Face Vertical Dimension change and Incisors position Following Orthodontic Treatment with Extraction of Four First Premolars

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Introduction: The aim of this study was to evaluate vertical dimension of face and position of incisors following extraction of four first premolars in patients with class I malocclusion and bimaxillary dentoalveolar protrusion and/or crowding. **Materials and Methods:** This study evaluated 22 patients with class I molar relationship, bimaxillary dentoalveolar protrusion and/or crowding with the treatment plan of extraction of all four first premolars. The change in U1-PP, L1-MP, IMPA, U1-SN, saddle angle, articular angle, gonial angle, and the sum of Bjork was determined by assessing the before and after-treatment cephalograms. The changes in cephalometric parameters were analyzed by ANOVA and paired t-test. **Results:** The U1-SN, IMPA, U1-PP and sum of Bjork significantly changed following extraction of the four first premolars ($P<0.05$). However, the changes in saddle, articular and gonial angles and L1-MP were not significant ($P>0.05$). **Conclusion:** We observed retraction and extrusion of incisors and increase of vertical dimension following extraction. Retraction of incisors will relatively retract lips. Also, it is not advisable to extract premolars to improve vertical dimension, although extrusion of incisors will facilitate the bite closure.

Keywords: Premolar Extraction; Vertical Dimension; Orthodontics; Malocclusion; Crowding

Introduction

The debate over orthodontic treatment with or without extraction has continued from many year ago (1, 2). The extraction rate has decreased by 30 percent or more, but still is a vital option in treatment planning (2, 3). The most important diagnostic criteria for decision of each patient's treatment, are soft tissues of the facial profile, lip protrusion, arch length discrepancy and protrusion of mandibular incisors (4). Tooth size arch length discrepancy and bimaxillary dentoalveolar protrusion are the most important factors to extract teeth. Considering the vertical dimension and closing the open bite are debatable (2, 5).

Severe anterior crowding or lip protrusion is most commonly treated by extraction of first premolars. There is almost no difference in vertical dimension change between first and second premolar extraction (6).

Extraction of premolars can effect stability of treatment, facial morphology, soft tissue profile and facial height (7, 8). But effectiveness of extraction on soft tissue, vertical dimension and facial height is on debate.

Extraction may cause flatter profile (9). Some studies comparing profile changes between extraction and non-extraction treatments, confirmed that more retruded lips is seen in extraction treatments (10). On the contrary, other studies have declared that there is no difference in profile or lip position between extraction and non-extraction treatment (11). (We aimed to emphasize on controversy up on this subject)

Forward movement of the posterior teeth after extractions reduces vertical dimension and assists in closing openbite (10, 12, 13) . However some studies demonstrated no decrease in facial vertical dimension (6, 14).

Due to the controversies up on effect of extraction on position of incisors, soft tissue and vertical dimension, which are crucial criteria in deciding whether or not to extract, the aim of this study was to evaluate vertical dimension of face and position of incisors following extraction of four first premolars in patients with class I malocclusion and bimaxillary dentoalveolar protrusion and/or crowding.

Table 1. Changes in cephalometric parameters after orthodontic treatment and extraction of all four first premolars compared with the baseline values

Measurements	Pretreatment (Mean±SD)	Post-treatment (Mean±SD)	Change (Mean±SD)	*P*-Value	Significance
Saddle angle	123.28±3.8	124.23±3.9	3.2±1.94	0.119	NS
Articular angle	145.6±7.7	146.68±7.07	5.42±1.07	0.398	NS
Gonial Angle	129.84±9.19	128.05±7.07	-4.5±1.78	0.100	NS
Sum of Bjork	397.95±7.4	399.47±7.77	3.08±1.5	0.031	S
U1-SN	106.4±8.6	97.47±5.7	-9.34±8.93	0.000	S
IMPA	95.93±5.57	89.86±7.4	-6.06±6.2	0.000	S
U1-PP	31.45±3.22	32.49±3.4	2.44±1.03	0.048	S
L1-MP	43.77±3.85	44.23±4.6	2.56±0.46	0.404	NS

SD: Standard deviation, S: Significant, NS: Non-significant, U1: upper incisor, L1: lower incisor, SN: Sella-Nasion, PP: palatal plane, MP: mandibular plane, IMPA: incisor mandibular plane angle

Materials and Methods

This study was a retrospective study and written informed consent was taken from the patients. The sample consisted of a total of 22 Iranian patients, selected among those treated in the Orthodontic Department of Dental School of Tehran University of Medical Sciences, with class I malocclusion and bimaxillary dentoalveolar protrusion and/or crowding. The patients, whom treatment plan included extraction of all four first premolars were selected for this study. All patients were adults with a mean age of 16.38 years and were in the final stages of growth and development. The inclusion criteria was: (1) skeletally class I relationship and normodivergent with class I malocclusion, (2) no missing tooth, (3) orthodontic treatment by same protocol and MBT system. The patients with these criteria were excluded from study: (1) missing initial or final records, (2) class II or III primary malocclusion, (3) treatment plan included extraction of second premolars or asymmetrical tooth extraction, (4) young patients who had undergone serial extraction.

Cephalograms were obtained before initiation of treatment and extraction of all four first premolars and 6 to 12 months after completion of treatment. The cephalograms were obtained under standard conditions of natural head position (15) in habitual occlusion and relaxed position of the lips (16).

The lateral cephalograms were traced manually by one orthodontist who was also a faculty member of the university, and the cephalometric reference points were identified on acetate tracing paper. The Frankfurt plane was drawn as a horizontal reference line. A line perpendicular to this plane was also drawn from the glabella as the vertical reference line. The difference in size of angles (in degrees) and the difference in linear distances (in millimeters) were determined as the changes following extraction of all four premolars. The difference in magnification of cephalograms was adjusted for by standardizing the SN line separately for each patient. To assess the reliability of the measurements, the cephalograms were traced again by the same person after 1 month and the intra-examiner reliability of tracings was calculated to be 0.85, which indicated a high reliability. The cephalometric parameters included the angular and linear variables.

The data were analyzed using the SPSS software version 20.0 (IBM Corp, Chicago, IL). The measures of central dispersion of the vertical parameters before and after orthodontic treatment were calculated and reported for patients. Since the parameters were quantitative and their data were normally distributed (confirmed by the Kolmogorov-Smirnov test), their change after treatment in comparison with the baseline preoperative state was analyzed using the paired t-test and ANOVA. Type one error was considered to be 0.05 (α=0.05) and Significance level was set to $P \leq 0.05$.

Results

The mean change of post-treatment compared with pretreatment (Table 1), was significant for the mean value for the sum of Bjork (*P*=0.031), U1-SN angle (*P*=0.000) and IMPA angle (*P*=0.000) and U1-PP (*P*=0.048). But it was not significant for the mean size of saddle angle (*P*=0.119), articular angle (*P*=0.398), gonial angle (*P*=0.100) and the mean length of L1-MP (*P*=0.404).

Gonial angle was decreased after treatment (the mean change=-4.5±1.78), however it was not significant. But sum of Bjork was significantly increased after treatment (the mean change=3.08±1.5) (Table 1).

Also, both of U1-SN (the mean change=-9.34±8.93) and IMPA (the mean change=-6.0.6±6.2) angles was significantly decreased after treatment. The length of U1-PP and L1-MP was both increased (respectively, the mean change=2.44±1.03, 2.56±0.46), but it was just significant for U1-PP (Table 1).

Discussion

In this study, we evaluated the vertical dimension and position of incisors following extraction of four first premolars in patients with class I malocclusion and bimaxillary dentoalveolar protrusion and/or crowding, by comparing angular and linear cephalometric parameters before and after treatment.

The extraction rate according to Konstantonis *et al.*, is 26.8 %. The upper and lower crowding, lower lip to E-plane and overjet are the most important criteria for extraction (17).

In this study, U1-SN angle and IMPA was decreased (P=0.000). The mean length of U1-PP and L1-MP was increased, however it was statistically significant at U1-PP (P=0.048).

Upper incisor retraction to upper lip retraction ratio, has been shown between 1.4:1 to 3.6:1 (18).

Bravo observed retraction of upper and lower lip to the E-line and reduction in upper and lower lip protrusion relative to Sn-Pog′ line following extraction, but only 12 % of patients finished treatment with obviously flattened profile (7). Kocadereli (10) and Bravo *et al.* (19) showed more retrusive upper and lower lip after extraction treatment in patients with class I malocclusion. Bowman *et al.* evaluating the effect of extraction in class I and class II Caucasian patients, found an average 1.8 mm flatter faces after extraction treatment rather than non-extraction treatment (20). The results of these studies are consonant with our study.

On the contrary, Basciftci *et al.* evaluating effect of extraction in class I and class II patients, found no differences in soft tissue and facial profile between extraction and non-extraction groups, however incisors was more protruded after non-extraction treatment (11). In addition, Stephens *et al.* investigated long term differences in profile between extraction and non-extraction patients and observed no significant differences between two groups at long-term follow-up. They concluded that if extraction and non-extraction treatments causes the same incisor and lip position, the treatment type does not influence long-term soft tissue profile changes (21). In our study, extraction caused more retrusive incisors which will relatively result in retrusive lips and it is not consonant with the mentioned study. Verma *et al.* showed same soft tissue profiles after extraction and non-extraction treatment in class II division 1 patients, except more retrusive lower lip in extraction patients (4). In this study, patients had class I malocclusion that could have different results than class II malocclusion.

In our study, saddle angle and articular angle were increased and gonial angle was decreased, that were not statistically significant. With the exception of sum of Bjork (P=0.031), that may implicate vertical dimension changes.

Hans *et al.* showed intrusion of maxillary and mandibular incisors, 4.1mm decrease in overbite and no increase in vertical height of mandible after extraction of four first premolars (2). But, we observed extrusion of incisors and total increase of facial vertical dimension after extraction. The difference may be due to different treatment mechanics, which was Tweed edgewise treatment in the mentioned study. Also, Kim *et al.* declared no significant change in facial vertical dimension after extraction of four first or second premolar extraction (6). Same as this study, Ramesh *et al.* reported no changes in overbite and vertical dimension after first premolar extraction in class I high angle patients (14).

Kirschneck *et al.* found that in short-term after extraction of premolars, retraction of incisors and slightly more concave lip profile is observable, which is consonant with our study. But also they exhibited not significant vertical change after extraction, opposing the results of our study (22).

Sivakumar *et al.* comparing normodivergent patients with or without extraction, exhibited increase in vertical dimension after treatment in both groups, but greater in extraction group. They suggested not to extract teeth only to increase the overbite (23). Kumari *et al.* exhibited increase in vertical dimensions after extraction treatment, however it was not statistically significant (24).

Conclusion

This study showed extraction of four first premolars cause retraction and extrusion of incisors and increase of vertical dimension in class I patients in Iranian population. The sample size of the study prohibits a definitive conclusion. Retraction of incisors may relatively retract lips, improving facial profile with protrusive lips. Also, it can be deduced that is not justifiable to extract premolars to decrease vertical dimension and increase overbite.

Conflict of Interest: 'None declared'.

References

1. Rossouw PE, Preston CB, Lombard C. A longitudinal evaluation of extraction versus nonextraction treatment with special reference to the posttreatment irregularity of the lower incisors. Semin Orthod. 1999;5(3):160–70.
2. Hans MG, Groisser G, Damon C, Amberman D, Nelson S, Palomo JM. Cephalometric changes in overbite and vertical facial height after removal of 4 first molars or first premolars. Am J Orthod Dentofac Orthop. 2006;130(2):183–8.
3. Kravitz ND, Kusnoto B, BeGole E, Obrez A, Agran B. How well does Invisalign work? A prospective clinical study evaluating the efficacy of tooth movement with Invisalign. Am J Orthod Dentofac Orthop. 2009;135(1):27–35.
4. Verma S, Sharma V, Tandon P, Singh G, Sachan K. Comparison of esthetic outcome after extraction or non-extraction orthodontic treatment in class II division 1 malocclusion patients. Contemp Clin Dent. 2013;4(2):206.
5. Taner-Sarisoy L, Darendeliler N. The influence of extraction orthodontic treatment on craniofacial structures: evaluation according to two different factors. Am J Orthod Dentofacial Orthop. 1999;115(5):508–14.
6. Kim TK, Kim JT, Mah J, Yang WS, Baek SH. First or second premolar extraction effects on facial vertical dimension. Angle Orthod. 2005;75(2):177–82.
7. Bravo L. Soft tissue facial profile changes after orthodontic treatment with four premolars extracted. Angle Orthod. 1994;64(1):31-42.
8. Sabri R. The eight components of a balanced smile. J Clin Orthod. 2005;39(3):155–67. Available from: www.jco-online.com
9. Drobocky O, And RS. Changes in facial profile during orthodontic treatment with extraction of four first premolars. Am J Orthod Dentofac Orthop. 198995(3):220–30.
10. Kocadereli I. Changes in soft tissue profile after orthodontic treatment with and without extractions. Am J Orthod Dentofac Orthop. 2002;122(1):67–72.
11. Basciftci FA, Usumez S. Effects of extraction and nonextraction treatment on class I and class II subjects. Angle Orthod. 2003;73(1):36–42.
12. Cusimano C, RM-J of clinical, 1993 U. Effects of first bicuspid extractions on facial height in high-angle cases. J Clin Orthod. 1993;27(11):594–8.
13. Chua A, Lim J, And EL-AJ of O, 1993 U. The effects of extraction versus nonextraction orthodontic treatment on the growth of the lower anterior face height. Am J Orthod Dentofac Orthop [Internet]. 1993;104(4):361–8.
14. Ramesh GC, Pradeep MC, Arun Kumar G, Girish KS, Suresh BS. Over-Bite and vertical changes following first premolar extraction in high angle cases. J Contemp Dent Pract. 2012;13(6):812–8.
15. Solow B, Tallgren A. Natural head position in standing subjects. Acta Odontol Scand. 1971;29(5):591–607.
16. Burstone C. Lip posture and its significance in treatment planning. Am J Orthod Dentofac Orthop. 1967;53(4):262–84.
17. Konstantonis D, Anthopoulou C, Makou M. Extraction decision and identification of treatment predictors in Class I malocclusions. 2013;1–8.
18. Alkadhi RM, Finkelman MD, Trotman CA, Kanavakis G. The role of lip thickness in upper lip response to sagittal change of incisor position. Orthod Craniofacial Res. 2019;22(1):53–7.
20. Bowman SJ, Jr LEJ. The Esthetic Impact of Extraction and Nonextraction Treatments on Caucasian Patients. Angle Orthod. 2000;70(1):3–10.
21. Stephens C, Boley J, RB-A journal of, 2005. Long-term profile changes in extraction and nonextraction patients. Am J Orthod Dentofac Orthop. 2005;128(4):450–7.
22. Kirschneck C, Proff P, Reicheneder C, Lippold C. Short-term effects of systematic premolar extraction on lip profile, vertical dimension and cephalometric parameters in borderline patients for extraction therapy-a retrospective cohort study. Clin Oral Investig. 2016 May 1;20(4):865–74.
23. Sivakumar A, And AV-A journal of orthodontics. Cephalometric assessment of dentofacial vertical changes in Class I subjects treated with and without extraction. Elsevier. 2008;133(6):869–75.
24. Fida M, Kumari M. Vertical facial and dental arch dimensional changes in extraction vs. non-extraction orthodontic treatment. Vol. 20, Journal of the College of Physicians and Surgeons Pakistan. 2010.

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