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INTERMOLAR AND INTERCANINE WIDTH CHANGES FOLLOWING ORTHODONTIC TREATMENT WITH MAXILLARY AND MANDIBULAR FIRST PREMOLAR EXTRACTIONS IN DIFFERENT FACIAL PATTERNS

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ABSTRACT

Arch forms of maxillary and mandibular arches vary in different facial types. The purpose of this study is to compare the arch width changes in patients treated with fixed orthodontic mechanics with maxillary and mandibular first premolar extractions in different facial types. This retrospective study was conducted on pre-and post-treatment study models of 15 subjects who had undergone orthodontic treatment. They were equally divided into Vertical, Horizontal and Average facial patterns. Intercanine and Intermolar distances were measured using a Digital Vernier calliper. After orthodontic treatment, the Intercanine widths of both upper and lower arch increased and the maximum increase is seen in the Horizontal group in the maxillary arch (1.88mm) and in the Average group in the mandibular arch (1.5mm).TheIntermolar widths in maxilla narrowed more in Vertical facial pattern (-1.7mm) followed by average (-1.44mm) and least in horizontal facial types (-0.25mm). Even in the mandibular arch, Vertical facial pattern shows the maximum narrowing of the intermolar widths (-2.16mm). However the association of facial patterns on arch width changes was not statistically significant proving that the arch width changes post orthodontic treatment are not dependent on the facial pattern of a person.

INTRODUCTION

Dental arch width and facial form are important factors for determining success and stability of orthodontic treatment [1].Widening dental arches improves smile attractiveness as large buccal corridors have a negative effect on smile esthetics. Hence, it is believed that treatments which narrow the dental arches such as therapeutic premolar extractions can result in poor smile esthetics.

Hawley [2] stated that the ideal arch width is based on an equilateral triangle with a base representing the intercondylar width. The lower anterior teeth are arranged on an arc of a circle with a radius determined by the combined width of the lower incisors and canines, with the premolars and molars aligned with the second and third molars toward the center.

Factors that may influence post treatment changes are usually attributed to the type of treatment or to biological mechanisms, however facial patterns may also influence post treatment changes [3]. Facial morphology has been accepted to be the result of a person's genotype and its phenotypic expression. It is also commonly believed that there is an interaction between the functional capacity and the size of masticatory muscles and craniofacial form [4]. Three basic types of facial morphology exist: horizontal (short), average, and vertical (long). People with a long/vertical facial pattern have an excessive vertical facial growth which is usually associated with an anterior open bite, increased sella-nasion–mandibular plane (SN-MP) angle, increased gonial angle, and increased maxillary/mandibular plane angle. The short/horizontal facial patterns have a reduced vertical growth that is accompanied by a deep overbite, reduced facial heights, and reduced SN-MP angle. Between the two patterns lies the average facial pattern [5]. Investigators have suggested that various facial patterns behave differently in terms of growth and treatment response [6–8].

Arch forms of maxillary and mandibular arches vary in different facial patterns and the influence of premolar extractions followed by orthodontic treatment needs to be investigated. Our extensive research expertise ranged from epidemiological studies to randomised clinical trials that have been published in reputed journals [9–18]. This knowledge was instrumental for us to compare the arch width changes in patients treated with fixed orthodontic mechanics with maxillary and mandibular first premolar extractions in different facial patterns.

Materials And Methods

3.1 Study Design

The present study was conducted in a hospital in Chennai as a University/Hospital based study to compare the arch width changes in patients treated with fixed orthodontic mechanics with maxillary and mandibular first premolar extractions in different facial patterns. This retrospective study was done with the use of study models of 15 patients that

attended the hospital for treatment. The study was initiated after approval from the institutional review board.

3.2 Sampling

This retrospective study was conducted on pre treatment (T1).and post-treatment (T2) study models of 15 subjects of different facial patterns who had undergone orthodontic treatment. Intercanine and Intermolar distances were measured using a Digital Vernier callipers.

3.3 Inclusion Criteria

Angles Class 1 malocclusion patients with crowding treated with first premolar extractions. None of the patients had pre-existing facial asymmetries, congenitally missing teeth or congenital anomalies.

3.4 IdentificationOf Facial Patterns

The case records were divided into 3 groups according to their facial patterns: Vertical, Average or Horizontal and each group had 5 patients each. The facial types were determined based on;

-The ratio of the posterior facial height to the anterior facial height

-The inclination of the mandibular plane in relation to the anterior cranial base

-The inclination of the mandibular plane in relation to Franfurt's horizontal plane

-Measurement of SN-Gn angle to identify facial patterns (Table 1)

Table 1: Measurement of SN-Gn angle to identify facial patterns

Facial pattern	SN - Gn angle
Vertical	> 32 degrees
Average	29-32 degrees
Horizontal	< 29 degrees

3.5 Arch Width Measurements

Records available for each patient were lateral cephalograms and study models obtained prior to and immediately following orthodontic treatment. Intercanine and Intermolar distances were measured using a Digital Vernier calliper (Figure 1). The Intercanine width was measured between the canine cusp tips and the Intermolar width was measured between the mesiobuccal cusp tips of the first molars. In the maxillary arch models, C1and C2 are the intercanine widths measured pre and post treatment respectively. Similarly M1 and M2 are the intermolar widths measured pre and post treatment respectively. The difference between C1 and C2 was calculated and averaged. The same was done for the M1 and M2 in all the three growth patterns. This calculation was also done for the mandibular arch using C3, M3 measurement for pre treatment models and C4 and M4 measurements for post treatments models. The difference was measured and averages were calculated for

comparison as D1, D2, D3, D4 for all 5 patients in each of the 3 groups. Mandibular and maxillary arch width changes were evaluated within and between groups (Table 2).

Table 2: Method of calculation of measurement

Maxilla	**Pre-treatment**	**Post treatment**	**Difference**	**Average**
Intercanine	C1	C2	C1- C2	D1
Intermolar	M1	M2	M1-M2	D2
Mandible	**Pre - treatment**	**Post treatment**	**Difference**	**Average**
Intercanine	C3	C4	C3-C4	D3
Intermolar	M3	M4	M4-M3	D4

Figure 1: Intercanine and Intermolar arch width measurements using a Digital Vernier caliper

3.6 Statistical Analysis

The collected data was validated, tabulated and analysed with Statistical Package for Social Sciences for Windows, version 20.0 (SPSS Inc., Chicago, IL, USA) and results were obtained. One way ANOVA test was used to evaluate the associations between intercanine and intermolar arch width changes, post orthodontic treatment in patients with vertical, average and horizontal facial patterns. P value < 0.05 was considered statistically significant.

4. ResultsAnd Discussion:

The purpose of this study is to compare the arch width changes in patients treated with fixed orthodontic mechanics with maxillary and

mandibular first premolar extractions in different facial patterns. After orthodontic treatment, the Intercanine widths of both upper and lower arch increased and the maximum increase was seen in the Horizontal group in the maxillary arch (1.88) and in the Average group in the mandibular arch (1.5). The Intermolar widths in maxilla narrowed more in Vertical facial pattern (-1.7) followed by average (-1.44) and least in horizontal facial pattern (-0.25). Even in the mandibular arch, Vertical facial pattern shows the maximum narrowing of the intermolar widths (-2.16). (Table 3)

Akyalcinet al. [19] measured anterior maxillary (intercanine) arch widths using the points immediately distal to the incisive papilla and middle maxillary arch widths using the third lateral and medial rugae on the midpalatal raphe to measure the same point at the dental arch.However, these anatomical landmarks are only useful for maxillary measurements. In this study, cusp tips of canines were used for pre and post treatment measurement of intercanine width(C1,C2,C3,C4) and the mesiobuccal cusp tips of the first molars were used to calculate the pre and post treatment measurement of intermolar width (M1,M2,M3,M4) of the maxillary and mandibular arch.

The C1 and C2 difference among different facial patterns reveals that the intercanine widths in maxilla are increased and the maximum increase is seen in the Horizontal group (1.88). One way ANOVA test was done and association was found to be statistically not significant p value- 0.378 (>0.05) (Figure 2).

The M1 and M2 difference among different facial patterns reveals that the intermolar widths in maxilla narrowed more in Vertical facial pattern (-1.7) followed by average (-1.44) and least in horizontal facial pattern (-0.25). One way ANOVA test was done and association was found to be statistically not significant with p = 0.253 (>0.05) (Figure 3). In orthodontic treatment with extraction, a decrease in the distance between the first molars may occur as the first molars move forward and inward to close the extraction spaces.[20]

The C3 and C4 difference among different facial patterns reveals that the intercanine widths in mandible increased and the maximum increase is seen in the Average group (1.5). One way ANOVA test was done and association was found to be statistically not significant with p = 0.779 (>0.05) (Figure 4).

The M3 and M4 difference among different facial patterns reveals that patients with vertical facial patterns showed the maximum narrowing of the intermolar widths (-2.16). One way ANOVA test was done and association was found to be statistically not significant with p = 0.906 (>0.05) (Figure 5).

In a study conducted by Oz AA[20], he found that the Intercanine (anterior) and the Intermolar (posterior) arch widths increased significantly in patients without extraction and patients with upper first premolar extraction only. Intercanine (anterior) arch width in the maxilla increased in patients with upper and lower first premolar extractions, but the increases were not statistically significant. Changes in theIntercanine (anterior) arch width were higher in patients without extraction and patients with upper first premolar

extraction only when compared to those with upper and lower first premolar extractions. There was no statistically significant difference in mandibular arch changes. However, he did not associate the arch width changes with facial types.

In a study conducted by Gianelly[21] changes in anterior (intercanine) and posterior (intermolar) dental arch width after extraction and nonextractiontherapy were evaluated and compared statistically to determine whether the dental arches were narrower after extraction treatment. Measurements were made in the canine and the molar regions from the most labial aspect of the buccal surfaces of the canines and the molars. In both groups, anterior and posterior arch widths were the same except for the mandibular intercanine dimension, which was 0.94 mm larger ($p < .01$) in the extraction group. This indicated that narrow dental arches are not a systematic outcome of extraction therapy. In another study, by Isik et al. [22]intermolar, interpremolar, and intercanine distances were measured before and after orthodontic treatment with and without extraction. While intercanine maxillary arch width was unaffected by treatment modality, increases in interpremolar and intermolar maxillary arch widths were significantly higher with nonextraction treatment protocol when compared to extraction treatment.

Limitations of the study include a retrospective design of the study, randomization and blinding not done, restricted sample size, measurements were made on plaster models, sample size calculations were not performed, intraobserver reliability was not performed and gender distribution was not uniform. However, most of the studies have evaluated only changes in maxillary arch width following orthodontic treatment; this study, on the other hand measured changes in both the maxillary and mandibular arches to better evaluate how both arches are affected by extraction as compared to the maxillary arch only.

Table 3: Intercanine and Intermolar arch width changes in all three facial patterns.

MAXILLA	**Intercanine D1**	**Intermolar D2**
Vertical (Group 1)	+0.24	-1.7
Average (Group 2)	+1.12	-1.44
Horizontal (Group 3)	+1.88	-0.25
MANDIBLE	**Intercanine D3**	**Intermolar D4**
Vertical (Group 1)	+0.89	-2.16

Average (Group 2)	+1.5	-1.84
Horizontal (Group 3)	+0.29	-1.60

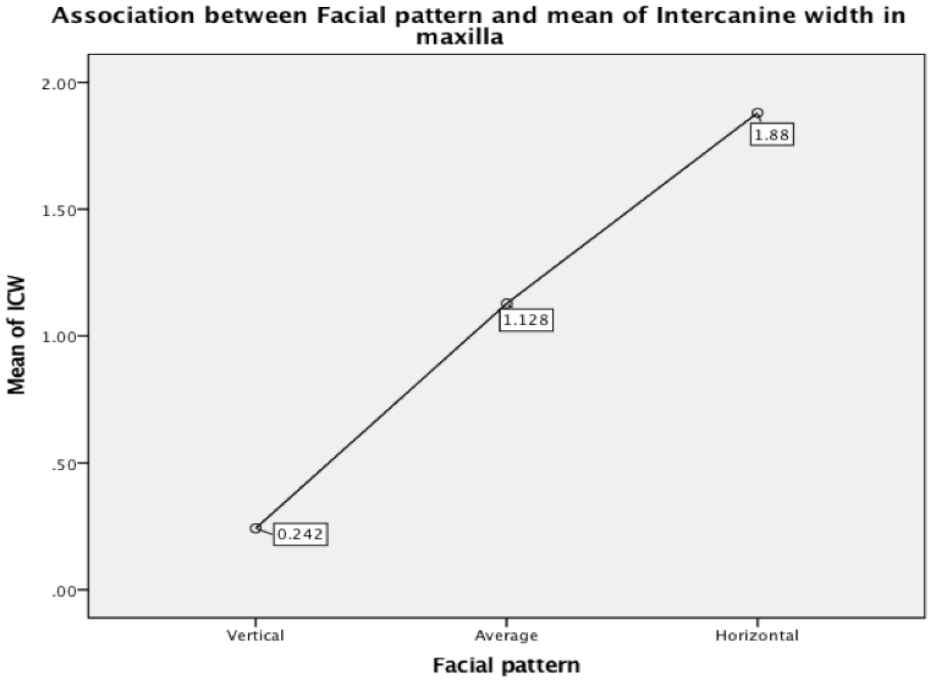

Figure 2: Mean plot graph depicting the association between the facial pattern and the mean of the intercanine width in maxilla. X axis represents the facial pattern and Y axis represents the Mean of Intercanine width. The Intercanine widths in maxilla increased and the maximum increase is seen in the Horizontal group (1.88). One way ANOVA test was done and association was found to be statistically not significant. One way ANOVA test; p = 0.378 (>0.05) statistically not significant, proving that the Intercanine width of maxilla is not dependent on the facial pattern of a person.

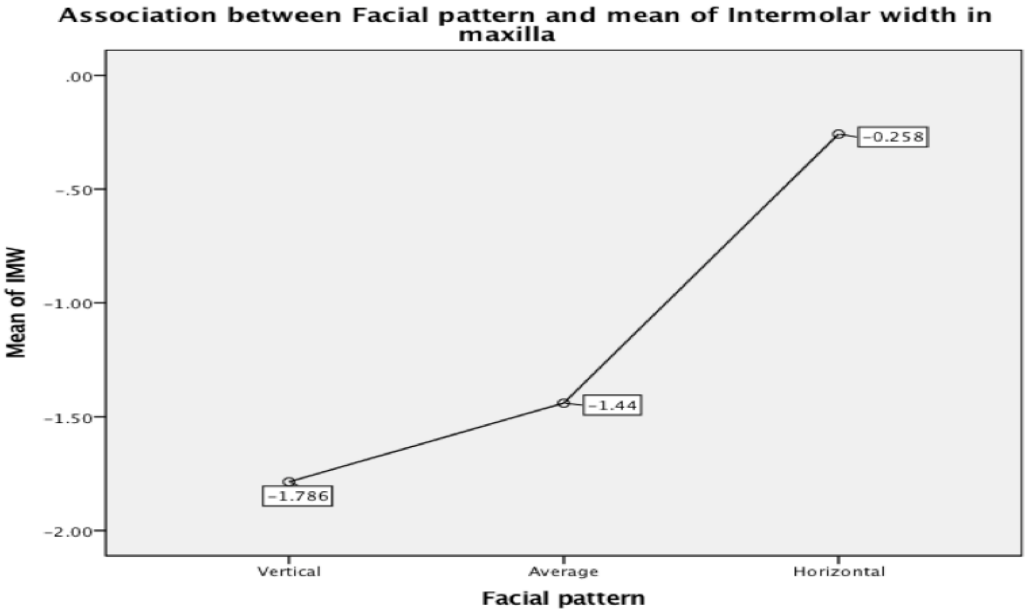

Figure 3: Mean plot graph depicting the association between the facial pattern and the mean of the intermolar width in maxilla. X axis represents the facial pattern and Y axis represents the Mean of Intermolar width. The Intermolar widths in maxilla narrowed more in Vertical facial pattern (-1.7) followed by average (-1.44) and least in horizontal facial pattern (-0.25). One way ANOVA test was done and association was found to be statistically not significant. One way ANOVA test; p = 0.253 (>0.05) statistically not significant, proving that the Intermolar width of maxilla is not dependent on the facial pattern of a person.

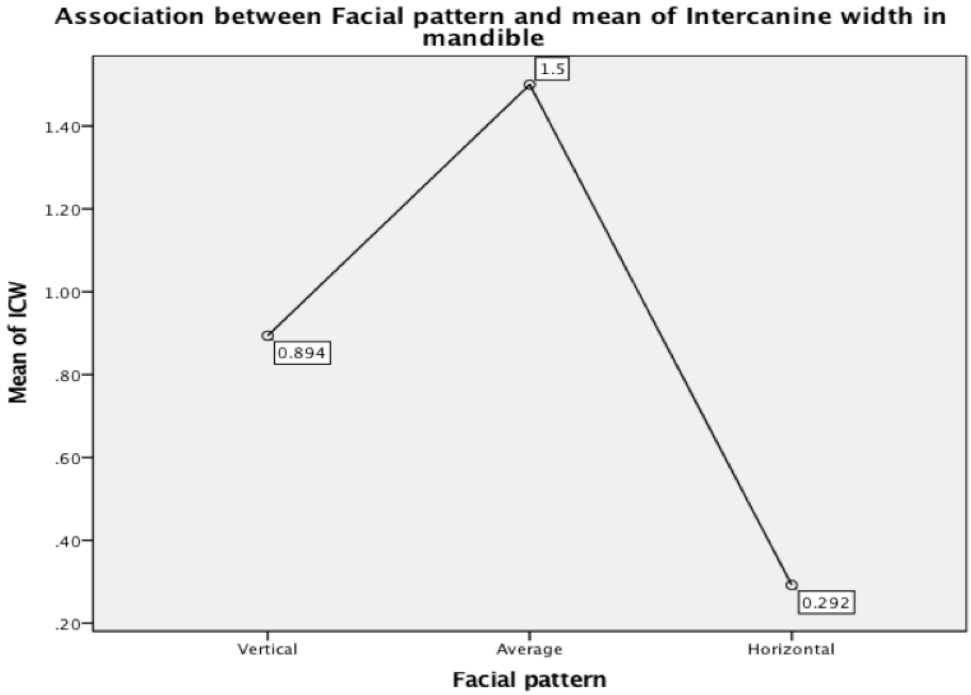

Figure 4: Mean plot graph depicting the association between the facial pattern and the mean of the intercanine width in mandible. X axis represents the facial pattern and Y axis represents the Mean of Intercanine width. The Intercanine

widths in mandible increased and the maximum increase is seen in the Average group (1.5). One way ANOVA test was done and association was found to be statistically not significant. One way ANOVA test; p = 0.779 (>0.05) statistically not significant, proving that the Intercanine width of mandible is not dependent on the facial pattern of a person.

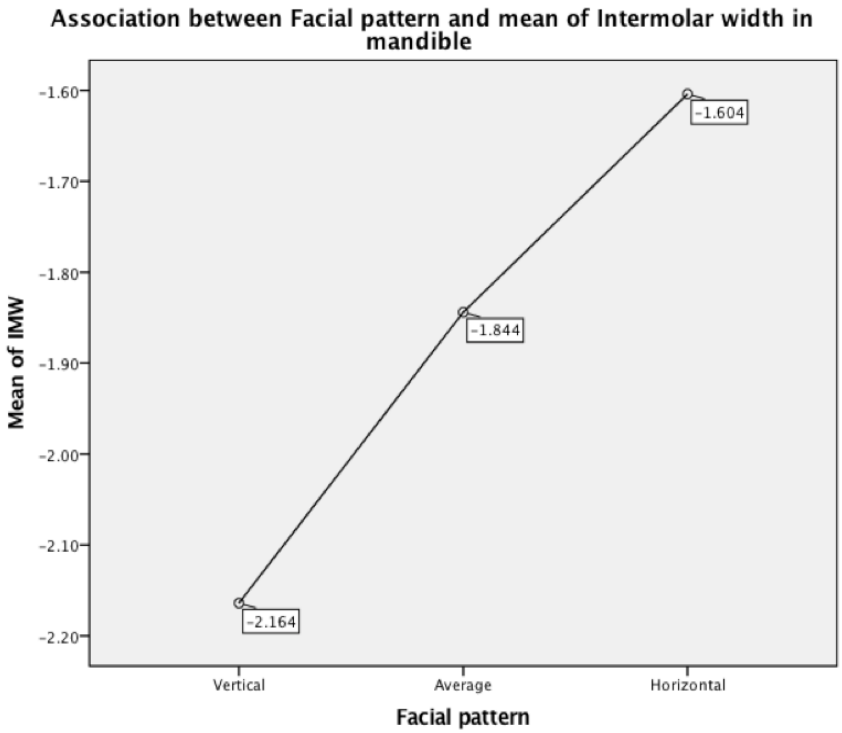

Figure 5: Mean plot graph depicting the association between the facial pattern and the mean of the intermolar width in mandible. X axis represents the facial pattern and Y axis represents the Mean of Intermolar width. In the mandibular arch, Vertical facial pattern shows the maximum narrowing of theintermolar widths (-2.16). One way ANOVA test was done and association was found to be statistically not significant. One way ANOVA test; p = 0.906 (>0.05) statistically not significant, proving that the Intermolar width of mandible is not dependent on the facial pattern of a person

5. CONCLUSION

In conclusion,horizontal facial types were associated with increased intercanine widths in both maxilla and mandible. In vertical facial type the Intermolar distances of maxilla and mandible reduced after treatment. The mandibular intercanine widths reduced more in horizontal facial types. However the association of facial patterns on arch width changes was not statistically significant proving that the arch width changes post orthodontic treatment are not dependent on the facial pattern of a person.

6. ACKNOWLEDGEMENTS

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7. Author's Contribution

R.J contributed to study conception and design, data collection, analysis and interpretation and drafted the work. A.M. contributed to data interpretation, study design and data collection. All authors critically reviewed the manuscript and approved the final version.

8. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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