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THE EFFECTS OF EXTRACTIONS IN FACIAL VERTICAL CHANGES

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The purpose of this investigation were to evaluate facial vertical changes occurring in patients treated orthodontically with first premolar, second remolar and second molar extractions ; to compare these changes with those occurring in patients treated orthodontically without extractions ; and finally, to evaluate the effects of extractions in facial vertical changes.

Cephalometric records of 50 male & female nonextraction patients and 88 male & female extraction patients were obtained from the department of orthodontics at Chosun University, College of Dentistry. The second molar fully erupted patients to have little variation according to growth were chosen as the sample for this investigation. For comparisons, the samples of 88 male & female extraction patients were subdivided into 42 first premolar extraction, 24 second premolar extraction, and 22 second molar extraction patients. Fourteen cephalometric measurements were selected to examine whether orthodontic extraction treatment led to vertical changes or not. The pretreatment and posttreatment lateral cephalographs were taken on the same radiographic unit. SPSS/PC$^+$ statistical program was used to compare and to analyze the changes between "before & after" orthodontic treatment. The results of this study were as follows :

1. There were no statistical significances in any cephalometric measurements between "before & after" orthodontic treatment regardless of orthodontic extractions for each group.
2. On average, the upper 6 to palatal plane and the lower 6 to mandibular plane after orthodontic treatment were increased in all group. This means most of orthodontic mechanics are extrusive in nature. Especially, in orthodontic extraction cases, it may be caused by orthodontic mechanics for space closure and alignments.
3. On average, in the second molar extraction group, the facial vertical dimension was increased after orthodontic treatment. It may be induced as a result of moving the molars distally to gain enough space to correct the molar relationship and to simultaneously improve the deep bite.
4. There was no statistical significance between orthodontic extractions and facial vertical changes. This means that orthodontic extractions have no influence on facial vertical changes.
5. The cephalometric measurements with statistical significance in ficial vertical changes for each group were PP-MP, Op-MP, $\underline{1}$ to PP and $\overline{1}$ to MP.

Key Words : facial vertical change, extraction

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To establish optimal proximal and occlusal contact of the teeth within the framework of acceptable facial esthetics, normal function and reasonable stability has been proposed for the treatment goals of orthodontics[1)]. One of the efforts of achieving these golas, the prediction of facial vertical changes by orthodontic extractions, has been greatly issued in orthodontics due to the close relationship of the orthodontic treatment results as well as facial esthetics.

But the effects of orthodontic extractions on the rotation of the mandible as an aid in the prediction of facial vertical changes have been debated in current orthodontics[7,8,13,20,26,27,29,30,44]. Generally, it is well known that the facial morphogenetic pattern and the treatment procedures may have a profound effect on the position of mandible[2,5,6,7,9,11,14,16,19,21,22,28,29,30,43]. In patients with long facial height accompanied by open bite, it may be appropriate to move the molars mesially to decrease the vertical dimension, to correct the intermolar relationship, or to simultaneously improve the open bite. In patients with short facial height, however, these procedures may prove detrimental.

Many clinicians believe that extraction of premolars with large anterior facial height and a steep mandibular plane, even when dental and skeletal discrepancies are deemed to be mild, may allow anterior rotation of the mandible following mesial movement of the molars [11,16,23]. The mandible is then allowed to overclose, and the masticatory muscles become contracted. As a result of the decreased vertical dimension, they also suggest that the condyles are posteriorly displaced in the condylar fossa and TMJ problems are likely to occur[3,18,36,39,40,42].

Since the 1970s, as the functional occlusion concept has been conceretely applied to orthodontic treatment, functional orthodontists[24,25,31,32,33,35,37,38,41] have emphasized the correct position of condyle and the maintenance of centric relation position when the teeth occlude in maximum intercuspation, which produces the greatest neuromuscular efficiency during function and stability in a static position. They have believed that a decrease in the vertical dimension of occlusion in orthodontic treatment may lead to a vertical distraction of the condyles with a forward and often lateral posturing of the mandible.

On the contrary, although this theory is popular, no controlled scientific studies have published results supporting this hypothesis. If the vertical dimension of occlusion is a critical etiologic factor in TMJ disorders, a high incidence of TMJ problems among totally edentulous patients would be expected. Yet this has not been reported in the literature. The lack of a high incidence of TMJ disorders among edentulous patients suggests that the vertical dimension of occlusion may not be a major etiologic factor as some believe. Gianelly[12] investigated condylar position in orthodontic patients treated with the extraction of first premolars and compared them with nonorthodontically treated controls. He found no differences in condylar position between the extraction group and the nonorthodontically treated controls.

Staggers[34] observed that the vertical changes occurring after the extraction of first premolars were not different than those occurring in the nonextraction cases. In addition, he found that orthodontic treatment, both extraction and nonextraction, resulted in an mean increase in the cephalometric parameters that were examined. Ahlgren et al[2] found no relationship between morphologic features in skeletal deep bite or open bite and activity of masticatory muscles, and Yildrim et al[44]. found no differences in the opening force between patients with high and low mandibular plane angles. Therefore, anterior displacement of the molars during orthodontic treatment may not be of any consequence in closing of an open bite.

But, even if may be true that posterior displacement of the condlyes have not been associated with TMJ disorders, it is hard to rationalize the belief of "functional orthodontists" who promote the posteriorly displaced condyle theory along with the loss of vertical dimension.

Still, there have been considerable controversies as to whether orthodontic extractions can result in facial vertical changes. With this is mind, the purposes of this investigation were to evaluate facial vertical changes occurring in patients treated orthodontically with first premolar, second premolar and second molar extractions ; to compare these changes with those occurring in patients treated orthodontically without extractions ; and finally, to evaluate the effects of extractions in facial vertical changes.

II. MATERIALS AND METHODS

1. MATERIALS

Cephalometric records of 50 male & female nonextraction patients and 88 male & female extraction patients were obtained from the department of orthodontics at Chosun University, College of Dentistry. The pretreatment age of the nonextraction group ranged from 16 years, 4 months to 28 years, 9 months with the mean age of 18 years, 2 months. The pretreatment age of the extraction group ranged from 14 years, 2 months to 27 years, 4 months.

For comparisons, the samples of 88 male & female extraction patients were subdivided into 42 first premolar extraction, 24 second premolar extraction, and 22 second molar extraction patients. The second molar fully erupted patients to have little variation according to growth were chosen as the sample for this investigation.

The number and age distributions were shown in Table 1-2. Each patient had been treated conventional edgewise appliances as a part of their orthodontic treatment.

Table 1. Number and age distributions of all groups

	Number	Age(Years)	
		Mean	Range
NON-EXTRACTION	50	18.2	16.4-28.9
EXTRACTION	88	17.0	14.2-27.4

Table 2. Number and age distributions of extraction groups

	Number	Age(Years)	
		Mean	Range
1st PREMOLAR ETRACTION	42	17.5	14.2-25.2
2nd PREMOLAR ETRACTION	24	16.4	14.9-23.2
2nd MOLAR EXTRACTION	22	17.1	15.0-27.4

2. cephalometric analysis

Pretreatment and posttreatment lateral cephalograms were taken on the same radiographic unit. For both the extraction and the nonextraction groups, pretreatment and postteatment cephalometric values were traced on frosted acetate and subsequently digitized on a digitizing board by one operator. Landmarks, as shown in Fig. 1., were located on each tracing prior to

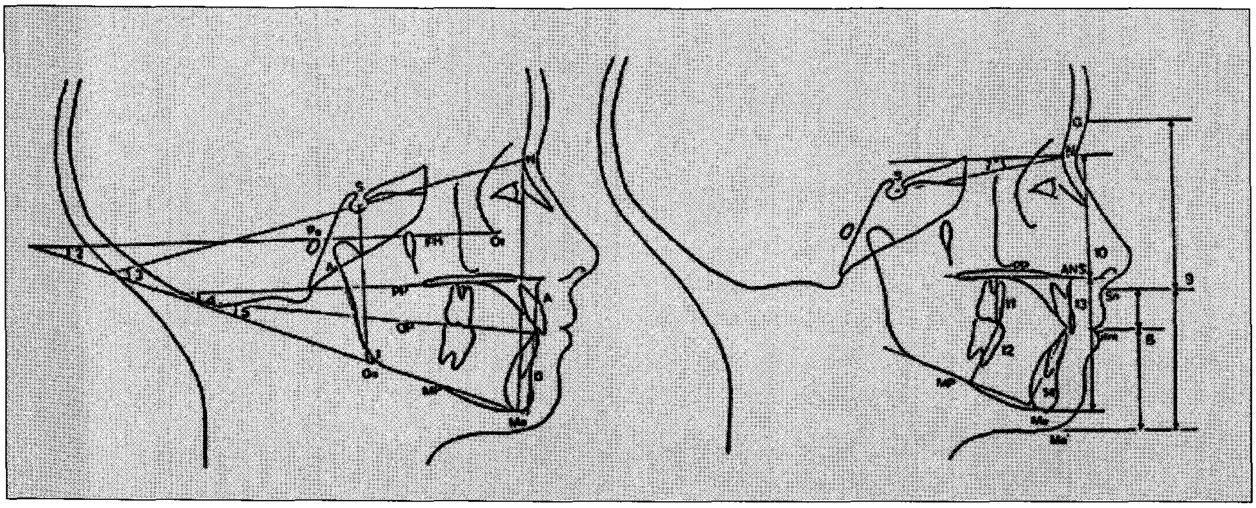

Fig. 1. Cephalometric legends used in this study, "angles, index, ratios and linear measurements" : 1. Ar-Go-Me 2. FH-MP 3. SN-MP $. PP-MP %. OP-MP 6. ODI(NS) 7. FHR(NS) 8. Sn-Stms/Stmi-Me' 9. G-Sn/Sn-Me' 10. N-ANS/ANS-Me 11. 6 to PP 12. 6 to MP 13. 1 to PP 14. 1 to MP *NS=not shown

digitizing. The Quick Ceph Image(QCI) program(Orthodontic Processing, 1990-1994 by Dr. Günther Blaseio) was used to calculate the various skeletal and dental measurements described in Fig. 1. Only vertical cephalometric measurements were chosen for the purpose of this study.

Fourteen cephalometric measurements were selected to evaluate facial vertical changes(Fig. 1). the cephalometric values examined were gonial angle(Ar-Go-Me), FH plane to mandibular plane angle(FH-MP), SN plane to mandibular plane angle(SN- MP), palatal plane to mandibular plane angle(PP-MP), occlusal plane to mandibular plane angle(OP-MP), overbite depth indicator(ODI, A- B to mandibular plane angle ± palatal plane to FH plane angle), facial height ratio(S-Go/Na-Me).

And also, as described by Burstone[4] and Legan[17], lower soft tissue facial height ratio(Sn-Stms/Stmi-Me′), soft tissue facial height ratio(G-Sn/Sn-Me′), anterior facial height ratio(N-ANS/ANS-Me), maxillary first molar to the palatal plane($\underline{6}$ to PP), , mandibular first molar to the mandibular plane(6 to MP), maxillary central incisor to the palatal plane($\underline{1}$ to PP) and mandibular central incisor to the mandibular plane($\overline{1}$ to MP) were examined. The cephalometric measurements surveyed were summarized in Fig. 1.

3. STATISTICAL ANALYSIS

Pretreatment values were substacted from posttreatment values to obtain the amount of facial vertical changes produced by orthodontic treatment, and the means and standard deviations for each sample were calculated.

The paired t-test were used to test for the differences between "before & after" orthodontic treatment : 1) nonextraction group 2) total extraction group 3) first premolar extraction group 4) second premolar extraction group 5) second molar extraction group.

Student's t-tests were used to test for the differences between : 1) nonextraction and total extraction groups 2) nonextraction and first premolar extraction groups 3) nonextraction and second premolar extraction groups 4) nonextraction and second molar extraction groups.

ANOVA(Analysis of Variance) and Scheffe tests were used to test for the differences between "before & after" orthodontic treatment among nonextraction, first premolar extraction, second premolar extraction and second molar extraction groups.

III. RESULTS

1. There were no statistical significances in any cephalometic measurements between "before & after" orthodontic treatment regardless of orthodontic extractions. The means and standard deviations for the cephalometric parameters for each group were given in Table 3-7.

On average, in the second molar extraction group, the facial vertical dimension was increased after orthodontic treatment. But there were no statistical significances in this group.

These results did not support the hypothesis that extractions in conjunction with orthodontic treatment result in facial vertical changes. However, even if there were no statistical significances, on average, the upper 6 to palatal plane and the lower 6 to mandibular plane after orthodontic treatment were increased in all groups.

2. In comparisons of cephalometric measurments among nonextraction, first premolar extraction, second premolar extraction, second molar extraction groups and between nonextraction and total extraction groups, there were only statistical significances ; in PP-MP of nonextraction & second molar extraction groups and first premolar & second molar extraction groups ; in $\underline{1}$ to PP of nonextraction & first premolar extraction groups and nonextraction & total extraction groups ; in $\overline{1}$ to MP of nonextraction & second molar extraction groups, nonextraction & second premolar extraction groups and first premolar & second molar extraction group in Talbe 8.

IV. DISCUSSION

The relative merits of mandibular rotation, opening versus closing, should be recognized as either a

Table 3. Means, standard deviations and paired t-tests between "before & after" orthodontic treatment in the nonextraction group(n=50)

	Pre		Post		Mean dif.		
Variables	Mean	SD	Mean	SD	Mean	SD	P value
ANGLE							
Ar-Go-Me	121.52	6.12	121.40	6.25	-0.12	2.26	NS
FH-MP	26.22	6.22	26.11	6.89	-0.11	2.59	NS
SN-MP	34.15	7.12	34.62	7.26	0.47	2.23	NS
PP-MP	24.83	6.44	24.68	6.27	-0.15	2.61	NS
OP-M,P	17.55	4.88	18.05	4.33	0.50	2.79	NS
INDEX							
ODI	68.40	1.34	69.13	8.69	0.73	8.28	NS
RATIO							
Facial height ratio	0.65	0.51	0.64	0.49	-0.01	0.28	NS
Sn-Stms/Stmi-Me'	0.53	0.68	0.51	0.60	-0.02	0.43	NS
G-Sn/Sn-Me'	1.09	0.20	1.00	0.11	-0.09	0.19	NS
N-ANS/ANS-Me	0.90	0.16	0.88	0.11	-0.02	0.12	NS
TEETH(mm)							
6 TO PP	24.39	2.25	25.24	2.26	0.85	1.83	NS
6 TO MP	34.55	2.60	35.44	2.60	0.89	1.90	NS
1 TO PP	43.83	3.32	30.69	3.12	-0.14	2.75	NS
1 TO MP	43.83	2.87	45.01	2.99	1.18	2.54	NS

NS=not significant

Table 4. Means, standard deviations and paired t-tests between "before & after" orthodontic treatment in the total extraction group(n=88)

	Pre		Post		Mean dif.		
Variables	Mean	SD	Mean	SD	Mean	SD	P value
ANGLE							
Ar-Go-Me	123.97	7.88	123.86	8.03	-0.11	2.72	NS
FH-MP	29.57	6.48	29.31	6.92	-0.26	3.01	NS
SN-MP	37.19	6.45	37.45	7.30	0.26	2.68	NS
PP-MP	25.28	7.44	25.76	7.84	0.48	2.32	NS
OP-M,P	19.30	4.75	18.84	5.57	-0.46	3.56	NS
INDEX							
ODI	69.29	7.82	69.53	8.14	0.24	4.06	NS
RATIO							
Facial height ratio	0.64	0.05	0.63	0.04	-0.01	0.04	NS
Sn-Stms/Stmi-Me'	0.53	0.07	0.51	0.08	-0.02	0.76	NS
G-Sn/Sn-Me'	1.03	0.22	1.00	0.96	-0.03	0.23	NS
N-ANS/ANS-Me	0.81	0.09	0.80	0.09	-0.01	0.06	NS
TEETH(mm)							
6 TO PP	25.06	3.06	26.06	3.17	1.00	2.04	NS
6 TO MP	34.64	3.61	35.66	3.50	1.02	2.01	NS
1 TO PP	31.08	2.89	31.55	3.64	0.47	2.21	NS
1 TO MP	44.47	3.62	44.83	4.15	0.36	2.66	NS

NS=not significant

Table 5. Means, standard deviations and paired t-tests between "before & after" orthodontic treatment in the first premolar extraction group(n=42)

	Pre		Post		Mean dif.		
Variables	Mean	SD	Mean	SD	Mean	SD	P value
ANGLE							
Ar-Go-Me	122.74	6.92	122.62	6.58	-0.12	2.63	NS
FH-MP	28.89	7.11	28.61	7.71	-0.28	3.13	NS
SN-MP	36.52	6.70	36.66	7.41	0.14	2.51	NS
PP-MP	26.58	7.30	26.48	7.68	-0.10	1.99	NS
OP-M,P	20.18	5.32	18.45	6.04	-1.73	2.86	NS
INDEX							
ODI	67.62	7.69	67.73	8.75	-0.11	3.78	NS
RATIO							
Facial height ratio	0.64	0.05	0.63	0.04	-0.01	0.03	NS
Sn-Stms/Stmi-Me'	0.53	0.67	0.52	0.10	-0.01	0.10	NS
G-Sn/Sn-Me'	1.05	0.31	0.99	0.11	-0.06	0.32	NS
N-ANS/ANS-Me	0.79	0.07	0.79	0.08	0.00	0.07	NS
TEETH(mm)							
$\underline{6}$ TO PP	25.98	2.99	26.68	3.03	0.70	1.75	NS
6 TO MP	35.85	3.74	36.95	3.27	1.10	2.01	NS
$\underline{1}$ TO PP	30.64	2.73	33.56	3.28	292	2.13	NS
$\overline{1}$ TO MP	45.69	3.75	45.33	4.09	-0.36	2.35	NS

NS=not significant

Table 6. Means, standard deviations and paired t-tests between "before & after" orthodontic treatment in the second premolar extraction group(n=24)

	Pre		Post		Mean dif.		
Variables	Mean	SD	Mean	SD	Mean	SD	P value
ANGLE							
Ar-Go-Me	121.93	8.95	121.94	9.41	0.01	2.97	NS
FH-MP	29.82	6.89	29.45	6.49	-0.37	2.73	NS
SN-MP	37.75	7.42	37.91	8.07	0.16	2.32	NS
PP-MP	27.55	5.96	28.17	6.67	0.62	2.34	NS
OP-M,P	19.13	4.58	18.69	5.31	-0.44	3.70	NS
INDEX							
ODI	71.75	6.75	71.67	7.05	-0.08	4.84	NS
RATIO							
Facial height ratio	0.64	0.05	0.64	0.05	0.00	0.02	NS
Sn-Stms/Stmi-Me'	0.52	0.07	0.52	0.08	0.00	0.07	NS
G-Sn/Sn-Me'	1.01	0.07	1.00	0.08	-0.01	0.05	NS
N-ANS/ANS-Me	0.81	0.08	0.81	0.08	0.00	0.05	NS
TEETH(mm)							
$\underline{6}$ TO PP	25.88	2.56	26.59	3.01	0.71	1.99	NS
6 TO MP	34.05	3.25	35.21	2.64	1.16	1.87	NS
$\underline{1}$ TO PP	30.60	3.11	31.61	2.82	1.01	1.82	NS
$\overline{1}$ TO MP	44.02	3.01	43.89	3.76	-0.13	2.25	NS

NS=not significant

Table 7. Means, standard deviations and paired t-tests between "before & after" orthodontic treatment in the second molar extraction group(n=22)

	Pre		Post		Mean dif.		
Variables	Mean	SD	Mean	SD	Mean	SD	P value
ANGLE							
Ar-Go-Me	128.30	6.80	128.55	7.60	0.25	2.71	NS
FH-MP	30.50	4.62	30.59	5.73	0.09	3.21	NS
SN-MP	37.85	4.75	38.52	6.26	0.67	3.36	NS
PP-MP	20.32	7.18	21.76	8.14	1.44	2.61	NS
OP-M,P	17.80	3.37	19.76	5.03	1.96	3.47	NS
INDEX							
ODI	69.80	8.67	70.63	7.60	0.83	3.77	NS
RATIO							
Facial height ratio	0.65	0.06	0.63	0.03	-0.02	0.06	NS
Sn-Stms/Stmi-Me′	0.54	0.07	0.50	0.06	-0.04	0.04	NS
G-Sn/Sn-Me′	1.03	0.10	1.00	0.10	-0.03	0.08	NS
N-ANS/ANS-Me	0.84	0.12	0.83	0.12	-0.01	0.04	NS
TEETH(mm)							
6 TO PP	22.41	2.10	24.32	3.01	1.91	2.40	NS
6 TO MP	32.98	2.99	33.68	3.80	0.70	2.20	NS
1 TO PP	28.46	2.39	29.55	4.32	1.09	2.63	NS
1 TO MP	42.64	3.18	44.91	4.65	2.27	2.82	NS

NS=not significant

Table 8. ANOVA(Analysis of Variance) and Scheffe tests for contrast groups according to cephalometric vertical measurements and Student's t-test between nonextraction and total extraction groups

Variables	NE-P4	NE-P5	NE-M7	P4-P5	P4-M7	P5-M7	NE-E
ANGLE							
Ar-Go-Me	-	-	-	-	-	-	-
FH-MP	-	-	-	-	-	-	-
SN-MP	-	-	-	-	-	-	-
PP-MP	-	-	*	-	*	-	-
OP-M,P	*	-	-	-	-	*	*
INDEX							
ODI	-	-	-	-	-	-	-
RATIO							
FHR	-	-	-	-	-	-	-
Sn-Stms/Stmi-Me′	-	-	-	-	-	-	-
G-Sn/Sn-Me′	-	-	-	-	-	-	-
N-ANS/ANS-Me	-	-	-	-	-	-	-
TEETH							
6 TO PP	-	-	-	-	-	-	-
6 TO MP	-	-	-	-	-	-	-
1 TO PP	*	-	-	-	-	-	**
1 TO MP	-	-	*	-	*	*	-

* $p<0.05$, ** $p<0.01$

NE : non-extraction, P4 : 1st premolar extraction, P5 : 2nd premolar extraction,
M7 : 2nd molar extraction, E : total extraction group

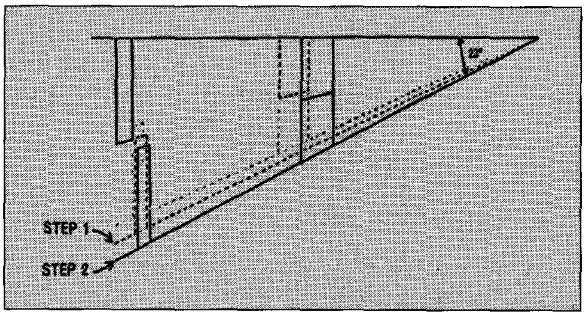

Fig. 2. Geometric demonstration illustrating the behavior of overbite and overjet when the molars are moved either anteriorly or posteriorly (from Jarabak JR and Fizzell JA, "Technique and treatment with light-wire edgewise appliances ", 2nd ed., The C.V. Mosby Co., 392, 1972)

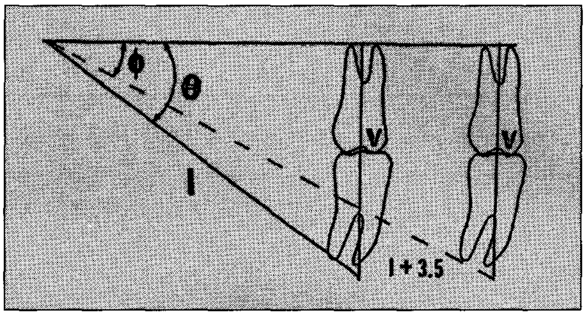

Fig. 3. Hypothetical triangle with molar occlusion (from Staggers JA, "Vertical changes following first premolar extractions", Am J Orthod, 105 : 22, 1994)

desirable or undesirable effect of orthodontic treatment as it relates to the individual. Certain types of malocclusion occasionally may cause undesirable effects during treatment and lead to unsatisfactory results. Therefore, to closely examine the effects of extractions in facial vertical changes is one of the most important tasks in orthodontics. This is because the effects of extraction and nonextraction treatment on facial vertical changes continue to be controversial issues in orthodontics as far.

Jarabak[15] explained vertical changes as the positional changes of posterior teeth by assuming that both maxillary and mandibular teeth are contained in a geometric area resembling as isosceles triangle(Fig. 2). Schematically, if maxillary and mandibular central incisors are placed near their base, by mandibulating the molars within the triangle to resemble a mesial movement or drifting, these teeth move away from the apex of the triangle. Assuming that there is no passive eruption when these teeth are tipped mesially, the angle at the apex of the triangle will become smaller when th teeth are brought into occlusion. This also makes the base of the triangle shorter. On the contrary, adding a distal force to the mandibular posterior teeth will move them into the apex of the triangle. This will increase the size of the angle at the apex and increase its length at the base of the triangle(step 1). The overbite decreases even more when the maxillary molars are driven distally with Class II mechanics(step 2).

On the contrary, Staggers[34)] explained vertical changes as supposing for a moment that extraction did not produce a loss in the vertical dimension(Fig. 3.) If CR is the center of rotation for the condyle, one can construct and imaginary right triangle with the molar occlusion representing one side of the triangle. Supposing that the molars are protracted forward 3.5mm, which is half of a premolar extraction site, the vertical position of the molars (v) remains unchanged, but the θ is reduced to ϕ. If the original angle ϕ is 25° and I is 75mm, then the angle resulting from the simulated protraction, ϕ, would be 23.8°. A reduction in the original angle of 1.2° truly represents a loss of vertical dimension. Even if the orginal angle, θ, were 40°, the resulting angle after simulated protraction, ϕ, would be 37.8°, only a reductuion of 2.2°.

In this study, there were no statistical significances in any cephalometric measurements between "before and after" orthodontic treatment regardless of orthodontic extractions for each group. However, on average, orthodontic treatment produced a mean increase in the upper 6 to palatal plane and the lower 6 to mandibular plane. This means that most of orthodontic mechanics are extrusive in nature and this extrusion appears to maintain or even increase the vertical dimension. Especially, in orthodontic extraction cases, it may be caused by orthodontic mechanics for space closure and alignments. On average, in the second molar extraction group, the facial vertical dimension was increased after orthodontic treatment. It may be induced as a result of moving the molars distally to gain space to correct the molar relationship and to simultaneously improve the deep Bite. But there were no statistical significances in this group.

Also, regardless of angular measurements, vertical ratios are unchanged or increased in any group. Consequently, the results of this study did not support the theory that orthodontic extractions reduce the vertical dimension, and thus predispose extraction patients to TMJ disorders, but was consistent with that of Staggers'. Therefore, it seems reasonable to conclude that orthodontic extractions to anticipate the increase or decrease of vertical changes should not be done.

In comparisons of cephalometric measurements among nonextraction, first premolar extraction, second premolar extraction, second molar extraction groups and between nonextraction and total extraction groups, there were only statistical significances ; in PP-MP of nonextraction & second molar extraction groups and first premolar & second molar extraction groups ; in OP-MP of nonextraction & first premolar extraction groups, nonextraction & total extraction groups and second premolar & second molar extraction groups ; in 1 to PP of nonextraction & first premolar extraction groups and nonextraction & total extraction groups ; in 1 to MP of nonextraction & second molar etraction groups, nonextraction & second premolar extraction groups and first premolar & second molar extraction groups.

This menas that the changes of occlusal plane and upper & lower incisors according to tooth movement for each group play and important role of facial vertical changes between " before & after" orthodontic treatment.

On the other hand, the relationships between orthodontic extraction and condylar position have been become a focal point in orthodontics. Specifically, Farrar and McCarty[10] have suggested that orthodontic treatment by four premolar extractions can be detrimental to the stability of the TMJ structures. This is because "overretraction" of the maxillary incisors can occur during space closure and displace the mandible posteriorly. A more posteriorly positioned condyle, in turn, can allow the disk to "slip off" the condyle, as a result, create an internal derangement.

In this study, it was not determined whether orthodontic extractions had influence on condylar position and TMJ disorders ; it is hoped that such further research will be needed.

V. CONCLUSIONS

The author evaluated facial vertical changes occurring in patients treated orthodontically with first premolar, second remolar and second molar extractions ; to compare these changes with those occurring in patients treated orthodontically without extractions ; and finally, to evaluate the effects of extractions in facial vertical changes.

Cephalometric records of 50 male & female nonextraction patients and 88 male & female extraction patients were obtained from the department of orthodontics at Chosun University, College of Dentistry. The second molar fully erupted patients to have little variation according to growth were chosen as the sample for this investigation. For comparisons, the samples of 88 male & female extraction patients were subdivided into 42 first premolar extraction, 24 second premolar extraction, and 22 second molar extraction patients.

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The results of this study were as follows :

1. There were no statistical significances in any cephalometric measurements between "before & after" orthodontic treatment regardless of orthodontic extractions for each group.
2. On average, the upper 6 to palatal plane and the

lower 6 to mandibular plane after orthodontic treatment were increased in all group. This means most of orthodontic mechanics are extrusive in nature. Especially, in orthodontic extraction cases, it may be caused by orthodontic mechanics for space closure and alignments.

3. On average, in the second molar extraction group, the facial vertical dimension was increased after orthodontic treatment. It may be induced as a result of moving the molars distally to gain enough space to correct the molar relationship and to simultaneously improve the deep bite.
4. There was no statistical significance between orthodontic extractions and facial vertical changes. This means that orthodontic extractions have no influence on facial vertical changes.
5. The cephalometric measurements with statistical significance in ficial vertical changes for each group were PP-MP, Op-MP, $\underline{1}$ to PP and $\overline{1}$ to MP.

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국문초록

발치가 안모의 수직변화에 미치는 영향

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본 연구는 교정치료시 발치가 안모의 수직 변화에 어떠한 영향을 미치는지 규명하기 위해서 비발치군과 발치군으로 구분하였고, 발치군은 비교분석을 위해 제1소구치 발치군, 제2소구치 발치군, 제2대구치 발치군으로 구분하여 교정치료 전, 후의 안모의 수직변화 여부를 평가함으로서 발치가 안모의 수직변화에 미치는 영향을 규명하고자 했다.

연구대상은 조선대학교 부속치과병원 교정과에 내원하여 교정치료를 받은 환자 중, 제2대구치까지 맹출하여 성장에 의한 변화요인이 적다고 인정되는 비발치군 남녀 50명, 발치군 남녀 88명으로 하였으며, 비발치군은 비교분석을 위해 42명의 제1소구치 발치군, 24명의 제2소구치 발치군, 22명의 제2대구치 발치군으로 구분하였다.

안모의 수직변화 여부를 규명할 수 있는 14개의 두부방사선 계측항목을 선정하여 교정치료 전, 후의 안모의 수직변화량을 측정하였고, SPSS/PC^{+} 통계프로그램을 이용하여 교정치료 전, 후의 안모의 수직변화여부를 비교 분석함으로써 다음과 같은 결과를 얻었다.

1. 교정적 발치여부에 관계없이 모든 군에서 교정치료 전,후의 두부방사선 계측치 사이에 통계학적인 유의성이 없었다.
2. 상, 하악 구치는 모든 군에서 교정치료에 의해 정출되었다. 이는 대부분의 교정치료의 역계 자체가 치아를 정출시키는 기전을 지니고 있음을 의미하며, 특히 발치에 의한 교정치료시 발치공간 폐쇄 및 치아배열을 위해 작용되는 역계

로 인해 일어나는 결과로 보인다.

3. 제 2 재구치 발치군에서 안모의 수직고경은 교정치료 후에 모두 증가되었다. 이는 치아배열 공간을 확보하기 위해 치열이 후방이동된 결과로 보인다.
4. 교정적 발치와 안모의 수직변화 사이에는 통계학적인 유의성이 없었다. 이는 안모의 수직변화와 교정적 발치는 아무런 관련이 없음을 나타낸다.
5. 두부방사선 계측항목 중 안모의 수직변화에 있어서 각 군 사이에 통계학적으로 유의성 있는 영향을 미치는 항목은 PP-MP, OP-MP, $\underline{1}$ to PP, $\overline{1}$ to MP였다.

주요 단어 : 안모의 수직 변화, 발치