

Delaying Premolar Extraction for Conservation of Anchorage: A Prospective Case Control Study

Dr Tarulatha R Shyagali,¹ Dr Tanvee Tiwari,² Dr Abhishek Gupta,³
Dr Rishi Joshi,⁴ Dr Anil Tiwari,⁵ Dr Pushp Raj,⁶ Dr Ruchi Jha⁷

¹Professor Head, ^{2,6,7}Post Graduate Student, ^{3,4}Senior Lecturer, ⁵Reader,
Department of Orthodontics and Dentofacial Orthopedics, Hitkarini Dental College and Hospital, India

Correspondence: Dr Tarulatha R Shyagali; Email: drtarulatha@gmail.com

ABSTRACT

Introduction: Anchor loss (AL) is the most common side effect of orthodontic treatment. Anchorage planning is the vital step of every orthodontic treatment. The aim of this study was to evaluate the amount of anchor loss of maxillary first permanent molar in early v/s delayed premolar extraction cases treated using fixed orthodontic mechanotherapy.

Materials & Method: Sixty orthodontic patients, having either Class I or Class II Division 1 malocclusion with no or minimal crowding were divided equally into early extraction and the delayed extraction group (30 each). The patients were treated using MBT prescription 022" slot brackets with standard wire sequencing until 0.019"x 0.025" stainless-steel wire. Pre and post levelling study models were used for assessing the amount of space loss using palatal rugae as a stable point from the points marked on the 1st molar (point A on mesiobuccal cusp and point B on the distobuccal cusp). The obtained data was tabulated and was subjected to statistical t test (p<0.05).

Result: The distance of point A to the 3rd rugae reduced after treatment by 0.39mm (3.4%) and by 0.48 mm (3.24%) in delayed and early extraction groups respectively. Similarly, the distance from point B was reduced by 0.48 mm (3.24%) and by 1.77mm (6.28%) in delayed and early extraction group respectively. The change in point A and point B in Early extraction cast group was 76% and 71% more respectively than the delayed Extraction cast group. All the findings were statistically significant (p<0.05).

Conclusion: Anchor loss is an inevitable after effect following premolar extraction. Greater chances of anchor loss in early extraction group is noted. And delaying premolar extraction in cases with mild crowding (<4mm) can effectively help in anchorage preservation.

Keywords: Anchorage, Anchorage Loss, Delayed Extraction, Early Extraction, Premolar .

INTRODUCTION

Anchorage in orthodontics is defined as a way of resisting movement of a tooth or number of teeth by using different techniques. It is an important consideration in the field of orthodontics as is a concept that is considered frequently while correcting malocclusions. Unplanned or unwanted tooth movement can have dire consequences in the treatment plan. Thus, using anchorage to prevent a certain tooth movement becomes important.¹ Anchorage can be used from many different sources such as teeth, bone, implants intraorally or with the help of headgear extra-orally.² Anchorage may be best defined as "the resistance which the dentofacial structures offer to change in form or position under an applied force". It appears preferable to consider anchorage entirely as various degrees of resistance, especially as applied to the

teeth, since it is impossible to achieve complete anchorage within the dentures.³

According to Tweed: "The production of a stable anchorage is most important for successful orthodontic treatment and should be the initial concern of the operator".⁴ If not taken care of, the failure to maintain anchorage leads to a phenomenon known as anchor loss.

Anchorage loss (AL) is an inadvertent side effect of orthodontic mechanotherapy. It is defined as the amount of mesial movement of the first permanent molar during premolar extraction space closure. Driftodontics is a term applicable when some teeth have been removed without any active orthodontic therapy.⁵ The posterior teeth also have a tendency to move towards the extraction space. This movement of

the molars toward the extraction site is sometimes an undesirable side effect.

Thus, the purpose of this study is to investigate the amount of anchor loss of the 1st permanent maxillary molar in cases treated using early and delayed pattern of 1st premolar extraction following fixed orthodontics treatment. As the amount of research is limited on the current issue, this study is aimed at highlighting the consequences of early extraction treatment so as to provide a sound base for future references.

MATERIALS AND METHOD

The cross sectional study was conducted on a sample of 70 patients of age 12-25 year. The patients were selected by simple random sampling. Two groups were made namely: early extraction group and a delayed extraction group. The early and the delayed extraction groups had 30 patients. The ethical clearance for the study was obtained by the institutional ethical committee. Before carrying out the study, patients were informed about the purpose of the study and the written consent was obtained for the same. The subjects were selected after they fulfilled the selection criterion like patients having Class I or Class II Division 1 malocclusion and who required extraction of first four premolars for the treatment and who had no or minimal crowding.

Seventy patients who visited outpatient department of orthodontics and dentofacial orthopaedics for the treatment were screened for the diagnosis and treatment planning with respect to early and delayed extraction. Of these 70 patients, 10 patients who didn't meet the screening criteria were discarded. These patients were finally allocated to two groups viz: early extraction (group I) and delayed extraction (group II), each having 30 patients. Based on the malocclusion, a comprehensive treatment plan was developed for each patient.

After the allocation in particular groups, group I (early extraction group) underwent extraction of both 1st premolars in the upper arch by a trained personnel.

All the patients were treated using MBT prescription 022" slot bracket system. Standard wire sequencing advocated by MBT system was followed until 0.019"x 0.025" stainless steel wire. With all the arch wires, 0.010" stainless steel ligation wire was used to ensure complete

engagement of the wire in the bracket slot. Pre and post levelling study models were taken to evaluate the amount space loss in both the groups.

In the study models, the centre of the 3rd ruga on the maxilla was taken as the reference point from which the anchorage loss was measured using a vernier caliper. Two points i.e, point A & point B were marked on the mesiobuccal and distobuccal cusp tips of maxillary first molar respectively on the casts for each individual and the distance between the mid- point of the 3rd ruga and points A & B on the pre-treatment and post leveling and alignment casts of each individual was measured in the early extraction, delayed extraction and control group. All the measurements were taken by the single examiner.⁶

The collected data was tabulated and was subjected to statistical analysis using the SPSS software version 21. Demographic data comparison was done using chi square test. Intragroup comparison was done using paired t test and unpaired t test was used for intergroup comparison.

The measurement of the 10 casts were repeated after a week and the obtained data was studied for the intraexaminer variability using the kappa statistics and the kappa for the same was 0.7 showing the moderate agreement.

RESULT

In early extraction group, out of 30 participants, 22 (73.3%) were females and 8 (26.7%) were males. In delayed extraction 22 subjects (73.3%) were females whereas 8 (26.7%) were males (Table 1). Significantly higher number of female participants (86.7%) belong to age group 18-22 years as compared to age groups 13-17 & 23-26 years ($p < 0.05$).

Mean change molar position in delayed extraction group is depicted in table 2. The distance of point A to the 3rd rugae reduced after treatment by 0.39mm (3.4%). Similarly, the distance from point B was reduced by 0.48 mm (3.24%). Both of the changes were statistically significant ($p < 0.05$).

Table 3 represent the data for the change in molar position for the Early Extraction group. The distance of point A reduced by 1.7 mm (7.7%) after treatment. Similarly, the distance of point B reduced by 1.77mm

Table 1: Demographic data of early and delayed extraction group

Early Extraction Group					
Age Group	Gender		Total	X2 Value	P Value
	Female	Male			
13-17 Year	5 (100%)	0 (0.0%)	5 (100%)	8.86	0.012*
18-22 Year	13(86.7%)	2 (13.3%)	15 (100%)		
23-26 Year	4 (40%)	6 (60%)	10 (100%)		
Total	22 (73.3%)	8 (26.7%)	30 (100%)		
Delayed Extraction Group					
Age Group	Gender		Total	X2 Value	P Value
	Female	Male			
15-19 Year	8 (80%)	2 (20%)	10 (100%)	1.3	0.5
20-23 Year	8 (80%)	2 (20%)	10 (100%)		
24-28 Year	6 (60%)	4 (40%)	10 (100%)		
Total	22 (73.3%)	8 (26.7%)	30 (100%)		

Table 2: Mean change in molar position in delayed extraction group on dental cast

Delayed extraction cast group		Mean (mm)	Std. Deviation	Mean difference (mm)	% reduction	T value	P value
Pair 1	Pre Treatment Point A	11.20	3.43	0.39	3.4%	5.1	0.001*
	Post treatment Point A	10.81	3.39				
Pair 2	Pre Treatment Point A	14.90	4.3	0.48	3.24%	5.9	0.001*
	Post treatment Point A	14.42	4.38				

*-Significant difference ($p < 0.05$)

Table 3: Mean change in molar position in early extraction group on dental cast

Early extraction cast group		Mean (mm)	Std. Deviation	Mean difference (mm)	% reduction	T value	P value
Pair 1	Pre Treatment Point A	22.13	5.32	1.7	7.7%	19.97	0.001*
	Post treatment Point A	20.43	5.21				
Pair 2	Pre Treatment Point A	28.17	5.25	1.77	6.28%	22.49	0.001*
	Post treatment Point A	26.40	5.43				

*-Significant difference ($p < 0.05$)

Table 4: Comparison of mean difference in change of molar position between early extraction and delayed extraction group

Groups		Mean (mm)	Mean difference (mm)	% reduction	Std. Deviation	T value	P value
Pre-Post Treatment Point A	Early Extraction group	1.70	1.27	74.7%	0.463	11.2	0.001*
	Delayed Extraction group	0.433			0.257		
Pre-Post Treatment Point B	Early Extraction group	1.77	1.33	75.14%	0.402	13.4	0.001*
	Delayed Extraction group	0.433			0.257		

*-Significant difference ($p < 0.05$)

(6.28%) after the treatment. Both these changes were statistically significant ($p < 0.05$).

Table 4 show the comparison of the change in molar position before and after treatment in Early Extraction cast and Delayed Extraction cast group. It was seen that a higher mean change in point A was seen in Early Extraction cast group as compared to Delayed Extraction cast group. Change in point A in Early Extraction cast group was 76% more than the Delayed

Extraction cast group. Similarly, Change in point B in Early Extraction Cast group was 71% more than the Delayed Extraction cast group. Both these changes were statistically significant ($p < 0.05$).

DISCUSSION

Anchor loss is the mesial movement of molars into the extraction site during orthodontic tooth movement. A certain amount of anchorage loss (AL) is a potential

side effect of every orthodontic mechanotherapy requiring extraction. Anchor loss is inevitable unless absolute anchorage was used.⁷ Various mechanisms such as the trans-palatal arch, differential forces, en-masse versus two step retraction and mini screws have been employed by different people so as to prevent this unwanted mesial movement of the first molar.

In the current study by delaying premolar extraction, we have comprehended upon whether maintaining the first premolar within the arch in extraction cases till after levelling and aligning phase have any effect on the conservation of anchor. Palatal rugae in the dental cast and nasion point in the lateral cephalogram were used as stable reference points so as to measure the amount of mesial movement.

The study included a total of 60 participants distributed amongst two groups, early extraction group (30) and the delayed extraction group (30).

Palatine rugae are small transverse extensions in the palate starting near the midpalatal raphae and extending outwards. These soft tissue landmarks have regularly been used as reference points to study various changes taking place in the palate as the position of these remain relatively stable throughout the life of an individual.⁸⁻¹⁰ It has been reported that rapid maxillary expansion and maxillary protraction do not have any effect on the maxillary rugal pattern.^{5,11,12} Thus, the study was done on dental casts keeping the mid-point of the 3rd palatal ruga as a stable point for the measurement of anchor loss of molar.

In delayed extraction dental cast distance of point-A to the mid-point on the third ruga reduced after treatment by 3.4%. Similarly, point B reduced by 3.24% after the treatment. Both these changes in point A and point B after treatment were statistically significant ($p < 0.05$). The probable reason might be the mesial component of force which is the physiologic phenomenon occurring in all human beings.¹³ Mesial or anterior component of force or physiologic tendency of mesial movement of teeth is acknowledged even by PR Begg in his standard textbook on Begg's philosophy.¹⁴

Compared to the delayed extraction group, in early extraction cast group distance of point A reduces after treatment by 7.7%. Similarly, point B reduced by 6.28% after the treatment. Both of these changes in point A and point B of the maxillary 1st molar after treatment

were statistically significant. This is not so surprising as it is well documented in the literature, that teeth follow the path of least resistance¹⁵ and in this case there was ample amount of extraction space in which the posteriors would have moved easily. Change in point A in early extraction cast group was 76% more than the delayed extraction cast group. Similarly, Change in point B in extraction cast group was 71% more than the delayed extraction cast group. Both these changes were statistically significant ($P < 0.05$). Thus, it can be concluded that delayed extraction subjects showed less amount of molar mesialization than the early extraction group. Nevertheless, there was some anchor loss still present in the delayed extraction group. Our results complied with Richard C et al who found molar mesialization occurred in both extraction and non-extraction cases minimal being seen in non-extraction cases.¹⁶ Similar to our study, Samira et al reported that TPA alone could not serve as a mechanism to control anchor loss and in cases of critical anchorage a temporary anchorage device serves as the best way to conserve anchorage.¹⁷

According to the study done by Su et al maxillary first molars have tendency to tip mesially, and if the molars are distally tipped before treatment, the more they will tip mesially during treatment.¹⁸ Moreover, mesial movement of first maxillary molar during orthodontic treatment is seen more commonly in class II malocclusion and in the premolar extraction cases. These findings support the results of the present study.

Our results indicated that early premolar extraction in the orthodontic treatment was related to anchor loss. This was supported by Geron et al who said that anchor loss was a multifactorial response which varied according to the extraction site (1st or 2nd premolar), appliance used, age, crowding, and horizontal overlap.¹⁹ However anchorage loss at the end is not a single factor dependent phenomenon. It depends on many factors, which can be majorly categorized into primary and secondary. In which primary includes the factors like crowding and mechanics. In secondary factors age, extraction site and overjet are included.²⁰

Further, the study carries the scope to check the anchorage loss in delayed and early extraction of second premolar cases and it can be further improved by including other variables like overjet and age to check their influence on the anchor loss.

CONCLUSION

Higher amount of anchor loss is seen in the early extraction group in comparison to the delayed extraction group. Delaying premolar extraction in

cases with mild crowding (<4mm) can effectively help in anchorage preservation in conventional extraction treatment cases.

OJN

REFERENCES

1. Nanda R. Temporary Anchorage Devices in Orthodontics. 2nd ed. Elsevier Health Sciences. Amsterdam 1994.
2. Krishna SP, Mandava P, Singaraju G, Ganugapanta VR. Anchorage in orthodontics: a literature review. *Annals and Essences of Dentistry*. 2016; 8(2): 7c-19c.
3. Ribeiro GL, Jacob HB. Understanding the basis of space closure in Orthodontics for a more efficient orthodontic treatment. *Dental. Press. J. Orthod*. 2016;21(2):115–125.
4. Vaden JL, Charles H. Tweed, 1895-1970. *Am. J. Orthod. Dentofacial. Orthop*. 2015; 147(5): S171–179.
5. Choi JI, Cha BK, Jost-Brinkmann PG, Choi DS, Jang IS. Validity of palatal superimposition of 3-dimensional digital models in cases treated with rapid maxillary expansion and maxillary protraction headgear. *Korean. J. Orthod*. 2012;42(5):235-241.
6. Shukla D, Chowdhry A, Bablani D, Jain P, Thapar R. Establishing the reliability of palatal rugae pattern in individual identification (following orthodontic treatment). *J. Forensic. Odontostomatol*. 2011 ;29(1):20-29.
7. Pratik C, Rohit SK, Ragni T, Abhishek S, Ashish K, Mohammed W. Horizontal and vertical changes in anchor molars after extractions in bimaxillary protrusion cases. *APOS.Trends. Orthod*. 2016; 6:154-159.
8. Goswami R, Garg R, Jolly R. Role of prosthodontics in forensic odontology. *Int. J. Clin. Dent. Sci*. 2011; 2:85-89.
9. Mishra SK, Mahajan H, Sakorikar R, Jain A. Role of prosthodontist in forensic odontology. A literature review. *J. Forensic. Dent. Sci*. 2014; 6:154-159.
10. Marco AA, Ceib P, Katherine K, Camilla T. Stability of the palatal rugae as landmarks for analysis of dental casts. *Angle. Orthod*. 1995;65(1):43-48.
11. Abdel A, Mohammed H, Sabet NE. Palatal rugae area: a landmark for analysis of pre- and post-orthodontically treated adult Egyptian patients. *EMHJ*. 2001;7 (1-2): 60-66.
12. Patil MS, Patil SB, Acharya AB. Palatine rugae and their significance in clinical dentistry. *The J. Am. Dent. Assoc*. 2008;139(11), 1471–1478.
13. Sarmad S, Al Qassar S, Mavragani M, Psarras V, Halazonetis DJ. The anterior component of occlusal force revisited: direct measurement and theoretical considerations *Eur. J. Orthod*. 2016; 38(2): 190–196.
14. Begg PR, Kesling P. *Orthodontic Theory and Technique*. 3d ed. Philadelphia: Saunders, 1977.
15. Creekmore TD. Teeth want to be straight. *J. Clin. Orthod*. 1982; 16:745-764.
16. Richard CP, Speidel TM, Isaacson RJ. A laminagraphic study of canine retraction versus molar anchorage loss. *Angle. Orthod*. 1969;40(1): 20-27.
17. Samira DB, Murilo NF, Humam S, Carlos FM, Tarek EB. Effectiveness of the transpalatal arch in controlling orthodontic anchorage in maxillary premolar extraction cases: A systematic review and meta-analysis. *Angle. Orthod*. 2017; 87:147–158.
18. Su H, Han B, Li S, Na B, Ma W, Xu TM. Factors predisposing to maxillary anchorage loss: a retrospective study of 1403 cases. *PLoS. One*. 2014;9(10): e109561.
19. Silvia G, Nir S, Samouil K, Moshe D, Alexander DV. Anchorage Loss—A Multifactorial Response. *Angle. Orthod*. 2003; 73:730–737.
20. Geron S, Shpack N, Kandos S, Davidovitch M, Vardimon AD. Anchorage loss—a multifactorial response. *Angle. Orthod*. 2003 ;73(6):730-737.