The pattern of orientation is formed by 12th–14th weeks of intrauterine life ⁽⁷⁾ from the hard connective tissue covering the palatine process and thus they are mutually controlled by epithelial–mesenchymal interactions. Rugae patterns have been also considered as a landmark during orthodontic treatment in dentistry.

It is the 6th- 8th week of embryonic period of time when the development of lips, palms, fingers, alveolus, palatal rugaes ⁽¹²⁾ i.e., at the same time as that of tooth formation in intraembryonic life⁻⁽⁹⁾. This means that the genetic message contained in the genome (normal or abnormal) is deciphered during this period ⁽⁹⁾. Thus, representing that cheiloscopy, dactyloscopy, palatal rugoscopy and dental occlusion are correlated with one another. Moreover, the mixed dentition period is considered as the best period to evaluate the malocclusion for its early prognosis.

There are some studies where the forensic parameters like cheiloscopy, dermatoglyphics and palatal rugoscopy were assessed individually with skeletal malocclusion to identified a specific type of lip pattern in a particular type of molar relation in an individual ^(1,14, 17) but a very limited studies were found where the above-mentioned parameters were evaluated together with dental malocclusion.

Hence, the aim of this study is to record and study the lip prints, finger prints, palatal rugae patterns and molar relationship of each sample in the study group and to determine the predominance of recorded cheiloscopic, dermatoglyphic and palatal Rugoscopic pattern with molar relation, if there exists any association between them.

Materials and Method:-

The present study was conducted among a total of 505 children aged 8-15 years attending the Department of Pediatric and Preventive Dentistry. Ethical clearance was obtained from Institutional Review Board. The purpose and procedure of the study was explained to the parents/guardians and informed consent was obtained to participate in the study. The patients were selected according to the **Inclusion criteria:** Cooperative children • Mentally and physically healthy children of aged 8 – 15 years of age • Normal lip mucosa • Subjects with mixed dentition along with complete eruption of 1st molar • Children whose parents agreed for participation. **Exclusion criteria:** • Uncooperative children • Medically compromised or children with special needs • Children with history of systemic and/or infectious disease. • Children with developmental anomalies • Trauma or any pathological findings in fingers, lips, and palate • Skin rashes • Children allergic to lipstick, ink pad, cellophane tape and alginate • Previous history of orthodontic therapy or under orthodontic treatment • Grossly decayed permanent molar teeth • Retained deciduous or root stumps • Subjects who had undergone molar extractions (except 3rd molars) • Quarter or half cusp molar relation • Congenitally missing teeth • Congenital facial defects Materials and Method 30 • Chapped or dry lips • Subjects who are unable to open mouth • Tongue thrusting or thumb sucking habits.

Methodology:-

In this study, (lip prints), (finger prints), and palatal rugae patterns of each participant were recorded in a A4 white sheet of paper with their name, age, sex and the angle's molar relationship were noted clinically.

For recording lips prints:

Before recording the lip prints, the lips of the children were cleaned using wet cotton and allowed to dry ⁽¹⁾. The lip stick was applied evenly on both upper and lower lips with cotton wools and the children were asked to rub their lips gently against one another so that the lipstick spreads evenly. Lip prints were recorded by the method **proposed by Sivapathasundaram et al. (2001), which is the lipstick-cellophane technique**^{(1),} using cellophane tape pasting in the relaxed position of lips, and by applying gentle and even pressure for a few seconds, the tape was carefully lifted from the lip, from one end to the other ^{(18),} in order to avoid anysmudging of the lip print followed by pasting on the A4 white sheet paper. The remnant lip stick was removed by cotton with Vaseline. The procedure was repeated, in case of any smudging of the lip print was noticed.







Fig 2:- Showing obtained lip print on the a4 sheet paper.

Interpretation of lip prints:

The prints were examined with the help of a magnifying lens and the middle part of the lower lip, 10 mm wide, was taken as study area as suggested by Sivapathasundharamet al. in 2001^{(19).} The grooves were **classified according to Suzuki and Tsuchihashi classification** and recorded on the A4 sheet.



Suzuki and Tsuchihashi (1971) classification

For obtaining fingerprints: At first all the fingers were cleaned with spirit and to avoid the duplication of finger prints, the fingers were numbered from 1-10 from the right little finger to the left little finger of both the hands on the A4 sheet white paper. Then the finger prints were recorded by pressing the fingers gently on the blue ink pad followed by placing them on the respective white paper where the numbering of fingers is done. In case of unsatisfactory recordings, the finger prints were repeated and verified.





Interpretation of finger prints:

The finger prints were analysed with magnifying glass based on Michael and Kucken method of finger print analysis i.e., whorls, loops and arch like and composite patterns ^{(20).}

A loop is recognized as a series of ridges that enter the pattern area on one side of the digit, recurves abruptly and leaves the pattern area on the same side. A whorl differs from the loop in the aspect of a concentric arrangement of ridges, with two or more triradii in the latter ⁽¹⁶⁾. Arches show the simplest ridge pattern, which is formed by the succession of one or more parallelridges, which cross the finger from one side to the other without recurving. Composite means combination of two or more patterns either of same or different types in one print.

For recording palatal rugae patterns:

Alginate impression of the maxillary arch was taken for each child with selected trays and poured with dental stone



Interpretation of palatal rugae patterns:

By using a sharp graphite pencil under adequate light and magnification the palatal rugae patterns were studied and the records were evaluated according to **Thomas and Kotze classification**^{(16).}

Thomas and Kotze classification (1983)

For recording Angle's molar relationship:

Clinical examination along their molar relationship was assessed by Angle's classification (1899) and noted.

Statistical Analysis

The data were tabulated and was subjected to statistical analysis. Data analysis was done using statistical package for the social sciences (SPSS for windows, Version 19.0) and chi-square test was used for analysis. The level of significance for the present study was fixed at a p-value of less than 0.05.

Results:-

All the parameters were cautiously analysed and patterns were verified. (Table 1,2,3)

		Molar Relation			
		Class 1	Class 2	Class 3	Total
	Ι	84	24	15	123
Cheiloscopy		27.9%	16.4%	25.9%	24.4%
	I'	45	26	10	81
		15.0%	17.8%	17.2%	16.0%
	п	68	33	10	111
		22.6%	22.6%	17.2%	22.0%
	III	30	21	6	57
		10.0%	14.4%	10.3%	11.3%
	IV	54	26	12	92
		17.9%	17.8%	20.7%	18.2%
	v	20	16	5	41
		6.6%	11.0%	8.6%	8.1%
Total		301	146	58	505
		100.0%	100.0%	100.0%	100.0%

Table 1. Cheiloscopic pattern in various classes of molar relation

Table 2. Dactyloscopic pattern in various classes of molar relation

		Ν			
		Class 1	Class 2	Class 3	Total
Dactyloscopy	Whor1	67	40	13	120
		22.3%	27.4%	22.4%	23.8%
	Loop	78	28	16	122
		25.9%	19.2%	27.6%	24.2%
	Arch	54	23	15	92
		17.9%	15.8%	25.9%	18.2%
	Composite	102	55	14	171
		33.9%	37.7%	24.1%	33.9%
Total		301	146	58	505
		100.0%	100.0%	100.0%	100.0%

		Molar Relation			
		Class 1	Class 2	Class 3	Total
Rugoscopy	Wavy	85	49	19	153
		28.2%	33.6%	32.8%	30.3%
	Curve	98	40	20	158
		32.6%	27.4%	34.5%	31.3%
	Diverge	60	25	7	92
		19.9%	17.1%	12.1%	18.2%
	Straight	44	19	6	69
		14.6%	13.0%	10.3%	13.7%
	Circular	6	4	2	12
		2.0%	2.7%	3.4%	2.4%
	Converge	8	9	4	21
		2.7%	6.2%	6.9%	4.2%
Total		301	146	58	505
		100.0%	100.0%	100.0%	100.0%

Table 3. Rugoscopic pattern in various classes of molar relation

Discussion:-

It has been observed that during the transition from primary dentition to permanent dentition various occlusal characteristics plays an important role in the establishment 21 of the aesthetics, phonetics and function of the normal occlusal relationship Understanding the development of occlusion, leads to determining the malalignment of the teeth that is considered as one of the widespread oral health problems by WHO in 2021 with an estimation of 39-93 % of children and adolescent being affected after caries and periodontal disease.⁽²²⁾Moreover, the development of facial structures like lip, alveolus, teeth and palate are formed from the same embryonic tissues during the 6th - 8th week of intrauterine life. ⁽¹²⁾ Thus, any factor that tends to affect the development of a particular structure will ultimately affect all the other structures that develops along with itSo, there is a likelihood for the developmental changes that takes place in relation to alveolus might be reflected ⁽¹⁾ in lip, finger and prints of palatal rugae patterns, which are not only use for forensic investigation but can be useful for identification and diagnosis in the field of dentistry.

There are only a few studies where Vignesh R et al. 1 and Sarika B et al. 2 evaluated cheiloscopic patterns with permanent molar relationship. That is why, the present study was an attempt to evaluate the association of lip prints, finger prints and palatal prints with malocclusion based on Angle's classification and thereby helping the practitioner to predict them and to provide preventive and interceptive orthodontic treatment when necessary. In the present study, the age group of 8-15 years was chosen because, by the age of 15 years all the 2nd permanent molars erupt upto the occlusal table which gives a better analysis for recoding the molar relationship as some of the individual studies suggested a strong correlation with dental development and pubertal growth⁽²⁴⁾. Moreover, by choosing the age group from 8 years (i.e. the mixed dentition period where the maxillary and mandibular 1st permanent molar erupts fully upto the occlusal table in the oral cavity) is considered as the best period to evaluate the malocclusion for its early diagnosis. In similar studies, conducted by Vignesh R1 et al. and Sarika B2 et al. the age group was selected from (14-16) and (18-30) years of age respectively.

In the present study, the analysis of the lip prints was based on the numerical superiority of the patterns of the line visible in the area of study and were classified according to Suzuki and Tsuchihashi in 1974, also known as

Tsuchihashi"s classification. The reason behind using this classification was that, it is the most widely used classification in literature, found to have a clear description of nearly all of the commonly encountered lip patterns and was easy to interpret, although different classifications like Martin Santos Classification (1966), Raynaud"s Classification, Afchar–Bayat Classification (1979), are available. The results of the current study helped us to correlate certain patterns which might be related to specific molar relationships.

In the present study, the type I lip pattern (clear-cut vertical grooves) was found the most prominent in children having both class 1 and class 3 molar relation with (27.9%) and (25.9%) respectively. Whereas, type II lip pattern (branched grooves) with 22.6% was found predominant in children having class 2 molar relation. The least predominant lip pattern found in all the three classes of molar relation was type V with 6.6% in class 1, 11% in class 2 and 8.6% in class 3 molar relation. In support of my study, similar results were obtained by Vignesh R et al. 1 where type I lip pattern was found as the most prominent in relation with class 1 molar relation. This was contradicting to the study done by B. Sarika et al.2 where type II lip pattern was found the most common in relation to Angle's class 1 molar relation with less caries experience.

In case of dactyloscopy, the Ink method was used where the patients were asked to pressed their cleaned fingers on the blue ink stamp pad with gentle pressure followed by placing them onto an A4 size white sheet to take their impressions. The prints were examined using a magnifying glass and classified according to Michael Kucknas method of finger print analysis: loop, whorl, archlike and composite pattern. In the present study, (as shown in table: 3) the most prevalent dactyloscopic pattern is composite with (33.9%) and (37.7%) in class 1 and class 2 molar relation and in class 3 molar relation showed loops as predominant with (27.6%). The least occurring dactyloscopic pattern was arch pattern in both class 1 and class 3 molar relation. (22.4%).Similarly, in support of the present study, Cheeli S et al. did a comparative evaluation on rugoscopy and dactyloscopy for predilection of malocclusion and dental caries in 800 children of 8-16 years old, who also observed loops as predominant in class 3 malocclusion. Few authors Reddy et al. (1997), Trehan et al. (2001), Tikare et al. (2010) and Jindal G et al. (2014) conducted studies in associations of dermatoglyphic features with malocclusion. But a very little study has been found where dactyloscopy with malocclusion was done.

In case of rugoscopic pattern, the class 1 and class 3 molar relation group showed predominance of curve pattern with (32.6%) and (34.5%) respectively. In class 2 molar relation, the predominant rugoscopic pattern was wavy (33.6%), and least occurring was circular (2.7%). Similarly, in support of the present study, Cheeli S et al. 11 also found curved pattern of palatal rugae in class 2 and class 3 malocclusion in "the study on comparative reliability of rugoscopy and dactyloscopy for predilection of malocclusion and dental caries in 800 children of 8-16 years old" and Juva R et al. 14 also found the wavy pattern of rugae as predominant in class 2 malocclusions. Moreover, in the present study, no statistically significant association was found between molar relation and the forensic patterns (cheiloscopy, dactyloscopy and palatal rugoscopy) which is similar to the statistical analysis found in the study by Vignesh R.et al., S Tikare et al. and Juva R et al respectively.

Conclusion:-

The variation in the results were reported by different investigators may be explained by difference in the study population size and varying ethnic and racial backgrounds and the environmental factors. Although, extensive scientific research on the study of the lip prints, palatal rugae, and finger prints are available, the study associating all these three variables with Angle's molar relation is minimal. In our present study, the sole objective is to distinguish a specific predominant pattern with above mentioned forensic parameters with Angle's molar relationship in the age group of 8-15 years. However, the results came out to be statistically nonsignificant.

Thus, by co-relating the lip, finger and palatal rugae patterns with molar relation might aid in the early diagnosis and interception of malocclusion among paediatric patients and also might be helpful in future forensic research as an easily accessible, economical and non-invasive marker for the aforementioned conditions. Moreover, the interpretations derived from this study are precluded by limited sample size. So, in order to see the effectiveness of these forensic parameters and to predict the malocclusion, further investigations, particularly longitudinal studies may be required in the future to shed more light on the relationship between cheiloscopic, dactyloscopy and rugoscopic patterns with malocclusion in order to substantiate the findings presented herein.

References:-

- Vignesh R, Rekha CV, Annamalai S, Sharmin DD, Norouzi-Baghkomeh P. A Comparative Evaluation Between Cheiloscopic Patterns And The Permanent Molar Relationships To Predict The Future Malocclusions. J Clin Exp Dent. 2019;11(6):e5537
- Sarika Balaganesh, L. Leelavathi, Meignana Arumugham Indiran. Cheiloscopy Pattern and Its Relation with Dental Caries and The Permanent Molar Relationship Among Dental Students - A Cross Sectional Study. Int J Dentistry Oral Sci. 2021;8(8):3652-3655.
- 3. Vignesh R, Rekha CV, Annamalai S, Norouzi P, Sharmin D. A Comparative Evaluation Between Cheiloscopic Patterns and Terminal Planes in Primary Dentition. Contemp Clin Dent 2017;8:522-5
- 4. Chaware S, Sangle V, Maniyar A, Kendre S. Lip Prints (Cheiloscopy): An Insight. Indian J Dent Res. 2021;3(1):25-28
- Chhikara P, Singh A. Lip-Prints Evidence Lost to Impertinence. Asian J Pharm Clin Res. 2022;15(10):131-133
- 6. Navit S, Pramanik S, Khan SA, **Jabeen S, Grover N, Bharti A.** Cheiloscopy and Dactyloscopy as Behavior Assessment Tool in Dental Settings: A Cross-sectional Study. Int J Clin Pediatr Dent 2021;14(2):238–242.
- 7. Madhusudan. K, Patel HP, Umesh K, Chavan S, Patel R, Patel R, Gadhavi N. Relationship Between Dermatoglyphics, Cheiloscopy and Dental Caries Among Dental Students of Visnagar Town, Gujarat. Int J of Adv Res. 2015;3: 952-959.
- 8. Reddy BR, Sankar SG, Roy ET, Govulla S. A comparative study of dermatoglyphics in individuals with normal occlusions and malocclusions. J Clin Diagn Res. 2013 Dec;7(12):3060-5.
- 9. Singh E, Saha S, Jagannath GV, Singh S, Saha S, Garg N. Association of Dermatoglyphic Peculiarities with Dental Caries in Preschool Children of Lucknow, India. Int J Clin Pediatr Dent. 2016 Jan-Mar;9(1):39-44.
- Sharma T, Chaitan SM, Somayaji NS, Mahajan B, Rajguru JP, Hajibabaei S, et al. The medicolegal importance of establishing human identity by using dactyloscopy and rugoscopy: A comparative study. J Family Med Prim Care 2020;9:3236-41
- 11. Cheeli S, Prasad MG, Radhakrishna AG, Kumar Santosh KVK, Dangeti D, Reddy SP. Comparative Reliability of Rugoscopy and Dactyloscopy for the Predilection of Malocclusion and Dental Caries in Children: A Cohort Study. Pesq Bras Odontoped Clin Integr 2017;17(1):e3796
- 12. Fatima F, Fida M, Shaikh A. The association between palatal rugae pattern and dental malocclusion. Dental Press J Orthod. 2019;24(1):37.e1-9.
- Lalitya D, Srinivasan I,Setty JV, Pamnani S, Dindukurthi MK and Allani S. Rugoscopy as a Gender Determination Tool and its Appositeness in Malocclusion among Adolescents Aged 13–18 Years. Int J Clin Pediatr Dent 2019;12(4): 307–311.
- 14. Juvva R, Prasad MGS, Ambati NRK, Kaniti S, Raviteja NVK and Jyothi V. The reliability of palatal rugoscopy in predicting various malocclusions. J. Stomat. Occ. Med.2016;8(1):S40-S43
- 15. D. Shukla, A. Chowdhry, D. Bablani, P. Jain, R. Thapar. Establishing The Reliability of Palatal Rugae Pattern in Individual Identification (Following Orthodontic Treatment). J Forensic Odontostomatol 2011;29(1):20-29
- 16. Agarwal M, Alex A, Konde S. Relationship between dermatoglyphics, cheiloscopy, rugoscopy, and dental caries: A cross-sectional study in Bengaluru, Karnataka. Contemp Clin Dent 2018;9:577-81
- 17. S Tikare, G Rajesh, KVV Prasad, V Thippeswamy and SB Javali. Dermatoglyphics A marker for malocclusion. Int Dent J 2010;60(4):300-304
- 18. Bansal N, Sheikh S, Bansal R, Pallagati S. Correlation between lip prints and finger prints in sex determination and pattern predominance in 5000 subjects. J Forensic Odontostomatol. 2013;31(1):8-14.
- 19. Aditi S, Tikku T, Khanna R, Maurya RP, Verma SL, Srivastava K, et al. Cheiloscopy: Association of lip prints in different skeletal malocclusions. Int J Orthod Rehabil 2019;10:156-60.
- 20. Mutalik VS, Menon A, Jayalakshmi N, Kamath A, Raghu AR. Utility of cheiloscopy, rugoscopy, and dactyloscopy for human identification in a defined cohort. J Forensic Dent Sci 2013;5:2-6
- 21. Phaphe S, Kallur R, Vaz A, Gajapurada J, Sugaraddy, Mattigatti S. To Determine the Prevalence Rate of Malocclusion among 12 to 14-Year-Old Schoolchildren of urban Indian Population (Bagalkot). J Contemp Dent Pract 2012;13(3):316-321.
- 22. Cenzato N, Nobili A, Maspero C. Prevalence of Dental Malocclusions in Different Geographical Areas: Scoping Review. Dent J (Basel). 2021;9(10):117.
- Lombardo G, Vena F, Negri P, Pagano S, Barilotti C, Paglia L, Colombo S, Orso M, Cianetti S. Worldwide prevalence of malocclusion in the different stages of dentition: A systematic review and meta-analysis. Eur J Paediatr Dent. 2020;21(2):115-122.

- 24. Bittencourt MV, Cericato G, Franco A, Girão R, Lima APB, Paranhos L. Accuracy of dental development for estimating the pubertal growth spurt in comparison to skeletal development: a systematic review and meta-analysis. Dentomaxillofac Radiol. 2018;47(4):20170362.
- 25. Raghav P, Kumar N, Shingh S, Ahuja NK, Ghalaut P. Lip prints: The barcode of skeletal malocclusion. J Forensic Dent Sci. 2013;5(2):110-7.
- 26. Allani S, Setty JV, Srinivasan I, Apoorva Jawa A and Lalitya D. Determination of Relationship between Lip Prints and Skeletal Malocclusion in Children of Age 9–14 Years. Int J Clin Pediatr Dent 2019;12(6):494–499.
- 27. Singh KK, Menka K, Anand K, Goel A, DontulwarA, Rajguru JP. Correlation between dermatoglyphics and dental caries in children: A case-control study. J Family Med Prim Care 2020;9:2670-5.