KOREA. J. ORTHOD. 1998. 28(6) : 893-904

The Diagnosis and Treatment of Anterior Openbite Malocclusion

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There are varieties of severe malocclusions, which can be treated orthodontically, but with a great deal of effort. Anterior openbite, in particular, is one malocclusion thought to be more difficult to treat, and therefore, most of them have to be corrected by means of surgical intervention. To solve these problems, numerous studies pertinent to treatment modalities have been introduced with controversies on the effectiveness of treatment. Suggested treatment modalities for anterior openbite are based directly or indirectly on the neuromuscular and morphological features and on the etiologic and/or the environmental factors. Even though the vertical relationship of the face is increased due to the growth variation, the normal occlusal relationship can be achieved by the adequate dentoalveolar compensatory mechanism, but in the case of inadequate or negative dentoalveolar compensation, openbite is likely to be present. If the skeletal dysplasia is too severe to be solved by orthodontic treatment alone, combined treatment with surgery should be done to restore the function and the esthetics of the orofacial complex. In many cases, however, orthodontic alteration of the dentition pertinent to the given skeletal pattern with the proper diagnosis and treatment planning can bring satisfactory results. The treatment changes with the Multiloop Edgewise Archwire(MEAW) therapy occurred mainly in the dentoalveolar region and showed a considerable similarity to the natural dentoalveolar compensatory mechanism. In other words, the MEAW technique allows orthodontists to produce the natural dentoalveolar compensation orthodontically. Even if an openbite is corrected by the orthodontic dentoalveolar compensation suitable for the skeletal pattern, relapse may still occur by the persisting etiologic factors which originally prohibited the natural dentoalveolar compensation. The etiologic factors should be determined at the time of initial diagnosis and should be controlled during treatment and retention.

Key Words : Multiloop Edgewise Archwire(MEAW), Openbite, Dentoalveolar compensation, Occlusal plane Reconstruction

The definition of anterior openbite is various according to different authors, one defined that the lower incisors are not overlapped in the vertical plane by the upper incisors and do not occlude with them[1]. Another mentioned that it is a condition of separation between upper and lower incisal edge from the occlusal plane and a state of non-overlapping of upper and lower occlusal plane[2].

Few malocclusions have a single specific cause, more often they are the results of a combination of many factors operating within the inherent predetermined growth potential of each individual patient. Etiology of anterior openbite is also not single but multifactorial[3-9]. Like the other malocclusions, anterior openbite is a congenital or acquired condition caused by hereditary or non-hereditary effects in orofacial area[10,11]. This vertical dysplasia can be associated with either Class I, Class II or Class III skeletal relationship[12-15].

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This paper was presented at the 3rd Asian-Pacific Conference in Taipei, Taiwan, 1998 and revised to be published.

There have been many studies regarding morphological characteristics of anterior openbite present various and contradicting opinions, but generally they are like the following[11-15]. The characteristics of skeletal openbite in craniofacial area are a long lower anterior facial height, a comparatively shorter posterior facial height, a steep mandibular plane, an open gonial angle, some retrusion of both the nasomaxillary complex and the chin relative to the cranium. The characteristics of dentition in skeletal openbite shows mesially tilted molars compared to the normal tooth axial inclination, more opened occlusal plane and greater tooth axial inclination[2]. Also Subtelny[11] reported that the maxillary molars and upper anterior teeth were supraerupted in the patient with skeletal openbite, so the supraerupted molars can incur retroposition of the mandible and thereby increase the lower anterior facial height.

Major environmental factors of anterior openbite are thumb and finger sucking habit, mouth breathing, fronted tongue posture incident to enlarged adenoid tissue and/or turbinate, and inadequate growth of the jaws to accommodate a disproportionately large tongue resulting in forward posturing of the tongue for its adaptation within the oral cavity[8,9,11,17].

As the above-mentioned morphological features of skeletal openbite malocclusion, it is possible to figure out a general tendency of anterior openbite. But, it is mandatory for a clinician to recognize that each case of anterior openbite has its own unique problems. And so, diagnosis and treatment plan must be established according to each case.

There have been controversies on the diagnostic reliability of many cephalometric measurements representing the feature of anterior openbite. Wardraw[18] mentioned that Overbite Depth Indicator (ODI) has more diagnostic value than other cephalometric measurements regarding vertical relationship. ODI is comprised of palatal plane angle and AB to mandibular plane (AB to MP) angle. The norm of the ODI is 74.5°. If a case has an ODI value above the norm, it has a deep bite skeletal pattern and is likely to have a deep bite in dentition. If a case has an ODI value below the norm, it has an openbite skeletal pattern and is likely to have an anterior openbite. ODI can be used not only to evaluate the vertical skeletal pattern, but also to prospect the progress of treatment so that we can prepare an adequate treatment plan[16].

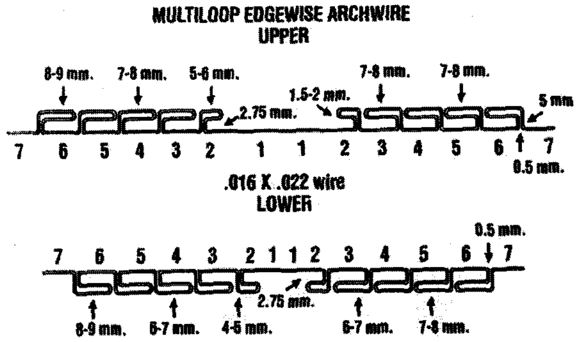

Fig. 1. Schematic drawing of MEAW

So far, the treatment modalities for anterior openbite, which has been suggested until now be listed as follows; tongue crib[8,17], orthopedic forces[19,20], spring loaded posterior bite block[21],functional appliance[22-24], magnetic appliance[25], anterior vertical elastics[26] and decreasing of vertical dimension through the mesial migration of posterior teeth after second premolar extraction[27].

These ways of orthodontic approach brought fairly good results sometimes, but in many cases brought despair. Because of this reason, orthognathic surgery including maxillary superior repositioning has been actively adopted in the treatment of openbite[28,29]. This kind of surgical approach needs a great cost to patient. Therefore, we should consider carefully the benefit and cost before the application of surgery.

If we use an adequate force system, we can expand the border of orthodontic treatment for openbite malocclusion. In other words, if we have an efficient orthodontic mechanics, we can treat more openbite malocclusions without orthognathic surgery.

Multiloop Edgewise Archwire (MEAW) appliance has been known that it has an unique biomechanical characteristics and outstanding efficiency in the treatment of openbite malocclusion[2] (Fig. 1).

In openbite, there is a mesial tilting of tooth axial

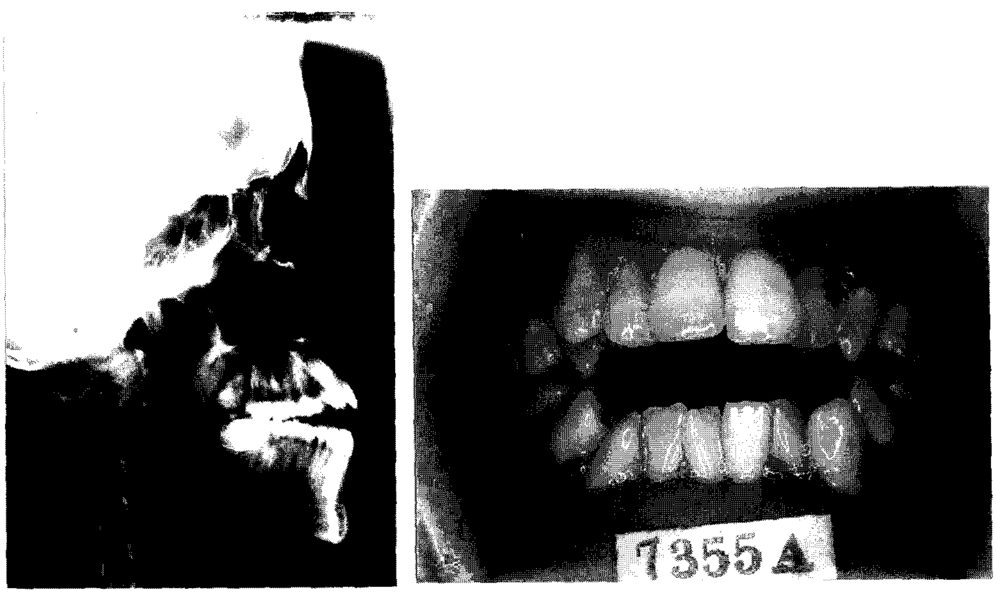

Fig. 2. A severe case of skeletal anterior openbite malocclusion.

inclination due to the crowding of upper posterior dentition and anterior component of occlusal force, and the more the upper and lower occlusal planes diverge, the greater the posterior tooth axial inclination has become. In severe openbite cases, the rearest teeth only occlude and all the rest of the posterior teeth showed marked mesial tilting and loss of contact to their opponents[2] (Fig. 2).

To treat anterior openbite, uprighting of the mesially tilted molars to the bisected occlusal plane, improvement of the buccolingual inclination of the posterior teeth for optimal intercuspation, and changing of the upper and lower occlusal plane to produce the anterior overlap are needed. The vertical position of upper lip to the incisal edge of upper central incisor is near 4 mm. This mean value can be used to position the lower occlusal plane to produce sufficient overlap between the upper and lower incisors[2].

MEAW appliance can be applied to achieve all the above-mentioned conditions. MEAW is made of .016″ × .022″, 14″ length stainless steel rectangular wire. The basic form of MEAW is an ideal archwire with L-loops from distal side of lateral incisor to all of the interproximal area. L-loop has a vertical and horizontal component to allow independent movement between teeth. So it can be used to achieve optimal intercuspation easily. And it can decrease the Load Deflection Rate and so enables physiologic tooth movement. The stiffness of anterior portion of MEAW is similar with that of the conventional ideal arch, but the stiffness of posterior portion with L-loops is very low compared with that of the ideal arch. In this appliance, according to the amount of tooth axial inclination, continuous tip back bends, usually $3^\circ \sim 5^\circ$, are given. The completed maxillary MEAW shows a marked curve of Spee and mandibular MEAW shows a marked reverse curve of Spee. In applying MEAW to openbite, it exerts downward pressure on anterior teeth. In order to compensate the downward pressure on anterior teeth and to function as an anchor for the movement of posterior teeth, uprighted by the tip back bends, anterior vertical elastics should be applied. For that purpose, 3/16″, 6 oz rubber elastics have been widely used and the force, exerted by the elastics, is roughly 50 gm on closing and 150 gm on opening of the mouth respectively[2].

Occlusal plane can be effectively controlled by force system composed of anterior vertical elastics and tip-back bends. In this process, functional occlusion can be obtained comparatively in short-term by acquiring intercuspation and controlling angulation and inclination of the posterior teeth at the same time. Treatment of malocclusion needs adequate diagnosis, treatment planning and proper force system. This is the same for the treatment adopting MEAW appliance. An Effective biomechanics itself never bring a good treatment result without adequate diagnosis and treatment planning.

We went through a study to examine and evaluate the treatment changes in anterior openbite cases treated by means of the MEAW technique. The treatment group is composed of sixteen young adult openbite patients (four males and twelve females, the mean age of 18.1 years at the start of treatment and 19.8 years at the end of treatment). All of the sample were in adult or late adolescent period to eliminate the growth factor from the treatment change. Also, the extraction cases were excluded from this study to eliminate any effects which may be caused by the extraction treatment. Eight cases were Class I and the others were Class III openbite. The mean treatment duration was 1.6 years and the mean duration of MEAW therapy was six months.

Regarding the treatment changes (Table. 1), there were no significant changes in the skeletal measurements, except slight increase of ODI which was due to the increase of the AB to MP angle. This change was probably caused by the distal movement of the lower dentition and the B point during the treatment of eight class III openbite patients. In the measurement of dentoalveolar region, upper dentoalveolar height was increased. But there was not significant change in the vertical dimension of upper posterior teeth. The lower anterior dentoalveolar height was increased, but the lower posterior dentoalveolar height was decreased. Concerning on positional change of upper and lower second molar to pterygomaxillary point (PTM), distal movement of posterior teeth cannot be neglected. This acquired space can be used to upright the posterior teeth distally and to improve the interincisal angle, which is usually small in openbite cases. From the results, we may suppose that MEAW appliance can prevent posterior teeth from extrusion during distal uprighting without placing any supplemental appliances such as posterior bite block and high-full headgear. In the point of change in tooth axial inclination, increase of interincisal angle was contributed to improvement of

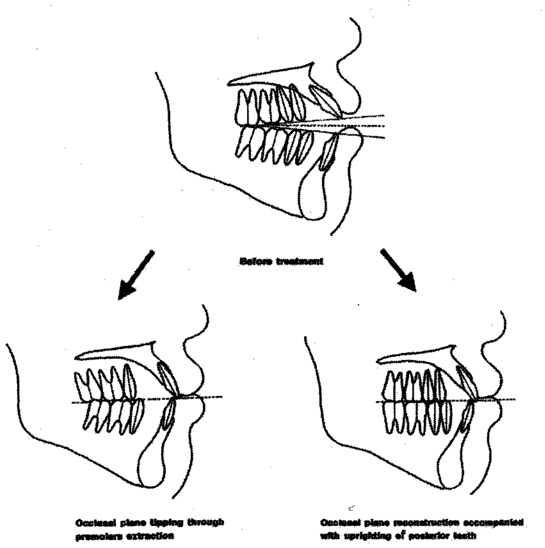

Fig. 3. Schematic drawing of the occlusal plane reconstruction, compared to the occlusal plane tipping .

protrusion. All of the upper and lower posterior teeth were uprighted to the bisected occlusal plane. Despite some variation, the change to the axial inclination of the upper posterior teeth to palatal plane and that of the lower posterior teeth to mandibular plane indicated the distal tilting movement of the upper and lower posterior teeth. Concerning on positional change in occlusal plane, upper occlusal plane to palatal plane angle and lower occlusal plane to mandibular plane angle were significantly increased. This kind of change in occlusal plane is different from that of the simple extrusion of anterior teeth.

We can say that occlusal plane reconstruction is an occlusal plane change accompanying the uprighting of the posterior teeth. And the occlusal plane tipping is an occlusal plane change without the uprighting of the posterior teeth, usually observed in the conventional orthodontic treatment methods to decrease vertical dimension through the mesial migration of posterior teeth after second premolar extraction (Fig. 3).

To compare the morphological features of treated group with normal occlusion group, 58 lateral cephalograms were chosen. The normal sample had pleasing facial profile, esthetically and functionally normal occlu-

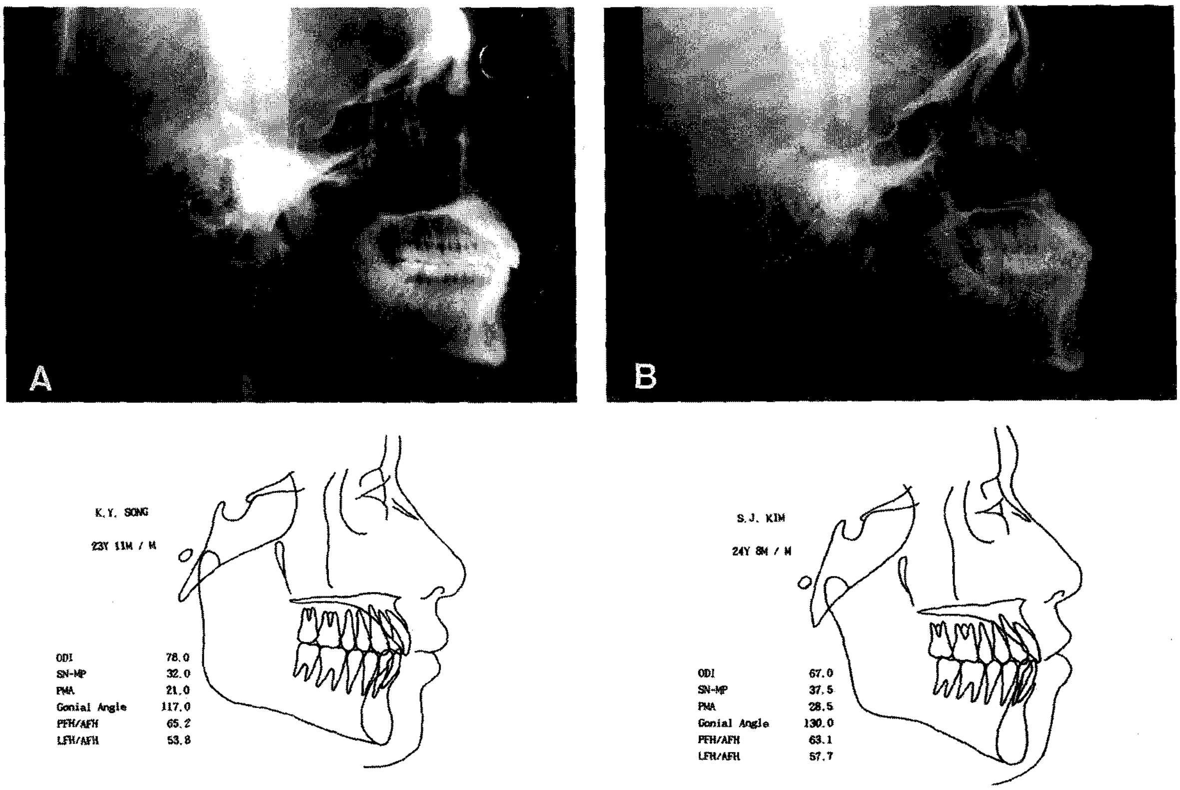

Fig. 4. Samples of Normal Occlusion Group 1(NOG1)(A) and Normal Occlusion Group 2(NOG2)(B).

sion, and also, no experience in orthodontic and prosthetic treatment.

In lateral cephalometric analysis of this normal sample, vertical relationship in facial profile showed large variation. By reason of that, the normal sample was divided into Normal Occlusion Group 1 (NOG 1) and Normal Occlusion Group 2 (NOG 2). NOG 2 showed lower than 1 standard deviation from the normal value of ODI and showed disharmony in vertical relationship which can be noticed from 5 cephalometric measurements; SN plane to mandibular plane angle, palatal plane to mandibular plane angle, gonial angle, posterior total facial height (PTFH)/ anterior total facial height (ATFH) ratio, anterior lower facial height (ALFH)/ anterior total facial height (ATFH) ratio. If more than 3 of these 5 measurements are out of 1 SD in a sample, we classified the sample into a group which showed normal occlusion but openbite skeletal pattern (NOG 2). There were 18 samples which could be classified into NOG 2. Rest of them were classified into NOG 1, defined as a group with normal range of vertical cephalometric facial relationship and normal occlusion (Fig. 4).

Even though there is an increased vertical cephalometric relationship of face, normal occlusion can be accomplished by the dentoalveolar compensatory mechanism, refered by Solow[31], which compensates the variation in the positional relationship between jaws due to the variation of craniofacial growth.

Björk[32] stated that, in case of positional change in jaws during facial growth and development, the eruption paths of the teeth should be changed compensatively. But if this compensation does not occur or is insufficient, occlusal variation and space problem can be brought about.

Solow[31] refered to the need of the dentoalveolar compensatory mechanism, that is, since there is large variation in amount and direction of growth, no perfect

Table 1. Treatment changes of anterior openbite malocclusion cases using MEAW technique.

VARIABLES	PRETREATMENT		POSTTREATMENT		T TEST
	MEAN	SD	MEAN	SD	
SKELETAL MEASUREMENTS					
1. SN-MP angle	43.75	4.68	43.44	5.40	N.S.
2. FH-PP angle	.66	3.13	.61	2.96	N.S.
3. AB-MP angle	60.16	3.78	61.36	4.17	**
4. ODI	60.86	5.28	61.99	5.49	*
5. PP-MP angle	33.31	4.66	33.28	4.78	N.S.
6. Gonial angle	129.01	6.34	128.45	6.01	N.S.
7. PTFH / ATFH (%)	59.52	3.87	59.74	4.53	N.S.
8. ALFH / ATFH (%)	56.87	2.09	57.09	1.81	N.S.
DENTOALVEOLAR MEASUREMENTS					
9. U1-PP (UADH)	28.56	2.27	30.57	2.27	***
10. U7-PP (UPDH)	21.19	2.12	22.26	2.54	N.S.
11. L1-MP (LADH)	43.14	2.31	45.92	3.50	***
12. L7-MP (LPDH)	30.31	2.07	29.27	2.45	**
13. Ptm to U7 distal (mm)	4.61	1.79	3.71	2.03	**
14. Ptm to L7 distal (mm)	5.91	2.66	3.98	2.58	***
15. Overbite	-4.63	2.13	.91	.66	***
16. Overjet	2.62	1.81	3.24	1.00	N.S.
17. UADH (long axis)	33.54	2.72	33.71	2.60	N.S.
18. LADH (long axis)	43.59	2.44	46.66	3.75	***
OCCLUSAL PLANE MEASUREMENTS					
19. PP-UOP	6.98	3.71	9.89	4.62	**
20. MP-LOP	21.22	3.26	26.20	4.39	***
21. PP-UOP / PP-MP	.20	.10	.29	.11	**
22. MP-LOP / PP-MP	.64	.10	.79	.16	***
TOOTH AXIS MEASUREMENTS					
23. Interincisal angle	118.74	9.86	129.44	9.75	**
24. BOP-U4	76.30	4.90	85.02	3.62	***
25. BOP-U5	82.86	3.74	89.78	3.04	***
26. BOP-U6	89.95	6.26	92.64	4.24	N.S.
27. BOP-U7	98.04	7.81	99.04	6.91	N.S.
28. BOP-L4	76.82	4.23	85.25	3.36	***
29. BOP-L5	77.99	4.72	87.05	3.39	***
30. BOP-L6	80.59	6.05	88.94	3.74	**
31. BOP-L7	81.01	4.54	92.41	5.89	***
32. PP-U4	93.91	6.46	86.11	5.53	***
33 .PP-U5	88.14	7.08	81.58	5.63	***
34. PP-U6	80.21	6.61	78.50	5.88	N.S.
35. PP-U7	72.16	7.68	72.14	7.09	N.S.
36. MP-L4	79.31	5.26	69.97	4.00	***
37. MP-L5	78.11	5.71	68.19	4.02	***
38. MP-L6	75.53	7.11	66.30	4.25	***
39. MP-L7	35.09	6.54	62.86	5.14	***

Not significant N.S. $P < 0.05$ * $P < 0.01$ ** $P < 0.001$ ***

Table 2. Comparison of skeletal features.

VARIABLES	NOG 1	NOG 2	PRETREATMENT	POSTTREATMENT
SN-MP angle	34.18 ± 5.31	41.68 ± 4.20*	43.75 ± 4.68	43.44 ± 5.40
FH-PP angle	1.00 ± 2.21	0.69 ± 2.83	0.66 ± 3.13	0.61 ± 2.96
AB-MP angle	69.20 ± 3.83	60.56 ± 2.95*	60.16 ± 3.78	61.36 ± 4.17
ODI	70.23 ± 4.81	61.30 ± 4.01*	60.86 ± 5.28	61.99 ± 5.49
PP-MP angle	23.74 ± 3.88	31.74 ± 3.53*	33.31 ± 4.66	33.28 ± 4.78
Gonial angle	121.45 ± 4.16	131.56 ± 4.14*	129.01 ± 6.34	128.45 ± 6.01
PTH / AFH (%)	66.99 ± 4.08	61.02 ± 3.43*	59.52 ± 3.87	59.74 ± 4.53
LFH / TFH (%)	55.27 ± 1.37	56.21 ± 2.21*	56.87 ± 2.09	57.09 ± 1.81

* P < 0.05 (between NOG 1 and NOG 2)
a P < 0.05 (between NOG 2 and Pretreatment)
b P < 0.05 (between NOG 2 and Posttreatment)

Table 3. Comparison of Dentoalveolar features.

VARIABLES	NOG 1	NOG 2	PRETREATMENT	POSTTREATMENT
U1-PP (UADH)	29.99 ± 2.76	31.63 ± 2.40*	28.56 ± 2.27[a]	30.57 ± 2.27
U7-PP (UPDH)	22.45 ± 2.48	22.94 ± 2.36	21.19 ± 2.12[a]	22.26 ± 2.54
L1-MP (LADH)	45.36 ± 3.67	46.52 ± 3.21	43.14 ± 2.31[a]	45.92 ± 3.50
L1-MP (LPDH)	33.16 ± 3.54	30.18 ± 2.33*	30.31 ± 2.07	29.27 ± 2.45
Ptm to U7 D (mm)	5.85 ± 2.52	5.81 ± 2.15	4.61 ± 1.79	3.71 ± 2.03[b]
Ptm to L7 D (mm)	5.93 ± 2.72	6.11 ± 2.68	5.91 ± 2.66	3.98 ± 2.58[b]
Overbite	1.45 ± 0.79	1.39 ± 0.77	-4.63 ± 2.13[a]	0.91 ± 0.66
Overjet	3.19 ± 0.79	3.01 ± 0.80	2.62 ± 1.81	3.24 ± 1.00
UADH (long axis)	33.70 ± 2.65	35.38 ± 2.51*	33.54 ± 2.72[a]	33.71 ± 2.60
LADH (long axis)	46.22 ± 3.92	47.03 ± 3.29	43.59 ± 2.44[a]	46.66 ± 3.75

* P < 0.05 (between NOG 1 and NOG 2)
a P < 0.05 (between NOG 2 and Pretreatment)
b P < 0.05 (between NOG 2 and Posttreatment)

harmony can be acquired in jaws. So, teeth eruption and the positional change of them to compensate the interarch variation can accomplish the normal occlusal relationship between two arches. The contributing factors of the mechanism, can be counted, are normal tooth eruption process, the effect of soft tissue envelope around dentoalveolar area, and inclined-plane effect of adjacent and opposing teeth during eruption and mastication.

The morphological features of pre-treatment and post-treatment groups were compared with NOG 1 and NOG 2. In the skeletal measurements, all variables showed significant differences between NOG 1 and NOG 2. There was no significant difference between

Table 4. Comparison of teeth axial inclinations.

VARIABLES	NOG 1	NOG 2	PRETREATMENT	POSTTREATMENT
Interincisal angle	121.91 ± 7.51	123.96 ± 6.45	118.74 ± 9.86	129.44 ± 9.75
BOP-U4	80.10 ± 4.17	82.83 ± 3.98*	76.30 ± 4.90a	85.02 ± 3.62
BOP-U5	85.04 ± 3.85	87.56 ± 3.28*	82.86 ± 3.74a	89.78 ± 3.04
BOP-U6	89.59 ± 4.00	90.37 ± 3.79	89.95 ± 6.26	92.64 ± 4.24
BOP-U7	96.67 ± 5.33	95.76 ± 4.62	98.04 ± 7.81	99.04 ± 6.91
BOP-L4	81.13 ± 4.24	83.02 ± 4.38	76.82 ± 4.23a	85.25 ± 3.36
BOP-L5	82.38 ± 3.48	84.16 ± 4.43	77.99 ± 4.72a	87.05 ± 3.39b
BOP-L6	83.58 ± 4.03	84.10 ± 3.98	80.59 ± 6.05a	88.94 ± 3.74b
BOP-L7	81.27 ± 4.82	82.68 ± 4.10	81.01 ± 4.54	92.41 ± 5.89b
PP-U4	93.19 ± 5.03	89.03 ± 4.62*	93.91 ± 6.46a	86.11 ± 5.53
PP-U5	90.23 ± 7.29	84.36 ± 4.27*	88.14 ± 7.08	81.58 ± 5.63
PP-U6	83.67 ± 4.65	81.47 ± 4.36	80.21 ± 6.61	78.50 ± 5.88
PP-U7	76.65 ± 5.34	76.15 ± 4.98	72.16 ± 7.68	72.14 ± 7.09
MP-L4	81.49 ± 4.57	73.01 ± 4.30*	79.31 ± 5.26a	69.97 ± 4.00b
MP-L5	80.24 ± 4.16	71.87 ± 4.24*	78.11 ± 5.71a	68.19 ± 4.02b
MP-L6	79.05 ± 4.70	71.88 ± 3.94*	75.53 ± 7.11	66.30 ± 4.25b
MP-L7	81.35 ± 5.06	73.34 ± 3.47*	75.09 ± 6.54	62.86 ± 5.14b

* $P < 0.05$ (between NOG 1 and NOG 2)
a $P < 0.05$ (between NOG 2 and Pretreatment)
b $P < 0.05$ (between NOG 2 and Posttreatment)

NOG 2 and the treatment group, NOG 2 and the treatment group showed the same vertically increased skeletal openbite pattern. The NOG 2 obtained normal occlusal relationship through the dentoalveolar compensatory mechanism which compensates the variation in the jaw relationship during growth (Table. 2).

In the dentoalveolar measurements, the upper anterior dentoalveolar height of NOG 2 was significantly greater than that of NOG 1. The lower posterior dentoalveolar height of NOG 2 was significantly smaller than that of NOG 1. All of the measurements of the pre-treatment group were significantly smaller than those of NOG 2, except the lower posterior dentoalveolar height. There were no significant differences between NOG 2 and the post-treatment group (Table. 3).

The axial inclination of the posterior teeth, palatal plane and mandibular plane showed some variation between the groups. However, these angles of the post-treatment group showed a tendency to become similar with those of NOG 2 (Table. 4).

In the treated group, actual treatment effect of MEAW appliance occurred in dentoalveolar area and the morphologic feature of post-treatment group was getting similar to that of NOG 2. Dentoalveolar height and position of occlusal plane were changed to follow the pattern of NOG 2, even though some variations were shown in the dentoalveolar measurements. In the position of the occlusal plane, significant difference were noticed in palatal plane to upper occlusal plane angle (PP to UOP) and mandibular plane to lower occlusal plane (MP to LOP) between NOG 1 and NOG 2 (Table. 5).

Table 5. Comparison of occlusal plane position.

VARIABLES	NOG 1	NOG 2	PRETREATMENT	POSTTREATMENT
PP-UOP	8.06 ± 2.96	$9.84 \pm 3.15^{*}$	6.98 ± 3.71^{a}	9.89 ± 4.62
MP-LOP	19.37 ± 3.21	$26.22 \pm 2.91^{*}$	21.22 ± 3.26^{a}	26.20 ± 4.39
PP-UOP / PP-MP	0.33 ± 0.10	0.30 ± 0.09	0.20 ± 0.10^{a}	0.29 ± 0.11
MP-LOP / PP-MP	0.82 ± 0.12	0.83 ± 0.13	0.64 ± 0.10^{a}	0.79 ± 0.16

* $P < 0.05$ (between NOG 1 and NOG 2)
a $P < 0.05$ (between NOG 2 and Pretreatment)
b $P < 0.05$ (between NOG 2 and Posttreatment)

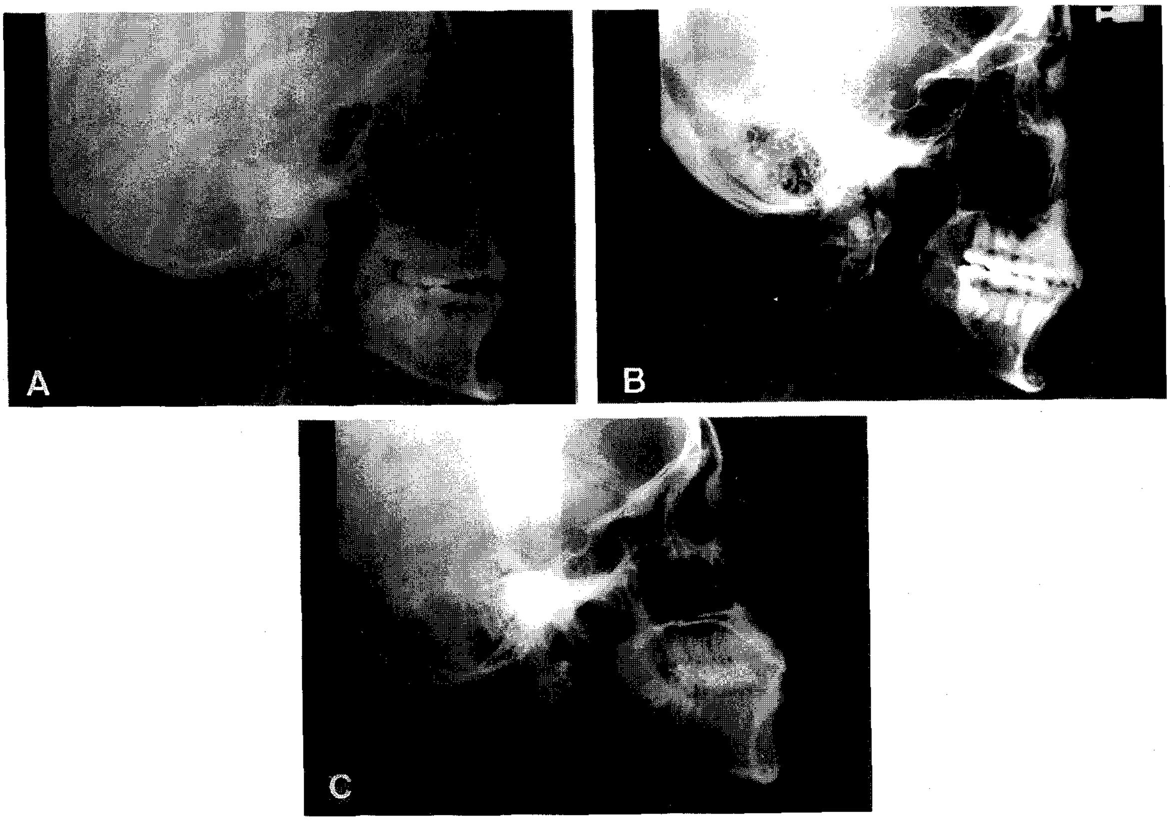

Fig. 5. Occlusal plane reconstruction of an anterior openbite case(A, B), compared to a sample of NOG2(C).

Nielson[33] defined maxillary zone as PP to UOP, normally $10 \pm 3°$, and mandibular zone as MP to LOP normally $20 \pm 4°$. In the space provided by basal part of each jaw (palatal plane to mandibular plane angle), ratio of PP to UOP and MP to LOP were constant in both group. For a case of increase in the vertical jaw relationship, increase in the maxillary zone and mandibular zone means a favorable dentoalveolar compensation. If there is not a favorable changes of the maxillary and mandibular zone in the case, it might mean inadequate dentoalveolar compensation.

In summary, NOG 2 and openbite treatment group showed vertically increased facial profile similarly. In the treatment of openbite using MEAW technique, orthodontic dentoalveolar reconstruction has been accomplished through the changes in occlusal plane and dentition. The changes were similar with NOG 2 that showed skeletal openbite pattern but established normal occlusion by natural dentoalveolar compensation. In other words, the treatment effect of MEAW technique is establishment of the natural dentoalveolar compensation orthodontically so as to make an appropriate dentition to the given skeletal pattern of anterior openbite. Orthodontic dentoalveolar compensation has been accomplished through the uprighting of mesially tilted posterior teeth and reconstruction of occlusal plane suitable for one's own skeletal pattern (Fig. 5).

Majority of openbite cases, have been treated so far, showed reasonable stability during the follow-ups. But some did not. In the study of Nemeth and Isaacson[34] on the relapse after orthodontic treatment and in the study of Denison[35] on the relapse of openbite cases treated by orthognathic surgery, they stated that relapse of openbite treatment had occurred and the relapse was caused by disharmony in the function of circumoral musculature and other uncontrolled, undetected functional factors which originally caused the malocclusion. It would be impossible to avoid the relapse, even if we achieve the orthodontic dentoalveolar compensation suitable to the skeletal pattern, but we could not control the contributing factors which prohibit the natural dentoalveolar compensation.

The known environmental factors for the anterior openbite are thumb and finger sucking habit, large tonsils and adenoid, disproportionately large tongue, incompetency of lips, etc[11]. Even though many researches regarding environmental factors have been accomplished, this field leaves much more studies to be done.

In some cases, environmental factors can be noticed at initial diagnosis. During the retention period, an exercise preventing the downward movement of tongue position or a lip exercise for improving lip competency have been applied to several cases. However, long term evaluation of the effects of these kinds of muscle exercises for post-treatment stability have not been established.

The problems in the long-term stability of anterior openbite treatment can be overcame by expanding knowledge about environmental factors and by progression in the diagnostic skill.

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국문초록

전치부 개방교합의 진단과 치료

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교정적으로 치료할 수는 있지만 많은 노력을 필요로 하는 부정교합들이 존재한다. 특히, 전방 개교는 치료하기 어렵고, 많은 경우 외과적 수술을 동반하여야 한다. 이러한 문제를 해결하기 위해, 여러 치료기전에 대한 연구가 소개되었다. 제안된 치료기전들은 직접, 간접적으로 근신경계와 형태학적인 특징과 원인적 혹은 환경적 요소에 기초를 둔다. 성장 변이에 따라 안모의 수직 관계는 증가하나, 적절한 치아치조 보상기전으로 정상교합 관계가 유지된다. 그러나, 부적절하거나, 부정적인 치아치조 보상기전이 일어나는 경우 개교가 발생할 수 있다. 골격 부조화가 너무 심해 교정치료만으로 해결되기 어렵다면, 악구강계의 기능과 심미를 증진시키기 위하여 수술이 행해져야만 한다. 그러나, 많은 경우 적절한 진단과 치료계획으로 주어진 골격패턴에 알맞게 교정 치료를 변형시키면, 만족스런 결과를 얻을 수 있다. Multiloop Edgewise Archwire(MEAW) 기법은 주로 치아치조

영역에서 치료 변화가 일어나며, 자연적인 치아치조 보상기전과 상당한 유사성을 보인다. 다시 말해서 MEAW기법은 교정의가 자연적인 치아치조 보상을 교정적으로 유도한다고 할 수 있다. 골격 패턴에 알맞은 교정적인 치아치조 보상으로 개교를 치료했다고 해도, 자연적인 치아치조 보상을 억제해왔던 원인요소가 남아 있다면, 재발이 일어난다. 원인요소는 초진시 진단되고 치료와 보정시기에도 고려되어야한다.

주요 단어 : Multiloop Edgewise Archwire(MEAW), 개교, 치아치조 보상, 교합면 재건