ARCH WIDTH CHANGES IN CANINE AND MOLAR REGIONS AFTER EXTRACTION AND NON-EXTRACTION TREATMENT

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The theory claiming the contraction of the dental arch in extraction treatment has been a point of discussion in extraction Vs non extraction debate. Because arch width appears to be a determinant of smile esthetics, the intent of this study was to compare arch width changes in canine and molar region in both extraction and nonextraction cases, to determine whether extraction treatment results in narrower dental arches, thereby increasing the buccal corridor. Materials & Methods: Study models of 25 extraction & 25 non extraction subjects were taken and intercanine & intermolar width were measured using digital caliper. A Paired sample t test was used to evaluate the treatment changes within each group. Intergroup comparisons were made by unpaired t test or Mann-Whitney test whenever required. Results: No statistical significant increase in intercanine and intermolar width was found in non extraction cases. The extraction cases however showed a statistically significant increase in the intercanine width post treatment. The intermolar width was found to be less post treatment in extraction subjects. Conclusion: Notion that extraction treatment will result in narrower dental arches is not justified.

To Paraphrase the Bard of Avon; to extract or not to extract? The question has spawned some intense debates in orthodontics[1]. It is almost as old as the specialty of orthodontics.

The criticism concerning the detrimental effects of premolar extraction therapy on smile esthetics has added another dimension to the 100 year old extraction vs non extraction debate[2]. It is well documented that arch dimensional changes occur with orthodontic treatment after extraction of teeth and that these dimensions also continue after the end of active treatment[3].

The theory claiming the contraction of the dental arch in extraction treatment has been a point of discussion. Some authors claim that arch width is an important factor in obtaining a "full smile"[4] and that extraction treatment constrict arch form[2,5], while others report that extraction treatment does not constrict arch form[6,7,8,9,10].

It has also been suggested that extraction of premolars leads to a narrowing of dental arch width and a decreased fullness of the dentition within the mouth during a smile. It is claimed that dark intraoral spaces lateral to the buccal segments, result from this decreased dental arch width, and that these spaces are unesthetic[2].

Because arch width appears to be a determinant of smile esthetics[11], the intent of this study is to compare arch width changes in canine and molar region in both extraction and nonextraction cases to determine whether extraction treatment results in narrower dental arches, thereby increasing the buccal corridor.

AIMS

This study was carried out with the following aims and objectives.

1) To compare the anterior and posterior widths of the dental arches by measuring intercanine and intermolar widths in pretreatment and posttreatment study models after both extraction and non extraction therapy.
2) To determine whether extraction treatment results in narrower dental arches and by inference, larger dark shadows in the buccal corridor.

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Materials and Method

The present study was a retrospective study done at Department of Orthodontics and Dentofacial Orthopedics, Manipal College of Dental Sciences, Manipal, Karnataka, India.

Sample

A sample of 50 orthodontic patients who had undergone fixed orthodontic treatment at the Department of Orthodontics and Dentofacial Orthopedics, Manipal College of Dental Sciences, were selected for the study. All of the above subjects had been treated either by Standard Edgewise Mechanotherapy or by PreAdjusted Edgewise Mechanotherapy.

Selection Criteria

A. Subjects of and above 12 years of age at the start of the treatment

B. Subjects having skeletal and dental class I malocclusion.

C. Subjects who had undergone only fixed appliance orthodontic treatment.

D. No previous history of orthodontic treatment done.

E. At the start of treatment, all patients were in the permanent dentition with exception of second and third permanent molars.

F. No missing or congenitally absent permanent teeth except third molars at the start of treatment.

G. The patients whose treatment involved extraction had undergone four first premolar extractions as part of a comprehensive orthodontic treatment plan.

H. Subjects without transverse maxillary deficiency (No posterior crossbite).

I. Subjects with labially placed/erupted canines were excluded.

J. Study models having broken or worn out cusp tips of either canine or first permanent molar were excluded.

Sample subjects were divided into two groups of 25 subjects each.

Group 1: Subjects who underwent non extraction fixed orthodontic treatment. (N=25).

Group 2: Subjects whose orthodontic treatment involved extraction of all four first premolars. (N=25)

Non extraction group consisted of 11 males and 14 females. Extraction group consisted of 9 males and 16 females. Mean age for non extraction group at beginning of orthodontic treatment was 18.3 ± 3.8 years. For extraction group mean age was 18.2 ± 3.5 years. Mean tooth size arch length discrepancy in nonextraction group was -1.50 ± 2.63mm, for extraction group it was -4.72 ± 2.64mm.

Table 1 lists a comparison between the general information of two groups.

Method

Pretreatment (T1) and posttreatment (T2) study models of patients in both groups were taken and measured using a Digital Caliper (Mitutoyo Digimatic Caliper, Japan, No.99, Series No. 500) with an accuracy of +0.02mm, resolution of 0.01mm and repeatability of 0.01mm.

The widths of the anterior and posterior parts of the maxillary and mandibular dental arches were measured in the canine and the molar regions.

Intercanine width was measured as the distance between cusp tips of right and left permanent canines. (Figure 1)

Intermolar width was measured as the distance between mesiobuccal cusp tips of right and left first permanent molars. (Figure 2)

The caliper was placed at the best estimate of a right angle to the palatal suture in the maxillary arch and to a line bisecting the incisor segment in the mandibular arch. Each distance was measured 3 times, and the average of the 3 values was used as the final measurement.

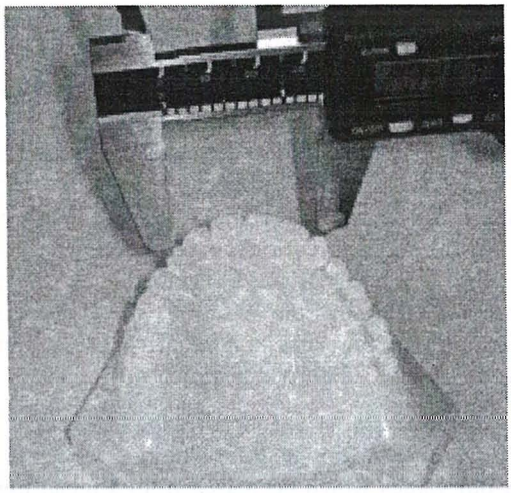


Fig 1: Measurement of intercanine width.

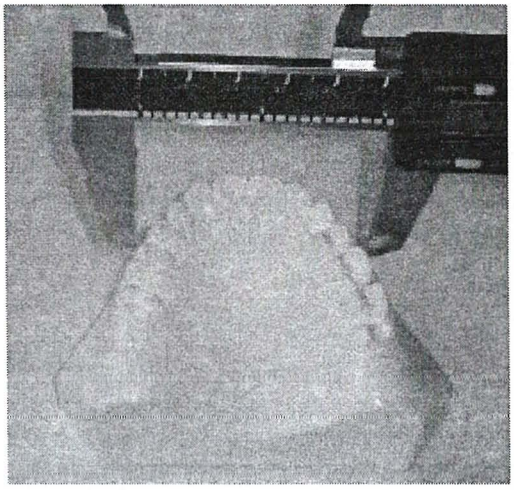


Fig 2: Measurement of intermolar width.

Table 2 shows a comparison of pretreatment arch widths in extraction and nonextraction samples to establish any arch width differences before treatment.

Statistical Analysis

All statistical analyses were performed using the SPSS software package (SPSS for Windows Xp, version 13.0, SPSS Inc, Chicago).Descriptive data that included arithmetic mean, standard deviation and range values were calculated for each variable as well as for each group and were used for analysis. A Paired sample t test was used to evaluate the treatment changes within each group. Intergroup comparisons were made by unpaired t test or Mann-Whitney test whenever required. For intraexaminer reliability Cronbach's alpha analysis was done. To determine measurement error ten patients were se-

Table-1: General Information in two groups

		Group I	Group II	Significance
		N=25	N=25	
Age	Mean ± SD	18.3 ± 3.8	18.2 ± 3.5	NS*
	Range	12-25 yrs	12-29 yrs	
Gender	Male	11(44%)	9 (36%)	NS**
	Female	14 (56%)	16 (64%)	
Tooth Size Arch Length Discrepancy	Mean ± SD	-1.50 ± 2.63	-4.72 ± 2.64	P < .001, HS***
	Range	-5.0 to 3.5	-9.0 to 0.0	
Treatment time	Mean ± SD	16.4 ± 4.1	26.6 ± 4.0	P < .001, HS*
	Range	10 - 26	19 - 34	

Group 1 – Non extraction group, Group 2 – Extraction group
** Unpaired t-test, ** Fisher's Exact test, *** Mann-Whitney U test*
p value > .05 (Non Significant), p value < .01 (Significant), p value < .001 (Highly Significant)

lected randomly from the study sample and intercanine width and intermolar width from both pretreatment as well as posttreatment study models were remeasured using same method as described above.

The method error (ME) was assessed using the formula of Dahlberg[12].

$$ME = \sqrt{\frac{\varepsilon d^2}{2n}}$$

Where d is the difference between two measurements of a pair and n is the number of subjects.

RESULTS

Table 3 depicts changes in intercanine width and intermolar width for maxillary and mandibular arches from pretreatment to posttreatment for non extraction and extraction groups.

The mean maxillary intercanine width for non extraction group (group 1) decreased from 38.35 ± 2.00mm at pretreatment (T1) to 38.31 ± 1.78mm at posttreatment (T2). For extraction group (group 2) maxillary intercanine width increased from 37.36 ± 2.82mm at T1 to 37.80 ± 2.71mm at T2. The changes in maxillary intercanine width from T1 to T2 were found to be statistically non significant for both group 1 and group 2. Mean maxillary intermolar width for non extraction group at T1 was 54.85 ± 2.93mm which changed to 54.86 ± 2.46mm at T2. The change was found to be statistically non significant. However for extraction group the change in intermolar width was found to be statistically significant as the intermolar width decreased from initial pretreatment value of 54.24 ± 3.18mm to 52.94 ± 2.30mm posttreatment.

Similar statistical significant changes were found for extraction group in mandibular intermolar width values which decreased from a mean initial value of 47.43 ± 3.15mm to 46.09 ± 1.91mm posttreatment. At T1 mean mandibular intermolar width for non extraction group was 48.51 ± 3.23mm which showed a mild increase to 48.61 ± 2.84mm at T2.

Mean mandibular intercanine width for non extraction group at pretreatment was 29.89 ± 2.13mm which increased to 30.62 ± 2.12mm and was found to be statistically non significant.

For extraction group however the change in mandibular intercanine width was found to be statisti-

Table-2: Comparison of pretreatment measurements of intercanine (I-C) and intermolar (I-M) regions.

Measurement	Group I		Group II		Group I vs Group II		
	Range	Mean ± SD	Range	Mean ± SD	Mean diff.	t-value*	p-level
Maxillary I-C width	33.02-41.43	38.35±2.00	33.14-43.22	37.36±2.82	0.99	1.46	0.15, NS
Maxillary I-M width	48.83-59.63	54.85 ±2.93	48.96-60.46	54.24±3.18	0.61	0.72	0.42, NS
Mandibular I-C width	26.81-35.10	29.89± 2.13	24.89-32.76	29.55±1.99	0.34	0.60	0.55, NS
Mandibular I-M width	43.14-54.47	48.51± 3.23	41.33-53.45	47.43±3.15	1.08	1.22	0.23, NS

* Unpaired t-test
p value > .05 (Non Significant)
p value < .05, < .01 (Significant)
p value < .001 (Highly Significant)

TABLE-3: PRETREATMENT (T1) & POSTTREATMENT (T2) COMPARISONS WITHIN GROUPS

Measurement	Group I					Group II				
		Mean ± SD	T_2-T_1				Mean + SD	T_2-T_1		
			Difference	t*	p			Difference	t*	p
Maxillary I-C width	T_1	38.35 ± 2.00	-0.04	0.12	0.91 NS	T_1	37.36 ± 2.82	0.44	1.23	0.23 NS
	T_2	38.31 ± 1.78				T_2	37.80 ± 2.71			
Maxillary I-M width	T_1	54.85 ± 2.93	0.01	0.01	0.99 NS	T_1	54.24 ± 3.18	-1.30	3.68	< .01 S
	T_2	54.86 ± 2.46				T_2	52.94 ± 2.30			
Mandibular I-C width	T_1	29.89 ± 2.13	0.73	1.50	0.14 NS	T_1	29.55 ± 1.99	1.18	3.41	< .01 S
	T_2	30.62 ± 2.12				T_2	30.73 ± 1.73			
Mandibular I-M width	T_1	48.51 ± 3.23	0.10	0.36	0.72 NS	T_1	47.43 ± 3.15	-1.33	3.57	< .01 S
	T_2	48.61 ± 2.84				T_2	46.09 ± 1.91			

p value > .05 (Non Significant)
p value < .05, < .01 (Significant)
p value < .001 (Highly Significant)
*** Paired t-test**

(-) Sign → Decreased from original measurement

(+) Sign → Increased from original measurement

TABLE-4: COMPARISON OF POSTTREATMENTVALUES BETWEEN TWO GROUPS

Measurement	Group I		Group II		Group I vs Group II		
	Range	Mean ± SD	Range	Mean ± SD	Mean diff.	t-value*	P-level
Maxillary I-C width	34.54-42.19	38.31±1.78	31.47-41.68	37.80±2.71	0.51	0.80	0.43, NS
Maxillary I-M width	49.96-61.06	54.86 ±2.46	49.77-57.95	52.94 ±2.30	1.92	2.91	<.01, S
Mandibular I-C width	27.46-31.51	30.61± 2.12	27.45-35.13	30.73 ±1.73	0.11	1.002	0.32, NS
Mandibular I-M width	43.91-53.93	48.61± 2.84	42.48-50.09	46.09±1.91	2.52	3.76	<.01, S

***Unpaired t-test**

p value > .05 (Non Significant)
p value < .05 ,< .01 (Significant)
p value < .001 (Highly Significant)

TABLE-5: COMPARISON OF POSTTREATMENT CHANGES BETWEEN TWO GROUPS

Measurement	Post-treatment changes (T_2-T_1)				Group I vs Group II (comparison of changes)	
	Group I		Group II			
	Mean ± SD	% change	Mean ± SD	% change	t-value	p-value
Maxillary I-C width	-0.04±1.42	0.1%	0.44±1.76	1.2%	0.90	0.37, NS
Maxillary I-M width	0.01±1.21	0.02%	-1.30±1.76	2.4%	3.11	<.01, S
Mandibular I-C width	0.73±2.4	2.44%	1.13±1.73	4%	0.33	0.74, NS
Mandibular I-M width	0.10±1.34	0.02%	-1.33±1.87	2.8%	2.73	<.01, S

*Unpaired t-test

p value > .05 (Not Significant)
p value < .05, < .01 (Significant)
p value < .001 (Highly Significant)

cally significant. The mean mandibular intercanine width for extraction group increased from 29.55 ± 1.99mm at pretreatment to 30.73 ± 1.73mm posttreatment.

Table 4 shows the comparison of posttreatment values of intercanine width and intermolar width for group1 and group2.

Range of method error for overall measurement was from 0.41-0.59. Intraobserver reliability analysis using Cronbach's alpha test was found to be 0.95.

DISCUSSION

This investigation incorporated the issue of arch width changes in the extraction-non extraction debate.

Pretreatment comparison of both groups showed proper standardization of extraction and non extraction sample groups as there were no statistically significant differences between them regarding age and sex variables.

Age was standardized such that the effects of growth and development on arch width were not of concern. Apart from age, ethnicity also influences arch width[13,14]. Present study samples were from same ethnic origin to remove this bias.

All the subjects included in the study had a Skeletal Class I relationship and dental Class I molar relationship. Previous studies reported significantly reduced intercanine, interpremolar and intermolar width in subjects with Class II division I and Class II division II malocclusion groups when compared to Class I normal occlusion sample[15,16]. Narrowed arch width in Class II malocclusion subjects lead to cross bite tendency which required expansion of arches to correct. This expansion influenced the posttreatment arch width measurements. Similarly for Class III subjects, studies showed a statistically significant increased interarch widths and alveolar widths compared to normal occlusion sample[7].

One of the criticisms of premolar extraction concerns its effects on the relationship between the width of the dental arch and the width of the smile[2,5]. Spahl and Witzig[2] argue that the removal of a tooth in each quadrant results in a reduction in the radius of the curve of the dental arch, "shrinking" the arch, and leading to a denture that is not of sufficient size to fill the oral slit during a smile. However it can be argued that the dental arch is not a circle that shrinks in radius when teeth are removed[17].

The inability to correlate smile esthetics with treatment modality was also noted in previous study by Paquette et al[8] who found no difference in smile esthetic scores of extraction and non extraction patients. When evaluating results of arch width changes the increases in mandibular intercanine width post treatment for both groups were in agreement with previous studies who evaluated patients treated by both strategies[18,19,20].

It can be said that increase in mandibular intercanine width was a consequence of arch alignment as well due to minimal expansion with arch wires in non extraction cases. In extraction cases the increase in mandibular intercanine width might be due to canines moving distally in a wider portion of arch and also because of a minor lateral movement of canines as they are moved distally into the premolar sites.

In extraction group, both maxillary intermolar width and mandibular intermolar width decreased from original width. This decrease was statistically significant. These results agree with the findings of Aksu et al[20] and Kim and Gianelly[6].

Typically, transverse arch width at any particular location in the buccal segments is maintained or slightly enlarged after extraction; what changes is the tooth occupying that space. Thus, first molar arch width may decrease after extraction of premolars, but this is because the first molars have moved forward to a narrower position in the arch. Second molars now occupy part of what was previously the first molar location, at the same arch width at which the first molars originally were found. The esthetics of smile width are not determined by which teeth occupy a particular space in the buccal segment,

since the general population does not recognize the difference between the buccal surface of a premolar and the buccal surface of a molar. Also the smile rarely reveals the buccal surfaces of second molars, even following four premolar extraction treatment.

Long term studies evaluating relapse have shown that expanding intercanine width from original dimension is unstable and also that an expanded intercanine width tend to return to its original position[21,22,23,24]. It has been found that arch form, particularly in mandibular arch, could not be altered by appliance therapy[25,26].

Assessment of results of present study showed no statistically significant differences in pretreatment and post treatment intercanine and intermolar width of cases treated with non extraction indicating proper use of treatment mechanics. As the intercanine width is kept close to pretreatment value without any change in arch form, the relapse tendency of non extraction cases on long term basis can be predicted to be less.

It should be borne in mind that present study only relates to the treatment findings of arch width changes in the canine and molar regions after extraction of first premolars or non extraction treatment modality. The long term stability of these treatment approaches may lead to differences between the extraction and non extraction groups in terms of treatment changes and relapse.

In a more global sense, the contention that extrac-tion treatment results in less esthetic smiles because of narrowing of the dental arches is, to an extent, similar to a once presumed damaging effect of extraction therapy on the temporomandibular joint[27]. In both instances, the consequences of extraction treatment are considered to be decidedly negative. The available results from present study indicate that narrow dental arches are not the expected consequence of extraction treatment. Therefore, the esthetically compromising effect of narrow dental arches on smiles is not a systematic outcome of extraction treatment.

Conclusions

The conclusions of this study are:

1. There is no difference between the effects of extraction and nonextraction treatment modalities on the intercanine width.
2. In mandibular intercanine width, extraction group presented with the widest arch width at the end of treatment.
3. Intermolar width showed a decrease at posttreatment in extraction group due to consolidation of extraction spaces.
4. Notion that extraction treatment will result in narrower dental arches is not justified.

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