Original Research

A Comparative Study of Dentoskeletal Changes Following Orthodontic Treatment with First Premolar Extraction in Long Face and Normal Patients

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Abstract

Introduction: The purpose of this study was to evaluate vertical facial and dental changes after orthodontic treatment with extraction of first four premolars, and to find whether long facial height could influence the treatment result. **Methods:** Fifty-six orthodontic patients with the minimum age of 15, whose treatment plan involved extracting four first premolars, participated in the study. The patients included 30 females and 27 males. Cephalometric measurements before and after treatment were compared using a paired T-test. Independent T-test was employed to compare post treatment changes for each parameter between normal and long face groups. The same analysis performed between male and female subjects. **Results:** Treatment changes revealed a significant increase in the vertical distance from the upper molar to palatal plane, the lower molar to mandibular plane and Menton to palatal plane in all groups. There was significantly more increase in most post-treatment linear measurements in males than in females, with the same direction in both genders. There were no significant differences between normal and long face in any measurement. **Conclusion:** All patients showed some extrusion of the molar teeth after extraction of the premolars. The difference between normal and long face groups was not significant.

Key Words: Extraction, facial height, orthodontic treatment.

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Introduction

To extract or not to extract has long been a crucial question in planning orthodontic treatment. There are two main reasons for extracting tooth; creating the necessary space to align the remaining teeth in case of severe crowding, and providing the opportunity for movement of the teeth when the aim is to correct Class II or Class III malocclusions or to reduce dental protrusion (1). The teeth chosen to be extracted for orthodontic purposes are often the first premolars (2). Since its introduction to orthodontics, extracting teeth was studied for its influence on occlusion and the resulting facial profile (3-5). Russell (1) showed that extracting teeth will bring about changes in facial profile and will help aligning the remaining teeth and reducing the lower facial height. In the same year, another study showed no significant difference in facial vertical changes between extraction and non-extraction groups although it found a general increase in vertical dimensions of both groups (6).

Except for the position of the incisors, studies have shown similar changes of both soft and hard tissues after orthodontic treatment with or without extraction

(7-9). Other criteria like incisor retraction, crowding, and the size of the teeth rather than changing the facial height are recommended to be taken into account when deciding on premolar extraction (10). The vertical changes that occur after extraction of the premolars were not significantly different from non-extraction treatment (11). In his study on the effects of facial pattern on the result of treatment with extraction, Hirschtelder et al. (12) concluded that the growth pattern of each person will have minimal relationship with the result of treatment. Furthermore, studies on the effects of extraction in brachyfacial and dolicofacial patients showed no difference in the movement of molar teeth between different facial types. They also found no significant changes in facial axis among different facial types or treatment plans (13).

The purpose of this study was to compare vertical facial and dental changes after orthodontic treatment with extraction of first four premolars in patients with normal and long facial heights.

Materials and Methods

Fifty-six patients (30 females and 27 males) with the minimum age of 15 years, admitted to a private orthodontic office, participated in this comparative study. All the patients were required to have their upper and lower premolars extracted as a part their orthodontic treatment plan. The participants were divided into two groups according to their gender. Both male and female groups were categorised into two groups of normal-face and long-face patients based on the following cephalometric indices: Y-axis to FH (Frankfurt horizontal plane) angle, GoGn (Gonion- Gnathion) to SN (Sella-Nasion) angle and the posterior facial height to the anterior facial height (PFH/AFH) ratio. In the male group, 12 patients had a normal face and 14 possessed a long face, while in the female group there were 14 normal-face and 16 long-face individuals. All the participants met the following criteria:

- No remaining growth
- Class I malocclusion
- Treatment done by the same orthodontist, with edgewise technique, and minimal use of inter-maxillary elastic.
- Extraction of first upper and lower premolars
- Lateral cephalograms taken before the treatment and right after that with the same device

The pre- and post-treatment cephalograms were traced on acetate papers (Ortho Technology Inc.) and 16 landmarks were determined by the same operator. Linear and angular indices were measured according to their definition (14) (Figs. 1,2).

A paired T-test was used to compare the pre- and post-treatment measurements. The P-value less than 0.05 was considered significant. The mean changes of each variable between male and female patients as well as between normal and log face individuals were compared by an independent T-test.

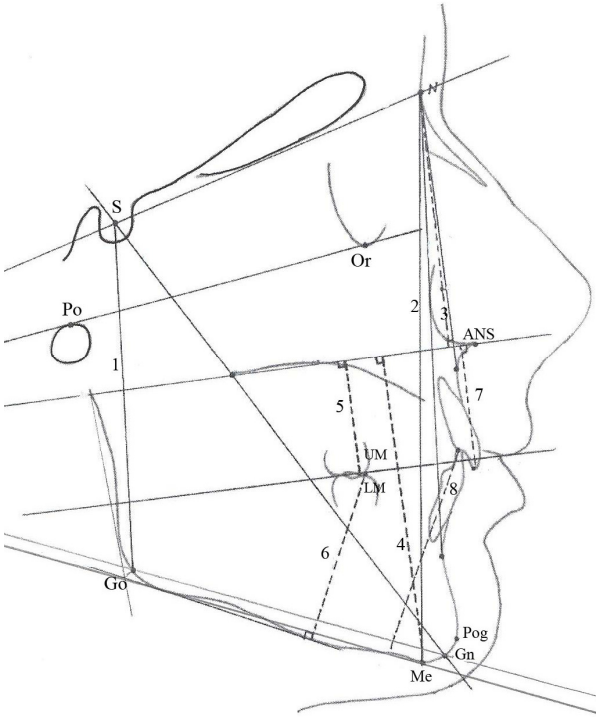

Figure 1. Linear cephalometric indices: 1- S-Go; 2- N-Me; 3- N ⊥ PP; 4- Me ⊥ PP; 5- Mesiobuccal cusp of upper first molar perpendicular to PP (UM⊥ PP); 6- Mesiobuccal cusp of lower first molar perpendicular to MP (LM⊥ MP); 7- Incisal edge of upper incisor perpendicular to PP (U1 ⊥ PP); 8- LI ⊥ MP

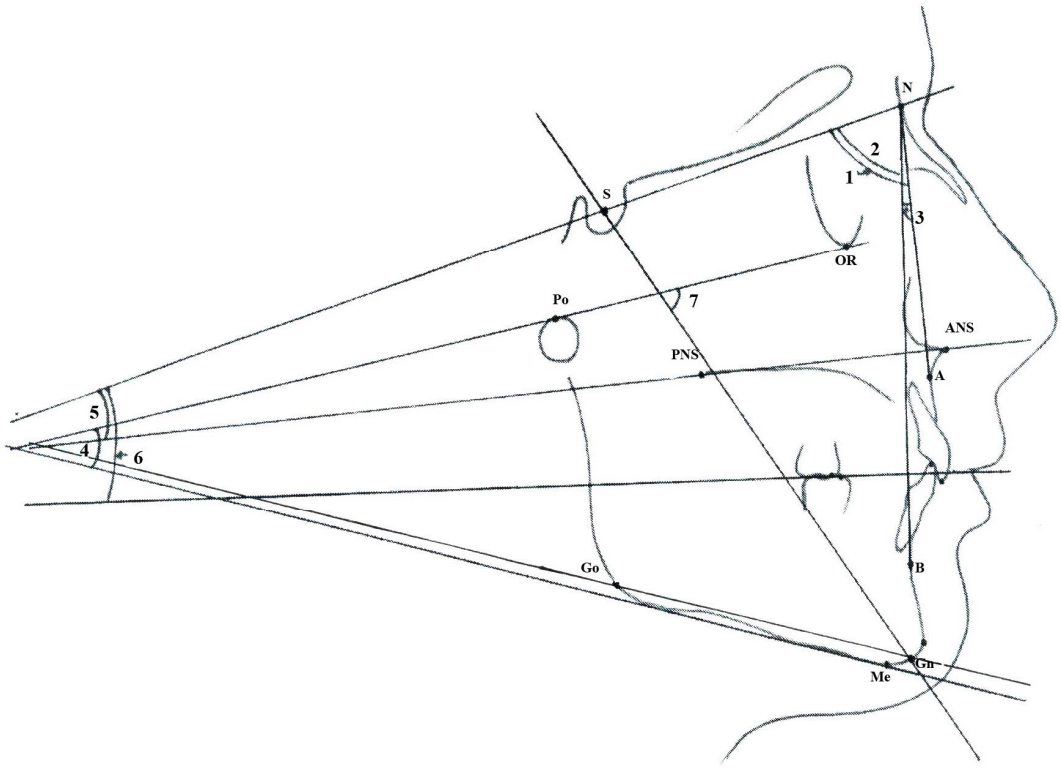

Figure 2. Angular Cephalometric indices: 1- SNA (Sella- Nasion to A point); 2- SNB (Sella- Nasion to B point); 3- ANB (A point - Nasion – B point); 4- GoGn-Sn (Gonion-Gnation to Sella-Nasion); 5- PP-SN (Palatal plane to Sella Nasion); 6- Occl-SN (Occlusal plane to Sella-Nasion); 7- Yaxis angle (Y-axis to FH)

Results

To determine the measurement error, 20 patients were randomly selected and their radiographs were traced again one month after the first measurement. Statistical analyses showed the confidence of 95%.

Although there was an increase in all post-treatment liner measurements, three were statistically significant: the vertical distance between the mesiobuccal cusp of the first upper molar (UM) and the palatal plane (PP), the vertical distance between the mesial cusp of the first lower molar (LM) and the mandibular plane (MP) and the vertical distance from Menton (Me) to the palatal plane (PP) had a significant increase in all groups (Table 1).

The ratio between Nasion (N) to PP and Me to PP showed a significant decrease. None of the pre- and post-treatment angular measurements changed significantly, except for the Y-axis to FH angle in long face males which increased significantly (Table 2).

The mean changes in UM to PP, LM to MP and U1 to PP distances after treatment were significantly higher in males. In addition, post-treatment Sella (S) to Gonion (Go), Me to PP, and N to PP distances as well as Y-axis to FH angle were significantly higher in males than in females. None of the indices showed significantly different changes between long-face and normal groups.

Table 1. Comparison of cephalometric measurements before and after treatment

		Normal-face female			Long-face female			Normal-face male			Long-face male		
		Mean	**SD**	**P-value**	**Mean**	**SD**	**P-value**	**Mean**	**SD**	**P-value**	**Mean**	**SD**	**P-value**
SNA	**Before**	81.57	3.83	0.888	78.75	3.73	0.289	81.57	3.08	0.775	76.67	3.68	0.111
	After	81.64	3.73		78.44	3.65		81.64	3.36		76.17	3.38	
SNB	**Before**	77.79	2.91	0.500	74.25	4.95	0.265	77.93	2.70	0.512	72.92	3.23	0.044
	After	77.50	3.00		68.94	18.20		77.71	2.89		72.08	3.19	
ANB	**Before**	3.71	2.09	0.290	5.13	2.19	0.150	3.64	2.34	0.365	3.83	2.08	0.339
	After	4.14	1.70		5.63	1.59		3.93	2.37		4.17	1.99	
Y-axis-	**Before**	66.36	2.98	0.793	68.69	5.39	0.230	68.21	3.29	0.075	68.50	3.55	0.019*
FH	**After**	66.50	3.46		69.31	4.96		69.57	3.52		70.67	3.45	
N ⊥ PP	**Before**	55.43	2.76	0.861	56.69	2.55	0.743	58.57	3.39	0.001*	57.92	2.43	0.046*
	After	55.36	3.25		56.81	2.14		59.93	3.63		58.92	2.39	
PP ⊥ Me	**Before**	65.36	3.73	0.013*	71.09	5.08	0.002*	75.00	5.11	0.002*	76.17	3.35	0.000*
(AFH)	**After**	67.21	4.19		72.44	5.760		78.36	4.88		79.50	2.58	
S-Go	**Before**	79.64	4.11	0.209	74.69	4.45	0.904	87.64	3.61	0.000*	80.00	3.69	0.003*
(PFH)	**After**	80.43	5.65		74.75	4.31		91.86	4.22		82.83	4.47	
N-Me	**Before**	121.86	5.33	0.068	129.44	7.28	0.173	134.14	3.53	0.000*	136.50	4.83	0.661
	After	123.64	6.88		130.38	6.23		139.71	5.66		132.67	28.69	
Occl-SN	**Before**	16.57	2.50	0.346	22.06	3.75	0.094	15.43	2.85	0.010*	21.83	2.95	0.509
	After	16.07	3.05		21.38	3.79		13.43	3.97		21.33	3.96	
PP-SN	**Before**	9.64	2.76	0.665	11.38	3.28	0.709	7.57	3.39	0.385	10.17	2.89	1.000
	After	9.79	2.12		11.56	2.92		8.00	3.76		10.17	2.48	
LI⊥MP	**Before**	43.64	2.82	0.038*	47.00	3.92	0.453	47.64	4.12	0.002*	46.83	4.22	0.453
	After	45.00	2.63		47.31	3.36		50.21	4.46		47.67	4.48	
UI⊥PP	**Before**	28.50	1.29	0.212	31.56	2.83	0.237	31.86	2.25	0.009	33.50	2.75	0.023
(mm)	**After**	28.93	1.49		31.88	2.80		33.36	2.40		34.67	2.87	
IM⊥PP	**Before**	23.07	.917	0.002*	25.38	2.42	0.000*	26.36	2.44	0.000*	26.67	1.92	0.000*
(mm)	**After**	24.50	1.51		26.38	2.45		29.14	2.54		29.17	1.70	
LM⊥MP	**Before**	34.64	2.79	0.000*	37.44	3.58	0.001*	38.93	3.43	0.000*	37.50	2.80	0.000*
(mm)	**After**	36.64	2.65		38.69	2.80		41.43	3.97		40.17	3.16	
(N⊥PP)/	**Before**	31.92	2.60	0.286	42.31	3.99	0.362	33.91	1.81	0.703	42.64	3.64	0.269
(PP⊥Me)	**After**	31.08	2.90		42.56	4.24		33.73	1.68		43.27	4.10	
(N ⊥PP)/	**Before**	.8503	.059	0.012*	.7973	.06	0.180	.7857	.09	0.042*	.7609	.029	0.001*
(PP⊥Me)	**After**	.8245	.036		.7842	.07		.7685	.080		.7414	.029	
PFH/AFH	**Before**	.6535	.014	0.320	.5776	.03	·.411	.6535	.03	0.342	.5862	.023	0.720
	After	.6503	.021		.5737	.03		.6577	.02		.5875	.025	

Table 2. Comparison of mean changes during treatment between different facial heights and different genders

	Male		Female		P-value	Normal		Long face		P-value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
SNA	-.1923	.98	-.1333	1.50	0.865	.0714	1.44	-.3929	1.07	0.176
SNB	-.5000	1.24	-2.9667	13.48	0.357	-.2500	1.35	-3.3929	13.89	0.116
ANB	.3077	1.12	.4667	1.36	0.638	.3571	1.28	.4286	1.23	0.939
Y-axis-FH	1.7308	2.65	.4000	1.98	0.036*	.7500	2.37	1.2857	2.42	0.406
N ⊥ PP	1.1923	1.33	.0333	1.47	0.003*	.6429	1.50	.5000	1.55	0.517
PP ⊥ Me (AFH)	3.3462	2.70	.7000	3.24	0.002*	2.6071	2.91	1.2500	3.49	0.120
S-Go (PFH)	3.5769	2.98	.4000	2.13	0.000*	2.5000	3.23	1.2500	2.66	0.120
N_ME	1.2308	20.28	1.3333	2.96	0.978	3.6786	3.87	-1.1071	19.07	0.083
Occl-SN	-1.3077	2.57	-.6000	1.69	0.238	-1.2500	2.30	-.6071	1.99	0.268
PP_SN	.2308	1.58	.1667	1.62	0.882	.2857	1.49	.1071	1.71	0.678
LI ⊥ MP	1.7692	3.15	.8000	1.95	0.167	1.9643	2.36	.5357	2.67	0.101
UI ⊥ PP	1.3462	1.67	.3667	1.10	0.011*	.9643	1.62	.6786	1.31	0.919
UM ⊥ PP	2.6538	1.13	1.2000	1.10	0.000*	2.1071	1.40	1.6429	1.22	0.191
LM ⊥ MP	2.5769	1.27	1.6000	1.33	0.007*	2.2500	1.38	1.8571	1.38	0.291
Go-Gn-SN	.2273	1.69	-.2414	2.03	0.385	-.5417	2.25	.4074	1.39	0.073
(N ⊥ PP)/ (PP ⊥ Me)	-0.0183	0.02	-0.0083	0.05	0.319	-0.0215	0.03	-0.0043	0.04	0.083
(PFH/AFH)	0.0032	0.01	-0.0036	0.02	0.080	0.0004	0.01	-0.0013	0.02	0.660

*Indicates significant finding

Discussion

In this study, we selected dental and skeletal Class I patients who had already passed the growth spurt of puberty and been treated with the least possible use of inter-maxillary elastics to minimize the risk of molar extrusion. In all four groups, the analysis of linear distances indicated some increase after orthodontic treatment. As all the patients in this study were in post-pubertal period, we did not take the residual growth effect into account. All the linear measurements after treatment showed an increase, which could indicate some extent of growth during the course of treatment. The results showed significant extrusion of the molars during treatment, which happened despite the fact that the use of inter-maxillary elastics was minimal. A deduction might be that orthodontic mechanics are extrusive. In orthodontic treatment, the aim of extracting the first premolars is to reduce severe anterior crowding or alleviate lip protrusion. Therefore, the space gained through extraction is used for retracting the incisors or reducing the crowding. The fact that tooth movement includes some extrusion in orthodontic treatment needs to be taken into account especially during adulthood when the vertical growth of the ramus or posterior alveolar bone cannot completely compensate molars' extrusion and the result will be an increase in the facial vertical height (15).

Some studies had claimed that the extraction of first premolars can cause a decrease in facial vertical dimensions (1,16). It was explained that the forward movement of the molars after extraction of the premolars would cause a collapse in mandibular alveolar bone and a decrease in facial height. Others did not support the hypothesis (6). Although Chua et al. (17) study showed that extraction had no significant effect on facial height; later studies concluded that there is an increase in vertical dimensions when treatment includes extraction (11,18,19). We also found a significant increase in the lower anterior facial height (Me ⊥ PP), which might be the effect of the remaining vertical growth. Even though in both genders the

direction of changes were similar, the mean changes in Y-axis to FH angle as well as in Me to PP, N to PP, S-Go, UM to PP, LM to PP and U1 to PP distances were significantly higher in males than in females which could be explained by the older age of puberty in males. This was consistent with the results of Bishara et al. studies (20,21) in which he showed greater changes in liner dimension in males (although with the same direction as in females) and stated that gender cannot be considered as a determinative factor for significant differences in post-treatment trend. The results of this study indicated that the post-treatment changes did not differ significantly between long face and normal patients. This was similar to the studies that showed a minimal relationship between growth pattern of individuals and their orthodontic treatment results (12,22) or no significant difference in molar movement and facial changes between different facial types (13) despite the fact that another study reported a significant difference in the lower posterior dentoalveolar height and the mandibular molars' extrusion between normal and hyper-divergent faces (23).

Conclusion

It appears that all of the orthodontic patients had some dental extrusion after the extraction of four first premolars during fixed orthodontic treatment. The difference between normal and long face patients was not significant.

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