Original Article

Evaluation of Upper Airway Dimension in all Four First Premolar Extraction Cases

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ABSTRACT

OBJECTIVE: To find out any noticeable size difference in the superior airway at the end of premolar extraction treatment and to find out the effects of extraction on axial inclinations of anterior teeth.

METHODOLOGY: It was a retrospective quasi-experimental study that consisted of 30 orthodontic patients in which all four first premolars were extracted. The orthodontic treatment of the participants was done at Department of Orthodontics, Jinnah Medical and Dental College, Karachi. The data was collected from January 2020 to March 2020. Sampling technique selected was consecutive which is a non- probability type of sampling. The cases included in this study were skeletal and dental class I having class I molar relationship with crowding that required all four first premolar extractions. Patients having syndromes or in need of orthognathic surgery were excluded from this study. The analysis was done on Lateral Cephalometric radiograph which was captured in the beginning and another one once treatment was completed. On these radiographs, changes in the soft palate and upper airway widths were measured.

RESULTS: No appreciable alterations observed in the superior airway and soft palate widths. The difference observed in the upper incisors inclination was significant when compared to their pretreatment values.

CONCLUSION: No appreciable change has been noted in the airway dimensions after extraction of premolars. The extractions done as a part of orthodontic treatment results in a great improvement in the correction of proclinations of anterior teeth and reduction of lip procumbency.

KEY WORDS: Premolar extractions, Lateral Cephalogram, Airway

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INTRODUCTION

There have been a lot of controversies regarding extraction and non-extraction approaches in orthodontics. Angle was in favor of non-extraction treatment modality. The effects of premolar extractions on the sagittal plane were highlighted by Janson G et al[2]. According to him; there was an improvement in the anteroposterior maxillomandibular relation, as shown by the reduction of ANB.

Most commonly extracted teeth for orthodontic purpose are premolars[5]. Extraction of premolars is a common practice, however, its effects on upper airway dimension is still a matter of debate[3]. Practitioners need routine orthodontic diagnosis and planning to maintain the airway since it is of utmost importance while performing physiological functions like respiration, swallowing and pronunciation[3]. Airway dimension can be studied in detail via lateral Cephalogram.

No change was noted in oro-pharyngeal dimension of patients who have undergone extraction treatment as indicated by recent studies[4]. This is in favor of findings reported by Stefanovic[13] et al where no significant change was noted after extractions in an orthodontically treated case. Narrowing of oropharynx at the area just posterior to soft palate and tongue in patients who underwent orthodontic treatment involving extractions was reported by Germen-cakan[5]. A study conducted by Chen[1] and his coworkers have found that premolar extractions resulted in the change in location of the hyoid bone, resulting in the reduction of the upper airway. The finding of Chen was further supported by a study done by ShanonTP 2012[15] who also reported net increase in airway dimension after extraction therapy in an orthodontic case.

The goal of our study was to figure out any difference in upper airway dimensions after doing orthodontic extraction four first premolars and to find out the most suitable treatment modality for the patient. Knowledge about any significant change in airway dimension will be helpful for the patients with compromised upper airways e.g. patients with adenoids, tonsils and obstructive type of sleep apneas. The second objective is to find out the changes in the axial inclinations of upper and lower anterior teeth after distalization in cases having crowding.

The purpose of conducting this research was to measure any alteration in the superior airway size in patients whose management was done orthodontically by extracting premolars for the correction of proclinations of incisors.

METHODOLOGY

This retrospective quasi-experimental study was conducted from January 2020 to March 2020. Thirty cases treated with all first premolar extractions at the Department of Orthodontics, Jinnah Medical and Dental College, Karachi, were included in this study. The analysis was done on the pretreatment cephalogram taken at the time of enrolment and post-treatment lateral cephalogram taken after 12-18 months of orthodontic treatment and then their measurements were compared to find out changes in the airway dimension. On the basis of data collected from studies done previously[10] and considering power to be at 80% with confidence level of 95%, sample size calculated was 30. Sampling technique selected was consecutive which is a non- probability sampling technique.

Inclusion criteria:

1. Cases which are managed by extracting all first premolars
2. Cases with skeletal class I relationship
3. Cases in which molar class is I on both sides
4. Cases having crowding of more than 6mm.
5. Cases with no congenitally missing teeth (excluding third molars)
6. Age of patient males (18-26 years) and females (19-28 years)
7. Cases in which growth has ceased so no need of orthopedic treatment

Exclusion criteria:

1. Cases with skeletal class II and III relationship
2. Cases in which molar class is II or III
3. Cases managed by performing orthognathic surgeries
4. Cases with syndromes like cleft lip and palate
5. Any medical history.
6. Adenoidectomy and tonsillectomy

The Cephalometric radiographs were collected from the orthodontic OPD of Jinnah medical and dental college. Cephalometric radiographs were captured by positioning the patient on a universal cephalostat. It was made sure that the Orbitale-Porion plane which is also known as Frankfort horizontal (FH) plane was aligned with the floor and jaw position was adjusted in such a way that upper and lower teeth were completely meeting. Lips were reposed and patient was in a standing position. Clear adhesive tape was used to stick a tracing sheet of around 0.5um thickness to the X-ray film. After this, registration marks were drawn so that it can be used as a reference in case tracing sheet slips from its position. Tracing of the landmarks and measurements were done in a dark room by placing a radiograph along with attached tracing sheet on the illuminator box.

The measurements were done on a cephalometric radiograph taken before and after the treatment. The variables that were used to judge the changes are listed below

Soft palate width

Posterior nasal spine to uvula in (mm) shows the extent of soft palate. It is measured from uvula to posterior nasal spine

Maximum Palatal Thickness in (mm) soft palate diameter (greater width of the soft palate seen at right angle to a line that runs from uvula to posterior nasal spine

Soft palatal angle (°) it is the intersection formed by palatal length (Uvula to Posterior nasal spine) and Palatal plane (ANS-PNS)

Upper airway dimensions

SPAS (mm) uppermost and posterior airway region (airway breadth posterior to soft palate parallel to a line that runs from Point B to Gonion)

MAS (mm) middle airway region (line passing though the tip of uvula to posterior pharyngeal space parallel to a line that runs from point B to Gonion)

IAS (mm) the anteroposterior depth of the pharynx measured between the posterior pharyngeal wall and the surface of the tongue on a line parallel to the Gonion-point B line through the most anteroinferior point on the body of the second cervical vertebra;

Skeletal and dental measurements

SNA intersection between Sella to Nasion and line from Nasion to point A

SNB, intersection between Sella to Nasion and line from Nasion to point B

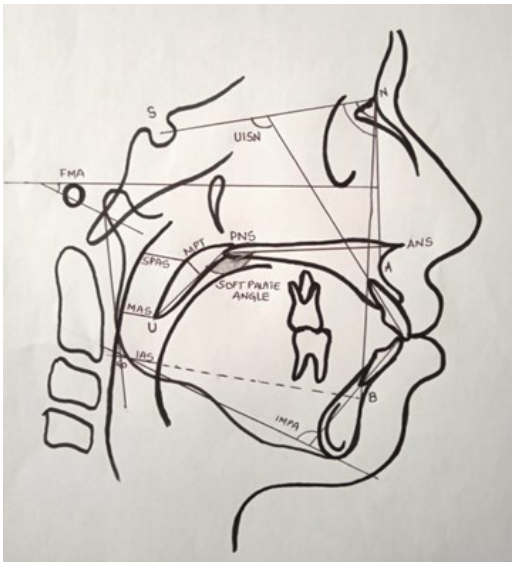
ANB, intersection between Nasion to point A and Nasion to point B

FMA, intersection between Frankfort horizontal plane and Mandibular plane

U1–SN, intersection between center axis of maxillary incisor and Sella to Nasion plane

IMPA, intersection of the center axis of the mandibular incisor and Mandibular plane which from Gonion to Menton

FIGURE I:
CEPHALOMETRIC PLANES AND ANGLES



Calculations for the results were done on Statistical Package for the Social Sciences SPSS (20). The means and standard deviations of all variables were calculated. The P-value of 0.05 or less than it considered important from statistics viewpoint. Student's t-test applied to differentiate variables of before and after treatment. Confidence interval used was 95%.

RESULTS

Mean changes in soft palate and superior airway dimension in subjects who have undergone orthodontic treatment with all four first premolar extractions is shown in Table I. Pre and post-treatment mean in the sagittal dimension (SNA, SNB, ANB) and dental inclination **(**U1–SN, IMPA) changes are shown in Table II.

No dimensional change was seen upper, middle and inferior airways. A minor change in soft palate length by 1.23 mm was noted but it was not statistically significant (p = .545). The axial inclinations of anterior teeth were noticeably decreased after their retraction.

TABLE I: THE MEAN CHANGE OF BEFORE AND AFTER TREATMENT IN SOFT PALATE AND UPPER AIRWAY DIMENSION IN PATIENTS WHO HAVE UNDERGONE ORTHODONTIC TREATMENT INCLUDING ALL FOUR FIRST PREMOLAR EXTRACTIONS

Soft palate dimensions Variables	Pre treatment	Post treatment	Mean change	P-Value
	Mean ±S.D	Mean ±S.D	Mean ±S.D	
PNS–U	25.59(±5-19)	23.9(±4.60)	1.53	.018
MPT	5.93(±1.43)	5.6(±1.42)	0.33	.125
Soft palate angle	132.56(±7.77)	133.8(±11.42)	-1.233	.545
Upper airway dimensions Variables				
SPAS	12.50(±5.09)	12.36(±4.45)	.133	.841
MAS	10.5(±4.56)	11.1(±4.93)	-.60	.310
IAS	13.03(±3.44)	11.8(±3.19)	1.23	.050

*Paired t test applied. * Significant*

TABLE II: THE MEAN CHANGE OF BEFORE AND AFTER TREATMENT IN SAGITTAL AND DENTAL MEASUREMENTS IN PATIENTS UNDERGOING ORTHODONTIC TREATMENT WITH ALL FOUR FIRST PREMOLAR EXTRACTIONS

Sagittal and vertical dimensions Variables	Pre treatment	Post treatment	Mean change	P-Value
	Mean ±S.D	Mean ±S.D	Mean ±S.D	
SNA	82.1(±4.80)	82.2(±4.69)	-.10	.820
SNB	78.73(±4.00)	78.93(±4.11)	-.20	.643
ANB	3.73(±3.10)	3.36(±2.04)	.36	.458
FMA	29.60(±6.44)	29.36(±5.89)	.23	.793
Dental Variables				
UISN	109.86(±10.33)	100.53(±7.53)	9.33	.000*
IMPA	92.53(±15.77)	90.00(±13.32)	2.53	.281

*Paired t test applied. * Significant*

DISCUSSION

The airway dimension is affected by different orthodontic modalities. Rapid palatal expansion increases the nasopharyngeal airway[6]. Orthognathic surgeries that involve forward positioning of jaws and orthodontic treatment with forward movement of dentition increase the airway dimension. [7]Then there are examples of orthopedic treatment like protraction facemask therapy and functional appliances, both can augment airway dimensions[8, 9].

The goal of this research was to analyze changes in the oro-pharyngeal dimensions after doing extractions of first premolars and then of distalization of incisors. The majority of first premolar extraction space is utilized by the posterior movement of incisors[10].

The results of this study showed no noticeable change in the airway dimensions after extraction of all four first premolars. This finding is consistent with the study done by Al Maaitah E 2012[11] & Bhatia S 2016[12] in which no appreciable change was noted in the volume of airway dimensions.

Another study that corroborated our findings was done by Stefanovic N 2013[13] in which he suggested no noteworthy change in airway dimension after the extraction of all four first premolars.

The majority of cases in our study had increased readings of upper and lower incisors inclinations. First premolar extraction was done to correct proclinations. Significant improvement was seen in the axial inclinations of anterior teeth after their retraction into the extraction space. Lip competency was also achieved after retraction of anterior teeth. These outcomes are parallel to the findings of Chen K 2010[14]. He reported that procumbency of lips was greatly improved by retraction of anterior teeth and hence improving overall patients' profile[13].

On the other hand, according to studies conducted by, Germec-Cakan D 2011[5] when incisors were distalized after extracting premolars, a decrease was seen in the size of the airway. This decrease was due to change in tongue posture in a more backward direction. This is in contrast to our findings, where no significant difference was reported after space closure.

One of the limitations of this study is that it was done on a cephalometric radiograph which was obtained by conventional method so it provides a two-dimensional

view. To overcome this shortcoming and to get a more valid and accurate picture of the changes in airway dimensions after extractions, three-dimensional imaging like CBCT should be considered in the future. Another shortcoming of this study was that the majority of patients were females. As males are less conscious esthetically, their needs and desires to undergo orthodontic treatment for aesthetic reasons are low[10]. So, to address this concern, future studies should be designed in such a way that an equal number of male and female patients are included in the sample size so that there is no gender bias.

CONCLUSION

There was no appreciable difference in the dimension of upper airway and soft palate after the extractions of all four first premolars.

The extraction treatment in orthodontics results in great improvement in the correction of proclinations of anterior teeth and a decrease in lip procumbency.

Extraction of first premolars can be safely recommended in patients with compromised airway as the majority of space is used up by the distalization of anterior teeth.

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AUTHOR CONTRIBUTIONS

Pervez H: Principle researcher, article writing, data analysis (SPSS) and interpretation

Shah S: Article discussion, cross referencing and proof reading

Haqqui R: Data analysis, interpretation and compilation of results

Naseer A: Data analysis, data collection and interpretation

Azam F: Data analysis (SPSS) and data collection

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REFERENCES

1. Chen Y, Hong L, Wang C, Zhanag S, Cao C, Wei F, et al. Effect of large incisor retraction on upper airway morphology in adult bimaxillary protrusion patients. Angle Orthod. 2012; 82(6): 964-70. doi: 10.2319/110211-675.1.
2. Janson G, Lenza EB, Francisco R, Aliaga-Del Castillo A, Garib D, Lenza M. Dentoskeletal and soft tissue changes in class II subdivision treatment with asymmetric extraction protocols. Prog Orthod. 2017; 18(1):39. doi: 10.1186/s40510 -017-0193-x.
3. Zhang J, Chen G, Li W, Xu T. Upper Airway Changes after Orthodontic Extraction Treatment in Adults: A Preliminary Study using Cone Beam Computed Tomography. PLoS ONE. 2015; 10 (11): e0143233. doi: 10.1371/ journal.pone.0143233.
4. Nagmode S, Yadav P, Jadhav M. Effect of first premolar extraction on point A, point B, and pharyngeal airway dimension in patients with bimaxillary protrusion. J Indian Orthod Soc. 2017; 51: 239-44.
5. Germec-Cakan D, Taner T, Akan S. Uvulo-glossopharyngeal dimensions in non-extraction, extraction with minimum anchorage, and extraction with maximum anchorage. Eur J Orthod. 2011; 33(5): 515-20. doi: 10.1093/ejo/ cjq109.
6. Buck LM, Dalci O, Darendeliler MA, Papageorgiou S, Papadopoulou A. Volumetric upper airway changes after rapid maxillary expansion: a systematic review and meta-analysis. Eur J Orthod. 2017; 39(5): 463-73. doi: 10.1093/ejo/ cjw048.
7. Gunson MJ, Arnett GW. Orthognathic virtual treatment planning for functional esthetic results. Sem Orthod. 2019; 25(3): 230-47.
8. Sayinsu K, Isik F, Arun T. Sagittal airway dimensions following maxillary protraction: a pilot study. Eur J Orthod. 2006; 28(2): 184-9. doi: 10.1093/ejo/cji095.
9. Ozbek M M, Memikoglu T U, Gögen H, Lowe A A, Baspinar E. Oropharyngeal airway dimensions and functional-orthopedic treatment in skeletal Class II cases. Angle Orthod. 1998; 68(4): 327-36. doi: 10.1043/0003-3219(1998) 068<0327:OADAFO>2.3.CO;2.
10. Aldosari M, Alqasir A, Algahtani N, Almosa N, Almoammar K, Albarakati S. Evaluation of the Airway Space Changes after Extraction of Four Second Premolars and Orthodontic Space Closure in Adult Female Patients with Bimaxillary Protrusion – A Retrospective Study. Saudi Dent J. 2020; 32(3):142-47. Doi: 10.1016/ j.sdentj.2019.11.004.
11. Al Maaitah E, El Said N, Alhaija Abu ES. First premolar extraction effects on upper airway dimension in bimaxillary proclination patients. Angle Orthod. 2012; 82 (5):853-9.
12. Bhatia S, Jayan B, Chopra SS. Effect of retraction of anterior teeth on pharyngeal airway and hyoid bone position in Class I bimaxillary dentoalveolar protrusion. Med J Armed Forces India. 2016; 72 (Suppl 1): S17-S23.
13. Stefanovic N, El H, Chenin DL, Glisic B, Palomo JM. Three-dimensional pharyngeal airway changes in orthodontic patients treated with and without extractions. Orthod Craniofac Res. 2013;

16(2): 87-96. doi: 10.1111/ocr.12009.
14. Chen K, Han X, Huang L, Bai D. Tooth movement after orthodontic treatment with 4 second premolar extractions. Am J Orthod Dentofacial Orthop. 2010; 138(6): 770-7. doi: 10.1016/j.ajodo.2009.01.030.
15. Shannon TP. "Oropharyngeal airway volume following orthodontic treatment: Premolar extraction versus non-extraction" (2012). Theses & Dissertations (ETD). Paper 231. http://dx.doi.org/10.21007/etd.cghs.2012.0284.

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