SKELETAL MALOCCLUSION AND LIP PRINTS- A COMPARATIVE STUDY

By

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2020-2023

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled "**Skeletal malocclusion and Lip prints – A Comparative study**" is a bonafide and genuine research work carried out by me under the guidance of **Dr. TONY MICHAEL**, Professor, Department of Orthodontics& Dentofacial Orthopaedics, St. Gregorios dental college, Chelad, Kothamangalam.

Date: 30|01|23

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fulfilment of the requirement for the Degree of *Master of Dental Surgery.*

Date: 30|01|23

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ABSTRACT

Background: Cheiloscopic analysis has been shown to have close association with skeletal malocclusions. The aim of the present study was to explore any association between lip print patterns and skeletal malocclusions.

Materials and Methods: A study sample of 60 subjects, aged between 18 and 25 years was selected from individuals opting for orthodontic therapy. Skeletal malocclusions were assessed using lateral cephalograms by analyzing ANB angle, witts appraisal and beta angle. The lip print patterns were analyzed using a dental scanner.

Results: Skeletal Class I group showed more of a reticular pattern (30%). Other patterns in decreasing order were vertical pattern (25%), intersected pattern (20%), and small vertical lip patterns (15%). The skeletal Class II pattern also showed more reticular pattern (35%) followed by branched pattern (25%), vertical (15%), intersected (15%), and small vertical lip patterns (15%) respectively. The skeletal Class III group showed vertical pattern (40%) showed as most common lip pattern followed by reticular pattern (30%), small vertical (10%), branched (10%) and intersected pattern (10%) respectively. No statistically significant relationship could be established between lip pattern and skeletal malocclusions in the study.

Conclusion: Lip print patterns are considered important indicators of malocclusion which can help in predicting the type of malocclusions at an earlier stage. Although certain associations were observed in the second level of patterns, a statistically significant association could not be established in the present study

Keywords: skeletal malocclusion, lip print pattern

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Introduction

<u>INTRODUCTION</u>

The research on growth and development of the craniofacial complex has provided a plethora of data on the pattern of facial growth and maturity[1]. The pattern of lip differs, not just based on gender, but also depending on facial types. Many biological indicators can be used for determination of the growth and development such as body weight, height, dental or skeletal development etc. Lateral cephalograms are recognized as a reliable method for determining skeletal malocclusion and dental abnormalities. Appropriate diagnostic procedures and analysis of relevant diagnostic data forms the basis of comprehensive Orthodontic treatment planning[1].

An orthodontic diagnosis is complete when a comprehensive list of the patient's problems is created, separating pathological and developmental problems. The more accurate and quantifiable the diagnosis, the easier it is to formulate a treatment plan.

The Orthodontic treatment planning is done based on appropriate diagnostic procedures and analysis of pertinent investigation data. There is a wide array of diagnostic soft tissue analysis. Some studies consider lip pattern as an indicator for future malocclusions.

The lip print patterns consist of normal lines and fissures, numerous wrinkles and grooves which are present in between the inner labial mucosa and outer skin. It is unaltered from sixth week of intrauterine life till death[2]. While latent prints are not visible with naked eyes, it can made visible by imprinting on a white surface after applying an opaque medium like lipstick on lips.

These patterns play an important role as they bear a unique identification, with the only exception being monozygotic twins. The lip print patterns are identifiable at 6th week of intrauterine life and persist unchanged throughout life, even after episodes of Herpes. The term 'Cheiloscopy' is derived from Greek Words; cheilos, 'lips' and ekopein, 'to see' and is used for studies of lip patterns. Lip print patterns have been widely studied in association with various orofacial and dental conditions like early

childhood caries, malocclusion, periodontal diseases, cleft lip and palate, and premalignant lesions and conditions.

The lip print patterns have been classified by many investigators. The classification of **Suzuki** and **Tsuchihashi** is used in this study. It divides the lip pattern into 5 types[3]

    (a) Type I: Vertical groove across lips

    (b) Type I': Partial groove pattern

    (c) Type II: Branched

    (d) Type III: Intersected pattern

    (e) Type IV: Reticular pattern

    (f) Type V: Other lip patterns

The embryological development of palate, alveolus, and lips takes place at the same time. Any disturbance during this period can affect all these structures. The Klein zone of vermillion border of lip is the area investigated in this study which is covered with print patterns or grooves[5] .

There are different approaches of recording lip prints such as lipstick-paper-cardboard method, photography, lipstick-paper method, lipstick-cellophane method, making dental impression to make three-dimensional casts of the lips or using Intraoral Dental Scanner to make a three-dimensional view of the lips. The Intraoral Scanning method was used in this study as it provided good clarity and accuracy.

Objectives

AIM AND OBJECTIVES

AIM

Aim of the study is to compare the relationship between skeletal malocclusion and lip prints in Kerala population.

OBJECTIVE

• To evaluate the association of different types of skeletal malocclusion with various pattern of lip print.

• To evaluate the relationship of skeletal malocclusion with various lip print patterns among males and females.

Background &Review of literature

BACKGROUND OF THE STUDY

Dental scanner, one of the essential diagnostic tools in orthodontics which is used to take intraoral hard tissue examination and the study model formation. Also, the dental scanner helps to modernize the dental clinic as alginate and plaster free clinic. It provides very accurate intra oral impression and help to do model analysis also.

This study is designed to explore the correlation of lip prints with skeletal base relationship and to assess the same correlation in the Kerala population. Lip print assessment may aid the orthodontist as an early diagnostic aid, predicting the type of malocclusion and planning the treatment. There is a wide array of diagnostic soft tissue analyses in which lips play a major role. Lip prints consist of normal lines and fissures, numerous wrinkles, grooves etc, which are present in between the inner labial mucosa and outer skin, which is established by the dental scanners.

REVIEW OF LITERATURE

Perizigian et al (1977) examined dental metric traits in Indian tribes and found higher fluctuating asymmetry in the teeth of individuals that subsisted on hunting than in those who subsisted on farming; the latter also had better live conditions and suffered less from environmental pressures than the former. The investigation assumed that these inter-tribal differences stemmed from differences in the intensity of environmental pressures exerting an influence on them but did not rule out the possible existence of genetic differences on the influence of different levels of inter-tribal inbreeding[15] .

Kharbanda O.P et al (1982) conducted a study in 25 samples using dermatoglyphics to predict malocclusion. All the subjects were males. Based on Angle's malocclusion, the groups were divided. Finger patterns were recorded. Increased frequency of radial loops was observed in Class 1 skeletal malocclusion[16] .

Reddy S et al (1997) aimed to predict malocclusion using Dermatoglyphics and so conducted a study using dermatoglyphics to predict and compare Class I, Class II,

div.1, div. 2 and Class III malocclusions. A total of 96 subjects were divided into 3 malocclusion groups, i.e. Class I (control group), Class II div.1, div.2 and Class III (experimental group) in the ages of 12- 14 years. The dermatoglyphic findings revealed that the craniofacial Class II div.1, div.2 pattern was associated with increased frequency of arches and ulnar loops and decreased frequency of whorls, whereas in Class III, there was an increased frequency of arches and radial loops with decreased frequency of ulnar loops. In predicting Class III malocclusion, based on frequency of arches, the sensitivity values were found to be higher and more reliable than the sensitivity values of Class II div.1 and div.2 malocclusion[17] .

P.A. Mossey et al (1999) in their review article stated that the relative influence of genetics and environmental factors in the etiology of malocclusion has been a matter for discussion, debate and controversy in the orthodontic literature. This paper reviews the literature and summarizes the evidence for the influence of genetics in dental anomalies and malocclusion. Since there is evidence that these Oro-facial structures are under genetic control and are significant in craniofacial development they must be considered in the etiology of malocclusion. Among the conclusions is that, while phenotype is inevitably the result of both genetic and environmental factors, there is irrefutable evidence for a significant genetic influence in many dental and occlusal variables. The influence of genetics however varies according to the trait under consideration and in general remains poorly understood[18] .

M Trehan et al (2000) conducted a study to find the correlation between dermatoglyphics and malocclusion. They analyzed and compared the dermatoglyphic parameters of individuals with normal occlusion and various Classes of malocclusion, based on the fact that development of teeth and palate occurs during the same period as the development of dermal patterns. A total of 60 subjects under the age group of 15-26 years were divided into 4 experimental groups i.e., Class-I control group, Class-I type 2, Class-II div.1 and Class-III. The justification for dividing the sample into these 4 groups is that each group is representative of a single Class of Angle's Classification of malocclusion. The dermatoglyphic findings revealed that when compared with normal occlusion, Class-I and Class-III malocclusions were associated with an increased frequency of whorls and both Class-I and Class-II div.1

malocclusions were associated with an increased frequency of radial loops and arches. It was seen that total finger ridge count was higher in males as compared to females in controls as well as in experimental groups. The percentage of total finger ridge count decreased in all experiment group when compared to the control group except in Class-III in which it increased. Increased frequencies of patterns in hypothenar area were also observed in all malocclusion groups as compared to normal occlusion[19] .

S Tikare et al (2010) studied about the relationship between fingerprints and malocclusion among a group of 696 high school children aged 12-16 years in Dharwad, Karnataka, India. Their fingerprints were recorded using duplicating ink and malocclusion status was clinically assessed using Angle's Classification. The results of this study revealed that association between whorl patterns and Classes I and II malocclusion were statistically significant (p<0.05). However, no overall statistical association was observed between fingerprint patterns and malocclusion (p<0.05). Thus, it was concluded that dermatoglyphics might be an appropriate marker for malocclusion and further studies are required to evaluate an association between fingerprint pattern and malocclusion[20] .

Kulkarni N et al (2012) conducted a study to find the relationship between lip prints and malocclusion for which they collected lip prints in a total of 90 patients with skeletal Class I, Class II, and Class III, comprising 30 patients in each group with equal gender distribution. It was observed that angle ANB (Angle formed between points nasion [N] to Sub nasal [A] and nasion [N] to supramental [B]) and beta angle were statistically significant, revealing a strong negative correlation (-0.9060) with different Classes of jaw relation. Significant difference was observed between genders in all the three Classes. Significant difference was observed in relation to lip print and the quadrants of upper and lower lips. A statistical significance was noted on the right side of both upper and lower arches. This study shows that lip prints can be employed for sagittal jaw relation recognition. A further study on various ethnic backgrounds with a larger sample size in individual group is necessary for comparing lip prints and malocclusion[21].

Karki et al (2012) conducted a study to find the correlation between lip prints and skeletal malocclusion in 150 medical students which included 75 males and 75 females of Kathmandu University School of Medical Sciences, Dhulikhel, Kavre in 2011. Lip prints were collected and analyzed as per Suzuki's Classification. There was significant difference between male and female lip print patterns. Type II was most common combining both. Type I and I' was more common in male whereas Type I was rare in female. Type II in fourth quadrant was seen in almost all female and also the commonest. Similar patterns in all four quadrants were common findings in female. The study showed that each lip print is unique and the sex of the person can be predicted on the basis of patterns present in prints[7] .

Raghav P et al (2013) evaluated 114 subjects to find the correlation between lip prints and skeletal malocclusion in the age group of 18-30 years with skeletal Class I, Class II and Class III malocclusion, each group comprising of 38 subjects with equal number of males and females. Lip prints of all the individuals were recorded. On comparison of Lip prints with different skeletal malocclusions. It was found that prevalence of vertical lip pattern was significantly higher in subjects having skeletal Class III malocclusion revealing a definite correlation of vertical lip patterns with skeletal Class III malocclusion[6] .

Rachana V. Prabhu et al 2013 determined to evaluate the uniqueness and to define a standard method for the analysis of lip prints. For that Lip prints of 100 students were taken using Scotch tape without any distortion. These prints were then scanned for the digital analysis. Using Adobe Photoshop 7 software an attempt was made to trace each line using Suzuki and Tsuchihashi's classification. Weighted value scoring system was used to check for the uniqueness of the lip prints. As the result there was no two lip prints had exactly matching scores in all four Quadrants. No statistically significant difference was found in the change of pattern in lip print images collected after 12 months from the same individual. With digital analysis, up to 15 lines were traceable in 66%, 71%, 52% and 51% of Quadrant I, II, III and IV respectively. Because of this they concluded Lip prints are unique to an individual. The digital method of analyzing lip print images serves better visualization, ease in identification and recording of the lip print pattern. Weighted Value Scoring system can be

considered as a standard method for determining the uniqueness of the lip prints

Rajput S et al (2014) conducted a study to find the correlation between finger prints and malocclusion in 24 subjects of which 10 were Class I, 8 were Class II and 6 were Class III malocclusion. The finger patterns, ab ridge count and atd angle was noted. Significantly higher proportion of whorl pattern in Class I when compared to the Class II and III. Significantly higher proportion of subjects from Class II and III had Loop pattern compared to the Class I. Increased proportion loops in Class III when compared to Class II, but there was no statistical significance. The average of both was not significantly different between three study groups[22].

Jindal G et al (2015) conducted a study to find if there was any relationship between dermatoglyphics and malocclusion. They collected Finger and palm prints in 237 children aged 12–16 years, and fingertip pattern frequencies, total ridge counts (TRCs), and atd angles (formed by the triradii below the first and last digits and that in the hypothenar region of the palm) were calculated. These parameters were analyzed with their Angle's Class of malocclusion. Although no fingerprint pattern was found to be specific for a particular Class of occlusion, increased tendencies toward high frequencies of whorls in subjects with Class II malocclusion and plain arches in those with Class III malocclusion were observed. Significant differences in atd angle and TRC were observed among malocclusion types (p = 0.0001) indicating that Dermatoglyphic analysis can be used to predict malocclusion at an early age, thereby aiding the development of treatments aiming to establish favorable occlusion[23].

Ruchi S et al (2015) conducted a study to find the correlation between malocclusion and lip prints for which he analyzed 300 subjects out of which 234 subjects including males and females were found to be fit for the study having dental malocclusion with age range of 18–25 years. The subjects were classified into three groups according to Angles classification of malocclusion as Class I, Class II and Class III malocclusions. The impressions of the lips were taken on the self-adhesive cellophane tape and then immediately transferred onto the bond sheets. The analysis of these lip prints patterns was done with the help of magnifying lens. The statistical analysis with chi square

test showed that lip print patterns were found to a have highly significant (p<0.001) association with malocclusion. The lip print patterns which are important tools for identification were found to have a highly significant association with malocclusion and it can also be said that the lip print patterns have a role in determining malocclusion[24] .

Shivani Y et al (2015) examined 30 patients with Skeletal Class III Malocclusion and recorded lip prints and analyzed. Descriptive statistical analysis was used to find the prevalence of lip prints patterns among sagittal Class III skeletal malocclusions. Central vertical grooves, Fork grooves, Intersected grooves, Reticulate Groove types of lip prints was the order of predominance in skeletal Class III group of individuals[25] .

Divyashree et al (2016) conducted a study on 40 individuals cephalometrically confirmed as Skeletal Class I and Skeletal Class II based on Downs and Steiner analysis between the age group of 15 – 30 years were selected. Fingerprint patterns of the study subjects were recorded using Ink and Paper method and the finger prints were studied. The study concluded that the Pattern distribution is significantly different between both the groups. Increased frequency of whorls was found both in Right & Left hands In Skeletal Class I Pattern Group. Increased frequency of Ulnar Loops was found in the Right Hand of Skeletal Class II pattern group[26] .

Eslami N et al (2016) conducted a cross-sectional study to find the correlation between fingerprints and skeletal malocclusion in 323 patients who were referred to Orthodontic Department of Mashhad Dental School. The participants were classified into three groups according to Angle´s Classification, i.e., Skeletal Class I (n = 163), Skeletal Class II (n = 111), and Skeletal Class III (n = 49). For all participants, atd angles, a-b ridge counts, and types of fingerprint patterns was recorded. Right and left - hand asymmetry scores were calculated. The Chi-square test was used to compare the dissimilarity of the types of patterns for each finger. Asymmetry of other parameters was analyzed statistically using the ANOVA or Kruskal-Wallis tests. A significant difference was determined between Class I and Class III patients in terms of a-b ridge count (p=0.049). Loop was the most frequent pattern among the 3 groups,

whereas the arch pattern occurred with the lowest frequency. No significant difference was found in the other parameters that were studied. Although there were some slight variations in dermatoglyphic peculiarities of different skeletal malocclusions, most of the palm and fingerprint characteristics failed to indicate any significant differences[11].

George SM et al (2017) conducted a study to find the relationship between dermatoglyphics and skeletal malocclusion in a total of 180 patients, aged 18-40 years, were selected from those who attended the outpatient clinic of the Department of Orthodontics and Dentofacial Orthopedics, Mar Baselios Dental College, Kothamangalam, Kerala, India. The fingerprints of both hands were taken by ink and stamp method after proper hand washing. The patterns of arches, loops and whorls in fingerprints were assessed. A significant association was observed between the dermatoglyphic pattern exhibited by eight fingers and the sagittal skeletal discrepancies (p<0.05). An increased distribution of whorl pattern was observed in the skeletal Class II with maxillary excess group and skeletal Class II with mandibular deficiency group while an increased distribution of loop pattern was seen in the skeletal Class III with mandibular excess group and skeletal Class III with maxillary deficiency group. Higher mean of total ridge count was also seen in the groups of skeletal Class II with maxillary excess and skeletal Class II with mandibular deficiency. Multinomial regression predicting skeletal pattern with respect to the fingerprint pattern showed that the left thumb impression fits the best model for predicting the skeletal pattern[27] .

Cheeli S et al (2017) conducted a study to evaluate the relation between finger prints, palm prints and skeletal malocclusion. 800 children between 8-16 years were screened and among them, 150 were who met inclusion criteria were selected and divided into 2 Groups. Based on Angle's malocclusion, Group 1 (n = 90) was subdivided into Group 1A (30 - Class I), 1B (30 - Class II) and 1C (30 - Class III). Based on DMFT, Group 2 (n = 60) were subdivided as Group 2A (30 - Caries free) and 2B (30 - Caries active). Both Groups had an equal distribution of boys and girls. Finger and palm prints were analyzed using Cummins and Midlo. Rugae patterns were analyzed using Thomas and Kotze Classification. The obtained data were

subjected to statistical analysis using Chi-square test. The study concluded that based on dermatoglyphics, predominant loop pattern was observed in all the subgroups of Group 1 (1A, 1B and 1C). Based on rugae pattern, predominant wavy pattern in Group 1A and curved pattern in both 1B and 1C were observed. In Group 2, loop dermatoglyphic pattern and wavy rugae pattern were predominant in Groups 2A and 2B. Atd angle was highest in Groups 1A (41.60) and 2B (42.36)[28] .

Ponnusamy S et al (2017) conducted a study to find the correlation between skeletal malocclusion and lip prints. He analyzed the Lip prints of 25 subjects with skeletal Class I and 25 with skeletal Class II malocclusion (age group of 18-35years) and found statistical significant difference between the two malocclusions. It was observed in the Vertical and Branched patterns while the intersected, reticular and undermined patters showed no difference. This was evident in the female gender while the male gender showed differences in the vertical pattern only. This study concluded that since sagittal jaw and dental relationships get established before lip prints, lip print assessment may aid the clinical orthodontist by predicting the type of malocclusion[29] .

Kaushal et al (2018) conducted a study to find out the relationship between lip pattern and skeletal malocclusion which included 90 subjects in the age group of 18-30 years, from Distt Solan, (H.P.) population who were divided into two groups, Group I (Skeletal Class I) and Group II (Skeletal Class II). Lip prints of all the individuals were recorded and compared between Skeletal Class I and Class II malocclusions. From the results it was found that Branched lip pattern was most common in Distt Solan population with no sexual dimorphism. In overall, Skeletal Class I group, branched lip pattern was most prevalent (28.9%), followed by Intersected (24.4%), Reticular (22.2%), Vertical (17.8%) and (6.7%) Undetermined lip patterns. In overall Skeletal Class II group, branched lip pattern was most prevalent (31.1%), followed by Reticular lip pattern (28.9%), Intersected lip pattern (17.8%), Vertical lip pattern (13.3%) and Undetermined lip pattern (8.9%). In this study they concluded that there was no statistically significant association of lip prints with Skeletal Class I and Class II malocclusion[30] .

Maheswari et al (2018) studied about the significant relation between the type of lip print and the Angle's molar relation. In this study 60 subjects were included and were divided to three groups corresponding to the Angles Classification of malocclusion as Class-I, Class- II and Class-III with 20 subjects in each group respectively. The lip print pattern of all the 60 subjects was traced using lipstick on a cellophane tape and was pasted on a chart paper for future analysis. The relation between type of lip print and the type of molar relation was assessed. Results of the study proved that the correlation coefficient between the Angle's Molar relation and lip prints were proved to be statistically insignificant (p->0.05). They found that Type I was the most prevalent lip print in all the 3 molar relations. This study had revealed unique 12-digit lip print which could further be explore established in this study can be further explored to prove the significance of lip print in biometrics[31].

Achalli S et al (2018) assessed the relationship between the fingerprint patterns with different skeletal malocclusions. In this study fingerprint patterns were collected from 90 subjects using ink method who were grouped into skeletal Class I, skeletal Class II, skeletal Class III malocclusion consisting of 30 subjects each. Loop pattern was more frequent in skeletal Class I and skeletal Class II malocclusion; whorl pattern was present with increased frequency in skeletal Class III malocclusion. From this study results, they suggested that the relationship of dermatoglyphic patterns with skeletal malocclusion can be used as an indicator of developing malocclusion at an early age[32].

Jalannavar P et al (2018) studied about the relationship between lip prints and malocclusion among 300 children aged 5-15 years was recorded by Angle's method. Lip prints were recorded on cellophane tape and analyzed by Tsuchihasi's Classification. The undetermined lip pattern showed the highest number of Angle's Class II malocclusion cases (21.6%) followed by the reticular pattern (15.4%). The reticular pattern showed the highest number of Angle's Class III malocclusion cases (4.6%) followed by the intersected pattern (2.7%). The p values for all these observations were > 0.05 and hence there was no statistically significant difference between the lip patterns and the malocclusions present[33].

Varsha Das et al (2019) conducted a study to determine & correlate the lip print patterns in Skeletal Class I & Class II malocclusions. A sample of 160 individuals (80 skeletal Class I & 80 skeletal Class II malocclusion) aged 12 years and above, were selected for the study. A dark colored lipstick was applied onto the cleaned & dried lips with a single stroke. A lip impression was made on a transparent cellophane tape strip which was removed & stuck to a white bond paper. Lip print patterns were analyzed based on the Tsuchihashi classification i.e., Type I, Type I', Type II, Type III, Type IV & Type V. The field of observation was confined to 10mm on either side of the quadrant from the midline and the pattern was resolved by counting highest number of lines in this area. Statistical analyses indicated that the prevalence of Type I & Type II lip pattern was significantly higher in Skeletal Class I & Class II malocclusion subjects respectively. The results showed a significant correlation between lip prints and skeletal sagittal malocclusion. Cheiloscopy can act as an early indicator of skeletal malocclusions, but further research is required for the evaluation of lip prints in a larger sample with distinct inherited malocclusions[4][5].

Sindura Allani et al (2019) examined to determine the relationship between lip prints and sagittal skeletal jaw relation in children of age 9–14 years. He concluded the study shows type I lip print pattern on lower lip was significantly higher (p < 0.05) in overall subjects having class II jaw relation; some interrelations between lip print patterns and malocclusions were found especially in skeletal class II and III jaw relation groups. No definite lip print pattern could be associated with any particular sagittal skeletal jaw relation[4][9].

Srishti Aditi et al (2019) conducted a study was to assess the association between lip print pattern and different types of skeletal malocclusion. Lip print was recorded by lipstick paper method and was classified according to Tsuchihashi classification as Type I, Type I', Type II, Type III, Type IV, Type V. And in results, it was seen that partial vertical groove (PVG) lip pattern was most prevalent for all the groups. In skeletal Class I, PVG lip pattern was most prevalent, whereas in skeletal Class II Division 1, intersecting groove, in skeletal Class II Division 2, PVG, and in skeletal Class III, complete vertical groove was prevalent. The difference between the four

malocclusion groups of each type of lip print was significant except for Type II[4][7].

Dr. Sandhya Jain et al (2019) conducted a study to determine association between lip print pattern and different skeletal malocclusions and gender. In skeletal Class I Males, type IV lip print is common; while in class I females IV are most common. In skeletal Class II males, Type IV. However, in Class II females – Lip print type II is most common. In skeletal class III males Type I lip print is more common and class III Females Type II lip print is commonest. So they Concluded, there is exists a particular pattern of Lip prints in certain skeletal malocclusion and gender[4][6].

Anuradha Pandey et al (2020) conducted study about Cheiloscopic analysis has been shown to have close association with skeletal malocclusion. The aim of the study was to explore any association between lip prints patterns and skeletal class I and II malocclusions. As the results, Skeletal class I group showed more branched pattern (29%). Other patterns in decreasing order were intersected (25%), reticular (24%), and vertical lip patterns (22%), while the skeletal class II group showed branched pattern as most common (32%), followed in decreasing order by reticular (29%), intersected (25%), and vertical lip patterns (14%). No statistical significance was derived between lip pattern type and skeletal malocclusion[4][8].

Vatchala Rani RM et al (2022) examined if there is a correlation between the skeletal base connection and lip and dermal prints, as well as whether there is a significant variation between genders. The study showed Class III skeletal malocclusion individuals had vertical lip pattern, as opposed to the branching lip pattern seen in Class I and II. All three research populations, including the South Indian population, had right loop pattern. Class I individuals exhibited a greater number of a b ridges and a greater atd angle. The majority of males and females had branching lip patterns. They concluded that Dermatoglyphics and cheiloscopy can be used to investigate the genetic correlations of malocclusion and to prevent malocclusion at an early stage. They were simple, affordable, and noninvasive. However, they were not totally dependable because to other ethnic and environmental factors[4][4].

Relevance

RELEVANCE OF THE STUDY

The study is designed to explore the correlation of lip prints with skeletal base relationships in the Kerala population. Lip print assessment may aid the orthodontist as an early diagnostic tool, predicting the type of malocclusion and planning treatment at an appropriate time.

Methodology

METHODOLOGY

EQUIPMENTS USED

1. Intraoral scanner : 3 shape triose
2. Cephalostat   : Dentsply Sirona

MATERIALS USED:

1. A4 sheet paper
2. Ruler, protractor, Divider
3. 0.5 black lead pencil
4. Pretreatment lateral cephalograms

STUDY SETTING

Department of Orthodontics and Dentofacial Orthopaedics,

St.Gegorios Dental College, Kothamangalam**.**

Sample Size calculation

The sample size was calculated using the G Power Software V.3.9.7. Considering the effect size to be measured at 0.5 for 'χ^2 tests - Goodness-of-fit tests: Contingency tables' with degree of freedom 8 and, α err prob at 0.05. The total sample size was estimated at 59 with a power of 80%. The sample size was rounded of to 60 ,20 subject per group, so each containing 10 male and 10 female subjects.

Sampling Procedure:

χ^2 **tests -** Goodness-of-fit tests: Contingency tables

Analysis: A priori: Compute required sample size

Input:	Effect size w	= 0.5
	α err prob	= 0.05
	Power (1-β err prob)	= 0.79
	Df	= 8
Output:	Noncentrality parameter λ	= 14.7500000
	Critical χ^2	= 15.5073131
	Total sample size	= 59
	Actual power	= 0.7911594
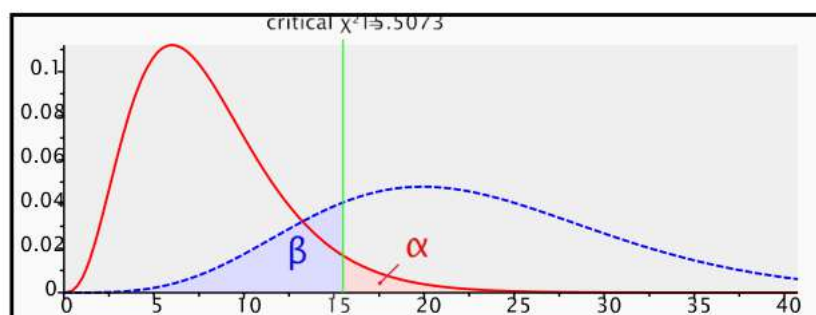
Inclusion Criteria

1　Individuals with Skeletal Class I, II, III Malocclusion
2　Individuals between the age range of 12-35years
3　Healthy and Co-operative individuals

Exclusion Criteria

1. Any previous history of Orthodontic treatment or Maxillofacial surgery.
2. Subjects with any developmental anomalies or pathologies of the lips and jaws.
3. Patients with restricted mouth opening.

Methodology

Detailed consent forms in English and Malayalam languages were made to explain the details of the study to all the subjects involved. Subjects who have consented for the study were requested to report to the Department of Orthodontics and Dentofacial Orthopedics, St Gregorios Dental college Chelad. The lips are scanned using a standardized intraoral scanner (3 Shape TRIOS). The following preparations were done to perform scanning on the subjects.

1. The tip of intraoral scanner was checked meticulously. It was ensured to be clean and clear to get an accurate image of the lip. After each use of the scanner, its tip was disinfected with alcohol pad(70% isopropyl alcohol)
2. External source of light was avoided in the working area, which may reduce the clarity of picture.
3. Subject was made to sit on the chair in an upright position and advised to relax the facial muscles.
4. Lip was kept clean, dry and moisture free
5. The Intraoral Scanning tip was kept in a comfortable position for the operator.
6. Lip was scanned completely and continuously with very slow running motion over the lip
7. After completing the lip scan, the image was verified in the computer.

8. The 3D print of the lip was oriented in the frontal view and the image was taken by using snipping tool and the image was analyzed on computer.

The middle part of the lower lip (10 mm wide) was taken as the study area[5] . Print outs of patterns were taken for record purpose. The groove patterns were then analyzed and classified according to Tsuchihashi and Suzuki classification[3].

The classification is as follows:

Type I   : Clear-cut grooves running vertically across the lips (Vertical)

Type I' : small vertical running groove

Type II : Fork grooves in their course (Branched)

Type III : Intersecting grooves

Type IV : Reticulate grooves

Type V   : Undetermined

Pretreatment cephalometric analysis of the subject were done to estimate the skeletal malocclusion by measuring ANB angle, Wits appraisal, and beta angle. The malocclusion was then compared with the lip print pattern of the subjects.

Fig 1: Intra oral scanner

Fig 2: Disinfection pad
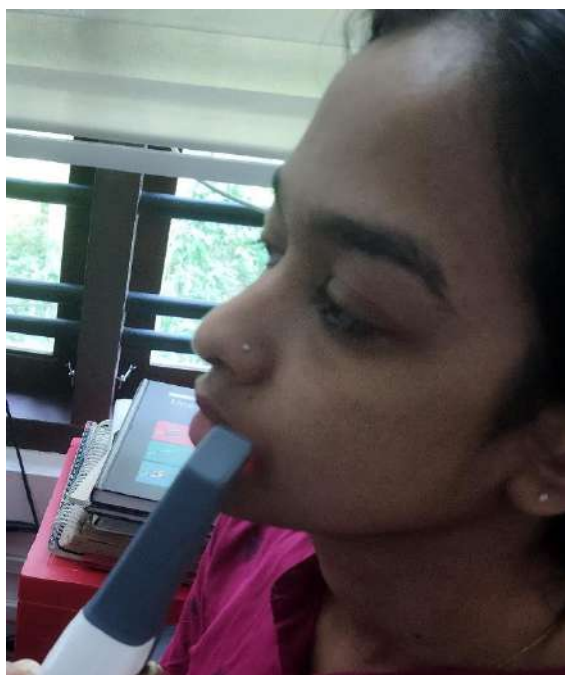
Fig 3: scanning of lip pattern by using Intaoral scanner
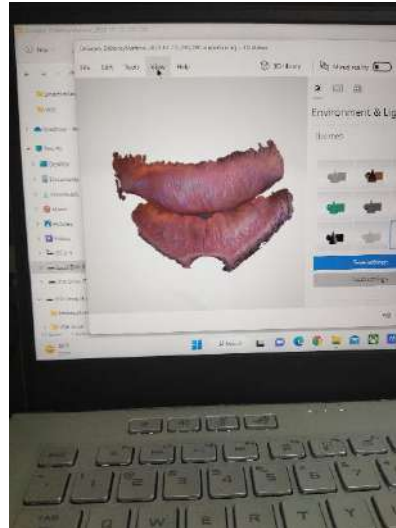
Fig 4: Checking of scanned data on computer

Fig 5: Collect the lip print by snipping tool and evaluate the lip pattern

Fig 6: Cephalostat (Dentsply Sirona) used to take lateral cephalography

Fig 7 : lateral cephalogram of subject

A   B

Fig 8 : Materials used for the study: (A)pencil , ruler, protractor and divider for tracing lateral cephalogram (B) Disinfection pad
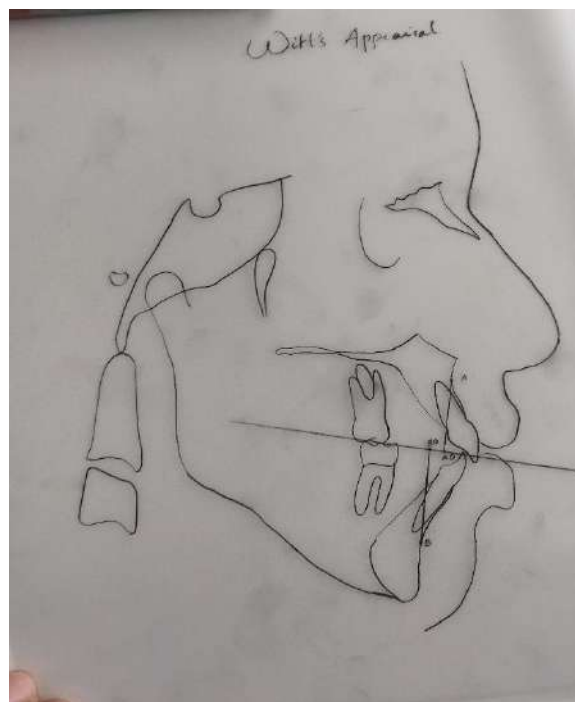
Fig 9: Tracing of lateral cephalogram for Witts appraisal

Fig 10: Tracing of lateral cephalogram to analyze the ANB angle

Fig 11: Tracing of lateral cephalogram to analyze the Beta angle

Results

RESULTS

This study involves the comparison of each malocclusion with associated lip prints. A prospective study was carried out among 60 individuals who were divided into three groups with 20 subjects in each group. The three groups included subjects with Skeletal Class I jaw base, Skeletal Class II jaw base and skeletal Class III jaw base. The mean age of the study subjects was 20.9 ± 5.2 years in Skeletal Class I , 21.4 ± 5.5 years in Skeletal Class II malocclusion and 20.5 ± 5.4 in skeletal Class III malocclusion.

Comparison of lip print in the study group

Table 2 compares the lip prints in study groups. Among 60 subjects, a majority of subjects (19) had reticular lip pattern followed by 16 subjects with vertical lip pattern , 9 subjects had intersected lip pattern, 9 subjects had branched lip pattern and 7 subjects had small vertical lip pattern.

Comparison of lip print in female study group

Among the 30 female study subjects, a majority of (10) subjects showed vertical lip pattern followed by 9 subjects with reticular lip pattern followed by 4 subjects each with small vertical and branched lip pattern. 3 subjects had intersected lip pattern.

 Comparison of lip pattern in male study group

Among the 30 male study subjects, a majority of (10) subjects had reticular lip pattern followed by 6 subjects each with vertical lip pattern and intersected lip pattern, 4 subjects showed branched lip pattern and 3 had small vertical lip pattern.

Comparison of Class I skeletal malocclusion with lip pattern

Among the 20 Class I subjects, most subjects had reticular lip pattern (6) followed by vertical lip pattern (5), intersected pattern (4), small vertical pattern (3), and branched pattern (2). In comparison of lip patterns of male and female Class I study group, the order of majority of lip pattern in male subjects were reticular pattern, followed by intersected pattern and vertical pattern. One subject each showed branched and small vertical pattern. In contrary to male subjects, majority of female subjects showed both vertical and reticular lip pattern equally, followed by subjects with small vertical lip pattern and equal subjects with branched and intersective lip pattern.

Comparison of Class II skeletal malocclusion with lip pattern

Among the 20 subjects of Class II skeletal malocclusion, a majority of subjects showed reticular type of lip pattern (7) followed by branched lip pattern (5), equal subjects with vertical and intersected lip pattern (3), and then small vertical pattern (2). In comparison of skeletal Class II malocclusion with lip print between female and male subjects, the order of majority of lip print in male subjects were reticular and branched pattern, followed by intersected pattern and then with equal subjects of vertical and small vertical lip pattern. In the order of lip print of female subjects, majority of subjects showed reticular lip pattern followed by equal subjects with vertical and branched lip pattern and then equal subjects with small vertical and intersected lip pattern.

Comparison of Class III malocclusion with lip pattern

Among the 20 subjects of Class III malocclusion, the majority of subjects showed vertical lip pattern (8), followed by reticular lip pattern (6) and then equal number of subjects (2 each) had small vertical, branched and intersected lip pattern . In comparison of skeletal Class III lip pattern between male and female subjects, the order of majority of lip pattern in male subjects were reticular lip pattern, followed by vertical lip pattern and then equal number of subjects showed small vertical lip pattern, branched and intersected lip pattern. In contrary, most female subjects showed vertical lip pattern, followed by reticular lip pattern and then equal number of subjects with small vertical lip pattern, branched and intersected lip pattern.

Relevance of type I (vertical) lip pattern in different types of skeletal malocclusions.

Among the subjects with vertical lip pattern, majority belonged to Class III malocclusion (8) followed by Class I (5) and Class II (3) respectively. In Class I malocclusion with vertical lip pattern, male subjects were more in number than female subjects. In contrary, the Class II skeletal malocclusion showed increase in number of female subjects while Class III skeletal malocclusion showed equal number of male and female subjects.

Relevance of type I' (small vertical) lip pattern in different types of skeletal malocclusions.

Among the subjects with small vertical lip pattern, majority of subjects belonged to Class I malocclusion (3), followed by equal subjects (2each) with skeletal Class II and Class III malocclusions. In Class I malocclusion with small vertical lip pattern, female subjects were more in number than male subjects. In contrary, the small

vertical lip pattern in subjects with skeletal class II and Class III malocclusion showed equal prevalence of male and female subjects.

Relevance of type II lip pattern in different types of skeletal malocclusions.

Among subjects with branched lip pattern, majority of subjects belonged to Class II skeletal malocclusion (5), followed by Class I (2) and Class III skeletal malocclusion (2) respectively. In Class I malocclusion with branched lip pattern, female subjects were more in number than male subjects. In contrary, Class II skeletal malocclusion with branched lip pattern showed increase in number of male subjects than female subjects, while Class III skeletal malocclusion with branched lip pattern showed equal prevalence of male and female subjects.

Relevance of type III lip pattern in different types of skeletal malocclusions.

Among subjects with intersected lip pattern, majority of subjects belonged to Class I skeletal malocclusion (4), followed by Class II (3) and Class III skeletal malocclusion (2) respectively. In Class I skeletal malocclusion with intersected lip pattern, male subjects were more in number than female subjects. In contrary, Class III skeletal malocclusion with intersected lip pattern showed increase in number of female subjects than male subjects, while Class II malocclusion with intersected lip pattern showed equal prevalence of male and female subjects.

Relevance of type IV lip pattern in different types of skeletal malocclusions.

Among subjects with reticular lip pattern, majority of subjects belonged to Class II skeletal malocclusion (7) followed by Class I (6) and Class III skeletal malocclusions (6) respectively. In class I skeletal malocclusion and Class II skeletal malocclusions with reticular lip pattern, female subjects were more in number than male subjects, while in Class III skeletal malocclusion with reticular lip pattern, males showed more prevalence than females.

TABLES

	CLASS I		CLASS II		CLASS III		total
	MALE	FEMALE	MALE	FEMALE	MALE	FEMALE	
TYPE I	2	3	1	2	3	5	16
TYPE I'	1	2	1	1	1	1	7
TYPE II	1	1	3	2	1	1	9
TYPE III	3	1	2	1	1	1	9
TYPE IV	3	3	3	4	4	2	19

Tab 1 : Samples size of each group

Lip print groove patterns	Skeletal Malocclusion			P Value
	CLASS I	CLASS II	CLASS III	
TYPE I	5 (25%)	3 15%)	8 (40%)	
TYPE I'	3 (15%)	2 (10%)	2 (10%)	
TYPE II	2 (10%)	5 (25%)	2 (10%)	
TYPE III	4 (20%)	3 (15%)	2 (10%)	0.71
TYPE IV	6 (30%)	7 (35%)	6 (30%)	
Total	**20 (100%)**	**20 (100%)**	**20 (100%)**	

Tab 2: Statistical analysis of the association between lip pattern and malocclusions by using Chi Square test

<u>GRAPHS</u>
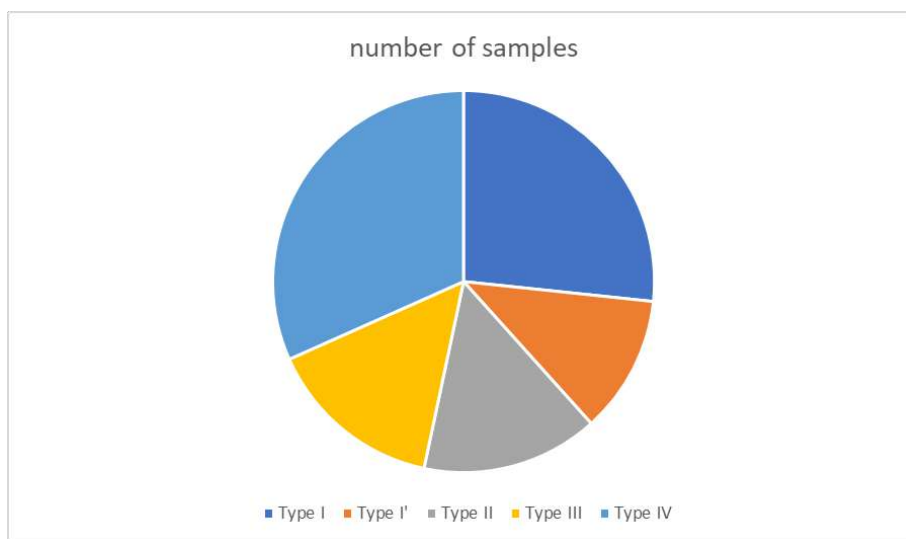
Graph 1 : **Lip pattern samples of total population**
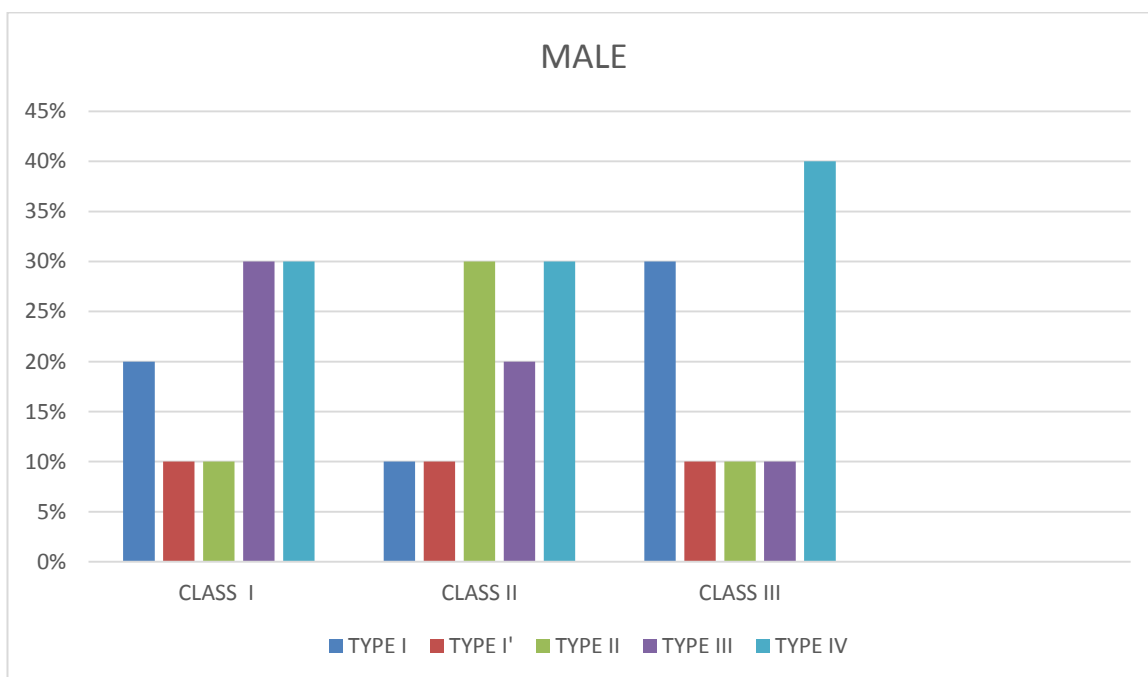
Graph 2: **Comparison of lip pattern in male study group**
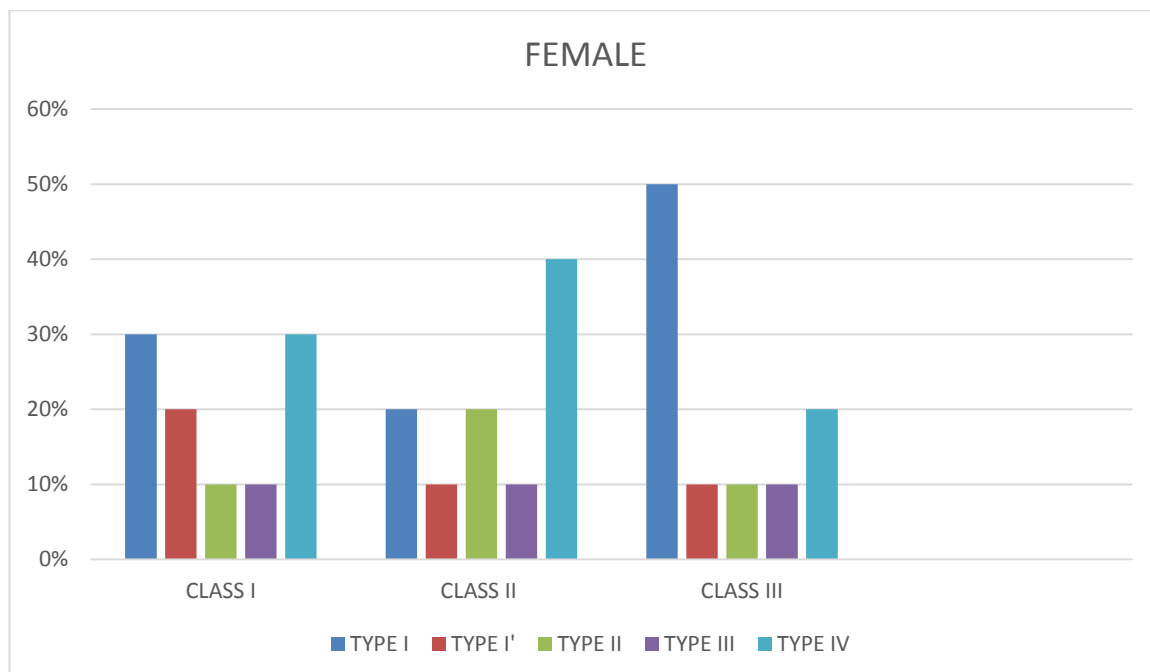
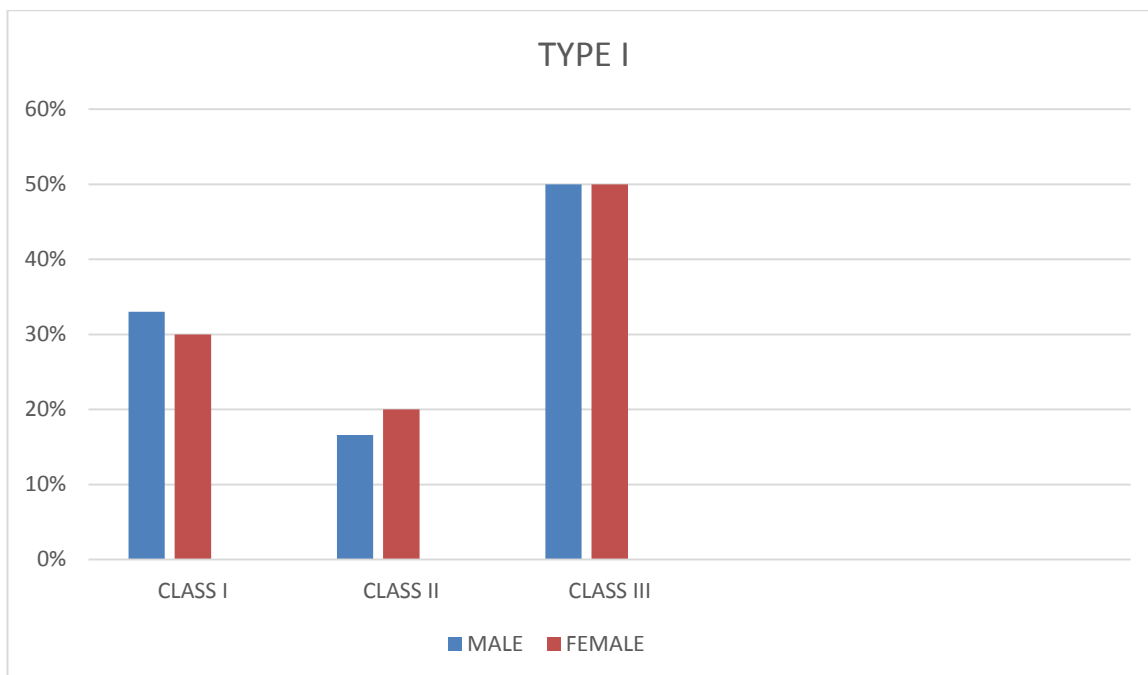Graph 3: **Comparison of lip print in female study group**
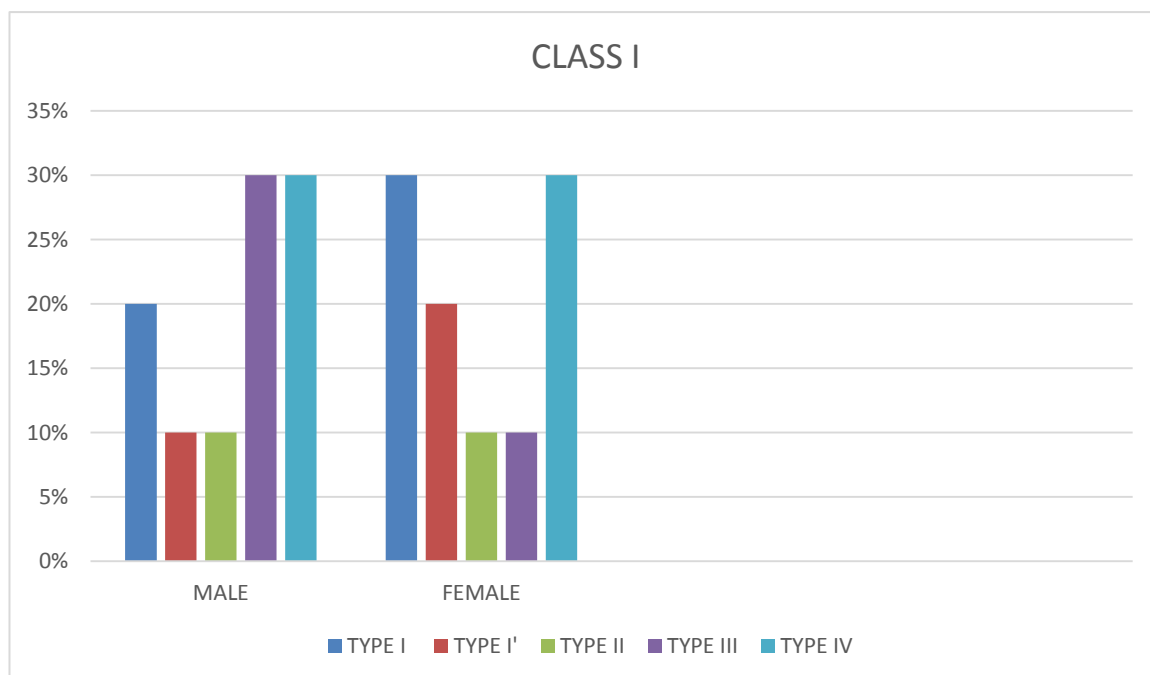
Graph 4 : **Comparison of Class I skeletal malocclusion with lip pattern**
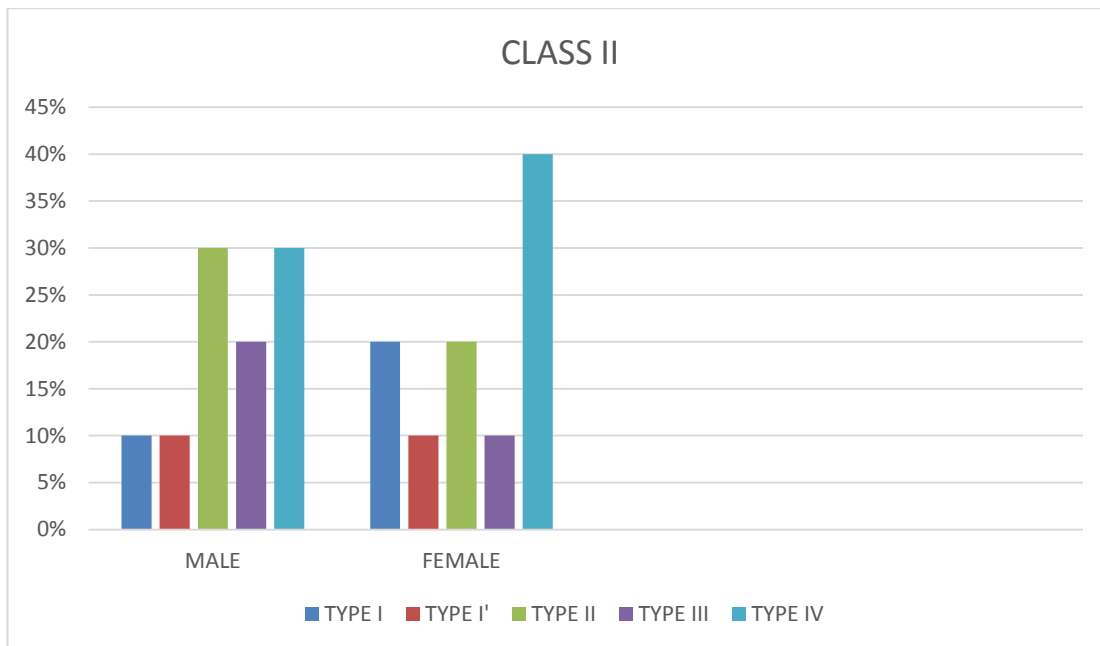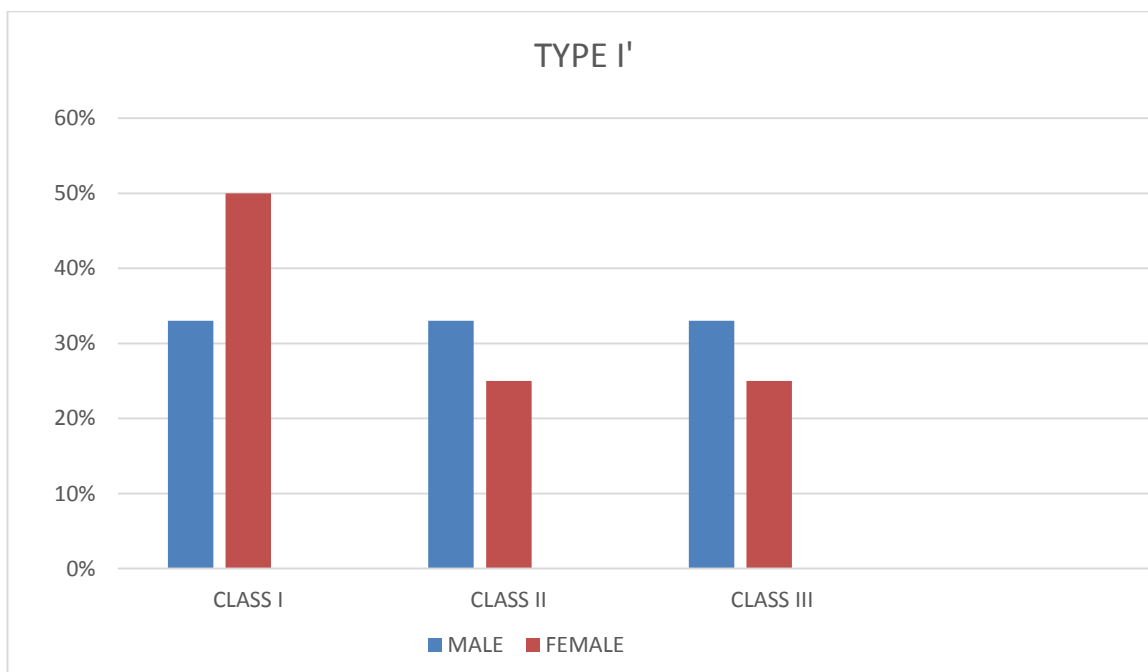
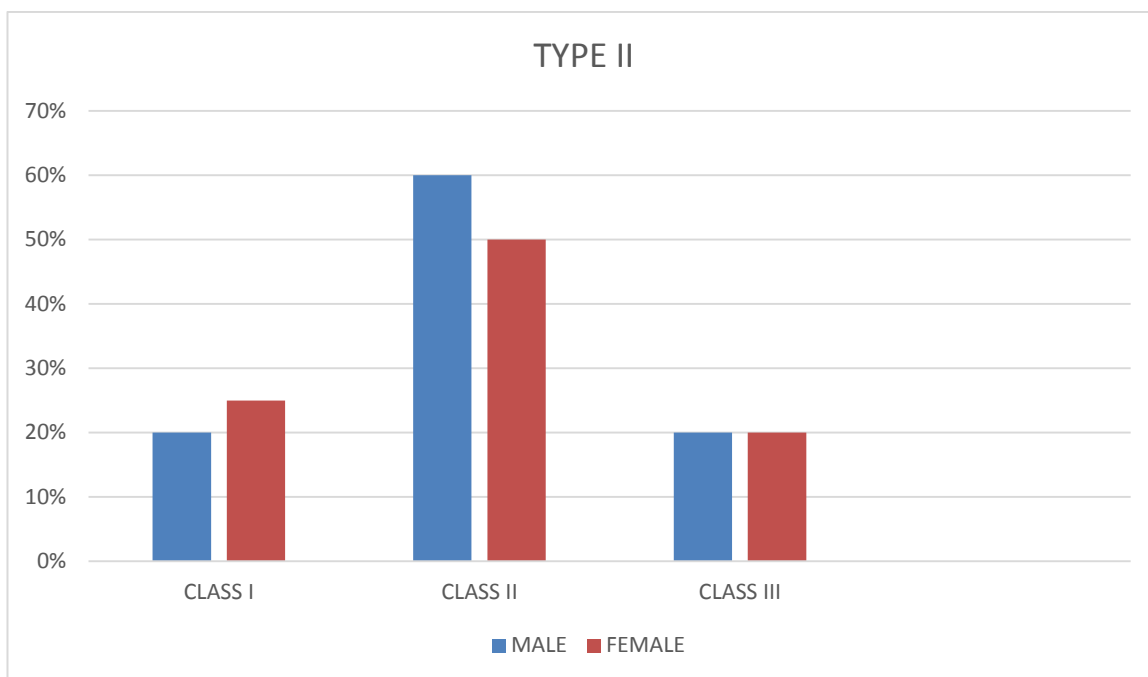Graph 5 : **Comparison of Class II skeletal malocclusion with lip pattern**
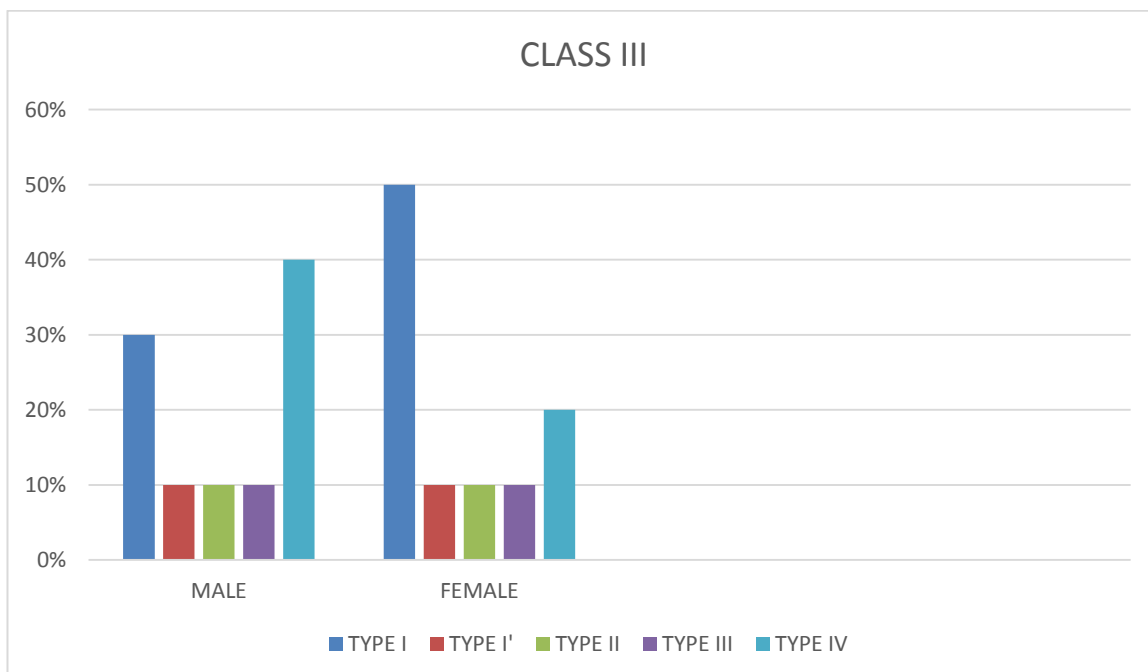
Graph 6 **: Comparison of Class III malocclusion with lip pattern**

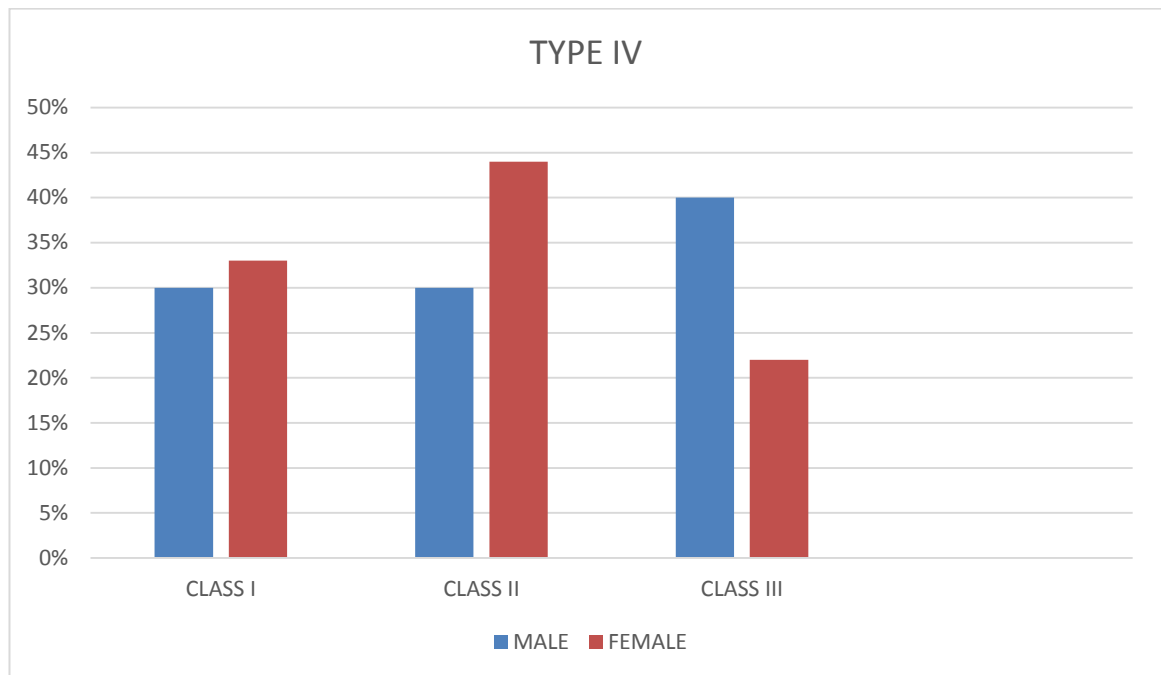Graph 7 **: Relevance of type I lip pattern in different types of skeletal malocclusions.**

Graph 8 : **Relevance of type I' lip pattern in different types of skeletal malocclusions.**

Graph 9 : **Relevance of type II lip pattern in different types of skeletal**

malocclusions.

Graph 10 : **Relevance of type III lip pattern in different types of skeletal**

malocclusions.

Graph 11: **Relevance of type IV lip pattern in different types of skeletal**

malocclusions.

Discussion

DISCUSSION

Lip prints consist of normal lines and fissures, wrinkles and grooves which are present in between the inner labial mucosa and outer skin. It is unaltered from sixth week of intrauterine life till death[2]. Alike finger print, lip prints vary from individual to individual.

The study of lip prints is called Cheiloscopy. The term 'Cheiloscopy' is derived from the Greek words; cheilos, 'lips' and ekopein, 'to see'[3]. Lip print patterns play an important role as they bear a unique identification while the only exception being monozygotic twins. These lip print patterns are identifiable at 6th week of intrauterine life and persist unchanged throughout life, even after episodes of Herpes. Lip print patterns have been widely studied in association with various orofacial and dental conditions like early childhood caries, malocclusion, periodontal diseases, cleft lip and palate, and premalignant lesions and conditions.

These patterns have been classified by many investigators

(I) Suzuki and Tsuchihashi classification[3]:

1. Type I: Vertical groove across lips

2. Type I': Partial groove pattern

3. Type II: Branched

4. Type III: Intersected pattern

5. Type IV: Reticular pattern

6. Type V: Other lip patterns

(II) Afchar Bayat classification :

1. A1 (straight vertical grooves covering entire lip surface);

2. A2 (vertical straight grooves not covering entire lip surface;

3. B1 (branched angulated grooves);

4. B2 (branched angulated grooves);

5. C (converging grooves);

6. D (reticular groove pattern), and

7. E (other patterns).

(III) Renaud's classification

1. Type A (complete vertical groove pattern);

2. Type B (vertical incomplete);

3. Type C (completely bifurcated);

4. Type D (incompletely bifurcated);

5. Type E (completely intersecting);

6. Type F (incompletely intersecting);

7. Type G (reticular pattern);

8. Type H (sword shaped pattern);

9. Type I (horizontal pattern) and

10. Type J (other lip print patterns).

(IV) Santos classification

1. Simple and

2. Compound types.

The simple type was further classified into

(i)   Straight lined;

(ii)   Curved lined;

while the compound type was subclassified into

(i)   Bifurcated pattern;

(ii)   Trifurcated pattern and

(iii)   Anomalous pattern.

The embryological development of palate, alveolus, and lip takes place at the same time. Any disturbance during this period can affect all these structures. Similarly, development of skeletal jaw bases which includes skeletal Class I, Class II and Class III jaw bases, may also be associated with alteration in lip pattern. Malocclusion can be measured by qualitative and quantitative methods. Qualitative assessment was done in this study. Skeletal malocclusions were measured by using beta angle, ANB angle and Witt's appraisal.

The Beta angle is a used for assessing the skeletal discrepancy between the maxilla and the mandible in the sagittal plane. It uses 3 skeletal landmarks—point A, point B, and the apparent axis of the condyle (C) to measure an angle that indicates the severity and the type of skeletal dysplasia in the sagittal dimension. Beta angle between 27º and 35º is considered as Class I skeletal pattern, beta angle more than 35º is considered as class III and beta angle less than 27ºis considered as Class II skeletal pattern.

ANB is the angular measurement proposed by Riedd. This angle is used to define sagittal discrepancy between maxilla and mandible. ANB angle between 0 and 4° is considered as 'skeletal class I' jaw relation while an ANB angle more than 4° is considered as 'skeletal class II' relation. The ANB angle less than 0º is considered as 'skeletal class III' jaw relation.

Witt's appraisal is a measure of jaw relation in an antero-posterior plane. For assessing the degree of jaw disharmony, the occlusal plane is drawn through the region of maximum cuspal interdigitation on the lateral cephalogram. Perpendiculars are drawn on the tracing from points A and B on the maxilla and mandible respectively. The point of contact on the occlusal plan from points A and B are labelled AO and BO respectively, and their linear distance is measured.

The Klein zone of vermillion border of lip is the area of concern in this study. It is covered with lip patterns or grooves. There are different approaches of recording lip prints such as lipstick-paper-cardboard method, photography, lipstick-paper method,

lipstick-cellophane method, using dental impression materials to make three-dimensional casts of the lips, or using intraoral dental scanner to make a three-dimensional view of lip. The intraoral scanner method was used in this study.

Many studies showed that the predominant lip pattern varied depending upon various ethnic groups. Suzuki and Tsuchihashi et al, investigated lip pattern of Japanese population and revealed that intersected lip pattern was the commonest in both female and male group followed in order by vertical, branched and reticular pattern[4] .

The present study showed predominance of reticular lip pattern in Keralite population. This variation may be due to the racial difference between Dravidians and Mongolians. The second most common type of lip pattern according to this study includes vertical lip pattern followed by branched, intersected and small vertical lip pattern. In the comparison of skeletal malocclusion and lip print, reticular lip pattern predominated in most of the skeletal malocclusions.

Dr Sandhya Jain et al, in her study concluded that the most common type of lip pattern in Class I malocclusion was reticular pattern in male subjects while her study also showed vertical lip pattern common in female subjects[4,6] . In this study, Keralite female subjects showed equal prevalence of both vertical and reticular lip pattern in skeletal Class I malocclusion.

Anuradha Pandey et al in her study on north Indian population, concluded that branched lip pattern predominated in skeletal Class II malocclusion followed by reticular lip pattern[4,8] . In contrary, this study in Keralite population showed reticular lip pattern as most common lip pattern in skeletal Class II malocclusion and second most common being branched lip pattern. The changes in the results is attributed to the variation in ethnicity of the population.

In this study, lip print analysis of Keralite population with skeletal Class III malocclusion showed predominant vertical lip pattern. The same inference was drawn by **Vatchala Rani** et al in her study group[4,4] . Similarly, **Raghav et al** in his study concluded that type I, vertical lip pattern predominated in skeletal Class III malocclusion[6] .

Statistical analysis of this study in Keralite population showed no significant relationship between the skeletal malocclusion and lip pattern. However, some studies showed a relationship between skeletal malocclusion and lip prints.

The present study involves the comparison of each malocclusion with various lip print patterns. Irrespective of the type of malocclusion, it was found that most subjects had reticular lip print pattern. In females, the vertical lip print pattern had a high incidence, as much as the vertical pattern.

The Class I and Class II skeletal malocclusions in this study showed more of reticular lip print pattern while Class III skeletal malocclusion showed more of vertical lip print pattern.

Thus, the result of the study are in contradiction to many other studies which shows more of vertical lip pattern in Class I and Class II malocclusion. This may be attributed to the ethnical variation of the study groups. But the results are in the line with other studies in case of Class III skeletal malocclusion, where it shows more of vertical lip print pattern.

Cheiloscopy has been a subject of great interest to most researchers, as it is noninvasive, economical and do not require any complex instrumentation for study purpose. Since lip prints get established before sagittal jaw and dental relationships, lip print assessment may aid the clinical orthodontist to predict the type of malocclusion. Lip prints can be used as an additional diagnostic aid for early detection of skeletal malocclusions. It is advisable that the clinician take a note of lip print pattern of patients during their routine record taking procedures. Cheiloscopy can act as an early indicator of skeletal malocclusions, but extensive research is needed for the evaluation of lip prints in larger samples of different inherited malocclusions to substantiate the correlation between lip patterns and skeletal malocclusions.

Conclusion

<u>CONCLUSION</u>

Cheiloscopy is considered as a predictor of many oro-facial and dental diseases. Its association has been proven with numerous developmental problem such as malocclusions, in both primary and permanent dentitions. Cheiloscopy, if proved, can serve as an easy, accessible, inexpensive and noninvasive method of exploring the genetic associations of malocclusion and for timely prevention. Numerous factors such as ethnic and racial variations, environmental, congenital and other local factors influence the development of malocclusions. Extensive studies of lip prints patterns must be done with several groups according to their racial and ethnic backgrounds which will help to get a clear picture about their association.

The result of this study gives us an insight into the association between skeletal malocclusion and lip patterns. Extensive genetic studies like twin study, familial studies may help in establishing any genetic relationship between the malocclusion and lip pattern.

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Annexures

ANNEXURES

Annexure 1: Informed Consent

സമ്മതപത്രം

സെന്റ് ഗ്രീഗോറിയോസ് ഡെന്റൽ കോളേജിലെ, ഓർത്തോ ഡോണ്ടിക്സ് വിഭാഗം നടത്തുന്ന സ്കേലേറ്റൽ മാൽ ഒക്ലൂഷൻ ആൻഡ് ലിപ് പ്രിന്റ്സ് - എ കോംപാരറ്റിവ് സ്റ്റഡിയിൽ എന്റെ മകൾ/ മകൻ .... പങ്കെടുക്കുവാൻ എനിക്ക് സമ്മതമാണ്. പഠനത്തെക്കുറിച്ചുള്ള എല്ലാ വിവരങ്ങളും എനിക്ക് അറിയാവുന്ന ഭാഷയിൽ എന്നോട് വിവരിച്ചിട്ട്. ഏത് ,നിമിഷവും, പഠനത്തിൽ നിന്നും പിൻമാറാം എന്നും , ഇത് തുടർന്നുള്ള എന്റെ മകളുടെ / മകന്റെ ചികിത്സയെ ബാധിക്കില്ല എന്നും, ചികിത്സാ വിവരങ്ങളുടെ സ്വകാര്യത നഷ്ടപ്പെടുത്താതെ സൂക്ഷിക്കു മെന്നും ഉറപ്പ് നൽകിയിട്ട്. ഇതിന്റെ ഭാഗ മായി ലിപ് പ്രിന്റ് എടുക്കുന്നതിനും, പ്രസിദ്ധീകരണങ്ങളിൽ പബ്ലിഷ് ചെയ്യുന്നതിനും എനിക്ക് സമ്മതമാണ്.

പേര്

ഒപ്പ് / വിരലടയാളം

രക്ഷകർത്താവിന്റെ പേര്

ഒപ്പ് / വിരലടയാളം

തീയതി

പരിശോധകന്റെ പേര് ഒപ്പ്

അഡ്രസ്സ്

സാക്ഷിയുടെ പേര്

ഒപ്പ് /വിരലടയാളം

ഡോക്ടർ ....
പി.ജി സ്റ്റുഡന്റ്

ഡോക്ടർ ....
പ്രൊഫസ്സർ / ഗൈഡ്

ST. GREGORIOS DENTAL COLLEGE

UNDER THE MANAGEMENT OF MJSCE TRUST, PUTHENCRUZ

CHELAD , KOTHAMANGALAM, ERNAKULAM DIST, KERALA - 686681

Sgdc/152/2021/4017

17/02/2021

ETHICAL CLEARANCE CERTIFICATE

To,

Dr. Sarjin S
St. Gregorios Dental College
Chelad, Kothamangalam

Dear Dr. Sarjin S
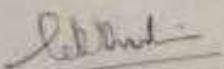
Subject: Ethics Committee Clearance-reg

Protocol: Skeletal Malocclusion and Lip prints – A
Comparative study.

At the Institutional Ethics Committee (IEC) held on 15th of January 2021, this study was examined and discussed. After consideration, the committee has decided to approve and grant clearance for the aforementioned study.

The members who attended the meeting at which the protocol was discussed were:

1) Dr .C.K.K Nair - Former BARC Scientist
2) Dr.Cinu Thomas A - Scientist, Vice Principal, Caritas College of Pharmacy.
3) Dr. Lissy Jose – Former member of Women's welfare Association.
4) Adv. Jose Aranjani – Advocate.
5) Dr. Sauganth Paul – Reader, Department of Biochemistry, St. Gregorios Dental College.
6) Dr. Eapen Cherian – Secretary, Professor, St. Gregorios Dental College
7) Dr. Jain Mathew – Principal and Head of the Department, Department of Conservative Dentistry and Endodontics.
8) Dr. George Francis – Head of the Department, Department of Prosthodontics and Crown and Bridge.
9) Dr. Binoy Kurian – Head of the Department, Department of Orthodontics and Dentofacial   Orthopaedics.

Dr. C.K.K Nair
Chairman Institutional Ethics Committee
St Gregorios Dental College, Chelad.

Dr. Eapen Cherian
Secretary

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ACKNOWLEDGEMENT

I thank my wife, **Pavitha P** for being so understanding. I greatly value her contributions and deeply appreciate her belief in me.

Dr. SARJIN S

LIST OF ABBREVIATIONS USED

ANB	Subnasal, Nasion, Supramental
Df	Degree of freedom
Fig	Figure
χ^2	Chi square