Research Article

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Evaluation of Maxillary Arch Width Changes with Orthodontic Treatment Involving First Premolar Extraction and Non Extraction Cases

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ABSTRACT

Background: A pleasant physical appearance is the most important factor in the well-being of an individual and among physical appearance face is the first criteria. In facial esthetics the balance between the hard tissue and soft tissue plays the key role. It has been suggested that a narrow maxillary arch might result from orthodontic treatment, especially when maxillary teeth have been extracted. This has become a rationale against extracting teeth during orthodontic treatment. The purpose of this study was to compare and evaluate the changes in maxillary arch width with orthodontic treatment involving premolar extraction and non-extraction.

Material and Method: Pretreatment and posttreatment casts of 20 all 4 first premolar extraction and 20 nonextraction patients were analyzed to determine any significant differences in arch widths, both within and between the 2 groups.

Result: There was a significant increase in the posttreatment maxillary intercanine width in the extraction group but not in the nonextraction group. Both the pretreatment and posttreatment arch widths between the maxillary first molars and at the level of the posterior rugae were greater in the nonextraction group than in the extraction group.

Conclusion: As they reflect different morphologies, there are likely to be significant differences in average maxillary anterior and posterior posttreatment arch widths in those treated with or without extractions. The treatment have to be carried out with thorough diagnosis and careful planning to make the choice of extraction or nonextraction treatment.

Keywords: Intercanine archwidth , intermolar archwidth.

INTRODUCTION

A pleasant physical appearance is the most important factor in the well-being of an individual and among physical appearance face is the first criteria .A harmonious balance between the hard tissue and soft tissue plays the key role in facial esthetics. The importance of an attractive smile is apparent when it is considered that the esthetic concern regarding a smile is often the main motivation of a patient seeking orthodontic treatment. The focus of attention initially was from the perspective of the lateral soft-tissue profile but in the past 2 decades, however, there has been a shift in emphasis toward frontal esthetic facial analysis. Hence there is recent increased interest in

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the esthetic effects of extracting teeth on the buccal corridors. There has been suggestion that a narrow maxillary arch might result from orthodontic treatment when maxillary teeth have been extracted, which has become a rationale against extracting teeth during orthodontic treatment.[1]

However, the concept of the arch width routinely narrowing after extraction treatment has been called into question. The Current perceptions of what is deemed to be esthetically pleasing differ from those of 50 years ago, since a broad smile is now seen as a projection of youth and health.[2] Currently, a nonextraction approach is increasingly advocated to be the aim of orthodontic treatment when possible. The reasons for this are partly patient driven because of patient's unwillingness for extraction of sound teeth and partly because of the belief by some that extracting premolars leads to poor esthetic results through creating larger buccal corridors from constriction of the dental arches. Present study was designed to investigate and assess the archwidth changes in orthodontic patients treated with and without extraction of premolars.

AIMS AND OBJECTIVES

- To compare and evaluate the changes in maxillary arch width with orthodontic treatment involving first premolar extraction and nonextraction.
- To draw an inference from the above results.

MATERIALS AND METHODS

The subjects for the present study were selected from patients reporting to the Department of Orthodontics and Dentofacial Orthopedics, Coorg Institute of Dental Sciences, Virajpet. Sample size consists of 40 subjects reporting to the department of orthodontics, Coorg Institute of Dental Sciences. Present as well as retrospective case were taken irrespective of gender bias.

The subjects were divided into two groups.

The first group (Group A) consisted of 20 patients who have undergone all 4 premolar extraction.

The second group (Group B) consisted of 20 patients who underwent non extraction treatment.

Inclusion criteria**:**

1. Male and female patients who have
a. Undergone all first premolar extraction(first premolar from each quadrant)
b. With no premolar extraction.
2. All subjects treated with maxillary and mandibular contemporary fixed appliances.
3. Subjects finished with class I molar and canine relation.
4. All subjects having early permanent dentitions with no congenitally missing teeth, with the possible exception of the third molars.

Exclusion criteria:

1. No functional appliances used
2. No palatal expansion appliances had been used.
3. No use of skeletal anchorage systems during any phase of treatment.
4. Generalized periodontally compromised patient.
5. Patients with developmental anomalies.
6. Mentally disabled patient.

Procedure:

sample consisting of 40 patients (20 premolar extraction, 20 non-extraction) with mean age of 15.12 years (±1.7) consisting of male and female subjects was assessed. The subjects were divided into 2 groups:-

Group A - consists of 20 patients who have undergone all 4 premolar extractions.

Group B - consists of 20 patients who underwent non extraction treatment.

Pretreatment and posttreatment maxillary arch study cast dimensions were measured using an electronic digital sliding caliper (150mm Rabbit Force Caliper,6" work zone, Japan) to the nearest 0.01 mm. Arch widths at the levels of the maxillary canines, the most anterior premolars, and the first molars were measured at the buccal cusp tips. Arch widths at the level of the point immediately distal to the incisive papilla (anterior rugae width) and at the conjunction of the third, lateral and medial rugae (middle width) and on the pretreatment casts, between the mesiobuccal cusp tips of the maxillary first molar, with the distance from the point immediately distal to the incisive papilla to the line

(posterior rugae width) were also measured according to Akyalycin et al[3]. The amount of crowding in pretreatment maxillary arch was calculated using the arch perimeter model analysis. All cast measurements were repeated 2 weeks after the initial measurements on 8 randomly selected subjects, 4 from each treatment group.

The reliability of these repeated measurements was tested using the intra class correlation coefficient (ICC) with a 95% confidence interval. A high degree of measurement reliability was found for all main outcomes, with ICC values from 0.79 to 1.0.(Table 2)

Statistical methods applied

SPSS (version 20.0) was used for statistical analysis.

Descriptive Statistics

Paired and Unpaired T-Test

COLOUR PLATE

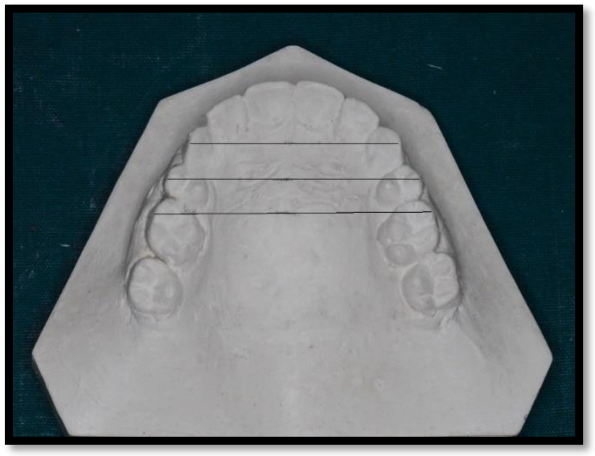


Fig 1: Cast measurement across rugae (anterior, medial, and posterior)

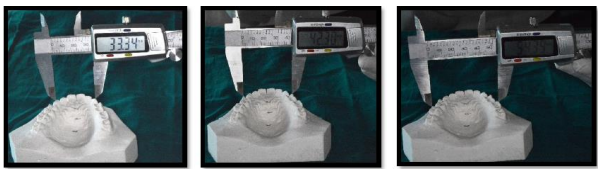


Fig 2: Measurement across inter canine, inter premolar, inter molar cusp.

Table 1: Pretreatment sample characteristics

	Gender	Mean age(y)	Std. Deviation	Mean Maxillary crowding(mm)
Extraction	Male	14.7143	1.88982	5.5
	Female	14.6154	1.70970	
Non - Extraction	Mal e	16.2500	3.45378	-0.85
	Female	15.1667	2.08167	
Total	Extraction	14.6500	1.72520	2.33
	Non - Extraction	15.6000	2.68328	

Table 2: ICC values at 95% coefficient interval

	ICC FOR PRETREATMENT	ICC FOR POSTTREATMENT
Canine TO Canine	0.795	.80
Premolar TO Premolar	1.000	1.000
M0lar TO Molar	1.000	1.000
ANTERIOR RUGAE	0.850	.999
MEDIAL RUGAE	1.000	1.000
POSTERIOR RUGAE	1.000	1.000

RESULTS

For within the treatment group outcomes the mean intercanine pretreatment and post treatment widths were not significantly different in the nonextraction group. In the extraction group, there was a significant mean treatment increase in

this measurement of 2.01mm. There was a significant increase in the mean interpremolar width in the nonextraction group of 1.88mm and a non significant increase in the extraction group. In both the groups, there was a significant increase in the mean widths across anterior rugae (extraction, 1.23mm; nonextraction , 1.33mm) and medial rugae (extraction , 2.18mm ; nonextraction , 1.75mm).also there was a significant increase in mean width across posterior rugae only in the nonextraction group of 1.27mm.(Table 3 and Table 4)

Table 3: Comparison of Maxillary arch widths changes within Extraction cases pretreatment and posttreatment

Paired Samples Statistics				
		Mean	Std. Deviation	Statistics
C TO C	Before treatment	36.13	2.52	t = 3.052
	After treatment	38.14	1.94	p = 0.007 S
PM TO PM	Before treatment	40.99	8.97	t = 2.016
	After treatment	45.37	3.19	p = 0.058 NS
M TO M	Before treatment	52.62	3.44	t = 1.770
	After treatment	51.79	3.10	p = 0.093 NS
ANTEIOR RUGAE	Before treatment	37.08	2.22	t = 2.593
	After treatment	38.31	2.22	p = 0.018 S
MEDIAL RUGAE	Before treatment	42.39	2.53	t = 4.153
	After treatment	44.57	3.29	p = 0.001 S
POSTERIOR RUGAE	Before treatment	50.33	3.74	t = 0.920
	After treatment	50.82	4.29	p = 0.369 NS

Table 4: Comparison of maxillary arch width changes within Non extraction cases pretreatment and posttreatment.

Paired Samples Statistics				
		Mean	Std. Deviation	Statistics
C TO C	Before treatment	36.50	3.18	t = 0.238
	After treatment	36.61	1.57	p = 0.815 NS
PM TO PM	Before treatment	43.45	4.12	**t = 3.268**
	After treatment	45.33	2.19	**p = 0.004 S**
M TO M	Before treatment	53.50	3.47	t = 1.197
	After treatment	53.99	3.47	p = 0.246 NS
ANTEIOR RUGAE	Before treatment	36.45	3.07	**t = 2.709**
	After treatment	37.78	1.90	**p = 0.014 S**
MEDIAL RUGAE	Before treatment	42.19	4.85	**t = 3.151**
	After treatment	43.94	3.73	**p = 0.005 S**
POSTERIOR RUGAE	Before treatment	50.18	5.83	**t = 3.238**
	After treatment	51.45	4.87	**p = 0.004 S**

(C- Canine, PM- Premolar, M- Molar, S- Significant, NS- Non significant)

Table 5: Comparison of pretreatment maxillary arch widths between extraction and Non extraction groups.

	Cases	Mean	Std. Deviation	Std. Error Mean
C TO C	Extraction	36.13	2.52	t = 0.410
	Non extraction	36.50	3.18	p = 0.684 NS
PM TO PM	Extraction	40.99	8.97	t = 1.112
	Non extraction	43.4	4.12	p = 0.273 NS

M TO M	Extraction	52.62	3.44	t = 0.803
	Non extraction	53.50	3.47	p = 0.427 NS
ANTEIOR RUGAE	Extraction	37.08	2.22	t = 0.738
	Non extraction	36.45	3.07	p = 0.465 NS
MEDIAL RUGAE	Extraction	42.39	2.53	t = 0.156
	Non extraction	42.19	4.85	p = 0.877 NS
POSTERIOR RUGAE	Extraction	50.33	3.74	t = 0.100
	Non extraction	50.18	5.83	p = 0.921 NS

(C- Canine, PM- Premolar, M- Molar, S- Significant, NS- Non significant)

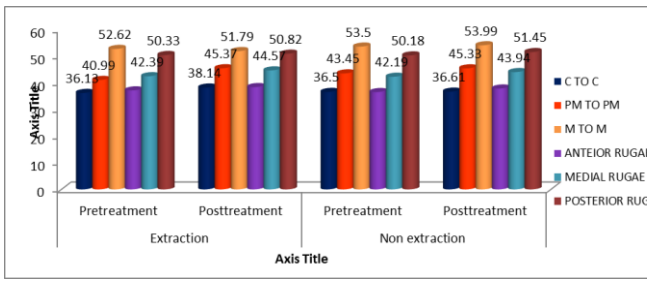
No significant relation was found pretreatment in between extraction and nonextraction groups. (Table 5)

Table 6: Comparison of posttreatment maxillary arch widths between extraction and Non extraction groups.

	Cases	Mean	Std. Deviation	Std. Error Mean
C TO C	Extraction	38.14	1.94	**t = 2.732**
	Non extraction	36.61	1.57	**p = 0.009 HS**
PM TO PM	Extraction	45.37	3.19	t = 0.044
	Non extraction	45.33	2.19	p = 0.965 NS
M TO M	Extraction	51.79	3.10	**t = 2.112**
	Non extraction	53.99	3.47	**p = 0.041 S**
ANTEIOR RUGAE	Extraction	38.31	2.22	t = 0.089
	Non extraction	37.78	1.90	p = 0.423 NS
MEDIAL RUGAE	Extraction	44.57	3.29	t = 0.569
	Non extraction	43.94	3.73	p = 0.573 NS
POSTERIOR RUGAE	Extraction	50.82	4.29	t = 0.432
	Non extraction	51.45	4.87	p = 0.668 NS

(C- Canine, PM- Premolar, M- Molar, S- Significant, NS- Non significant)

For the between – treatment group outcome (Table 6), the mean posttreatment widths across maxillary canine (1.53 mm difference) was significantly greater in extraction group. The mean posttreatment widths across the maxillary first molars (2.20 mm difference) was significantly greater in the nonextraction group. A statistically non-significant increase in arch width across interpremolar, anterior rugae and medial rugae was seen in extraction group and across the posterior rugae in the nonextraction group



Graph 1: Distribution of arch width changes pretreatment and posttreatment in both extraction and non extraction group

DISCUSSION

Conventionally, arch widths have been measured between the cusp tips of the canines, premolars, and molars. However, this method does not give a true representation of arch width change at the same point in the arch because it does not account for any anteroposterior dental movements of teeth during orthodontic treatment. Measurements of this nature should be taken at a constant reference point; for this reason, we also included arch width measurements using the palatal rugae as suggested by Akyalcin et al[3].

The concept of a prevailing arch narrowing after premolar extraction treatment is not supported by the results of our study. There was a significant mean posttreatment increase of maxillary intercanine arch width in the extraction

group of 2.01 mm, similar to the mean increases found in extraction patients in other studies by Meyer et al[1], Ishik et al[4], Gianelly[5], Aksu et al[6].The increases seen in this group might be because greater anterior pretreatment crowding was resolved, resulting in unavoidable buccal movement of the canines. Alternatively, it could also be because the canines were carefully retracted along the presenting arch form.

Anteriorly, in relation to rugae, there was a significant treatment increase in the mean widths across anterior rugae (extraction, 1.23mm; nonextraction, 1.33mm) and medial rugae (extraction, 2.18mm; nonextraction, 1.75mm). Also there was a significant increase in mean width across posterior rugae only in the nonextraction group of 1.27mm.These findings are contrary to the results of Meyer[1] et al where anterior archwidth increased significantly only in the nonextraction group and non significantly in the extraction group. This increase in anterior width in this study can be supported as by Johnson and Smith et al[7] that 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. Together, these results might indicate that the, a nonextraction technique specifically encourage overall all widening of the arch width. (GRAPH 1)

A decision to whether extract or not depends on individual patient's need , for example esthetically a patient with short face might need broader arches and narrow arches for patients with long face. This would support the conclusions of several previous studies that thorough diagnosis, treatment planning, and competent clinical management will lead to the best dentofacial results in orthodontic patients. [8]

CONCLUSION

The following conclusions can be drawn from the study:

1. There are significant differences in average posttreatment maxillary anterior and posterior arch widths in patients treated with or without premolar extractions, largely reflecting their presenting morphology.

2. Posttreatment anterior arch width widening is seen in both extraction and nonextraction patients.

3. Posterior posttreatment maxillary arch widths are greater, on average, in nonextraction patients than in extraction patients.

4. Anterior arch width posttreatment is greater in the extraction group but that difference have only marginal clinical significance.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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