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A COMPARISON STUDY OF THE EFFECTS OF NASAL BREATHING DYSFUNCTION DUE TO ADENOID OBSTRUCTION ON DENTITION BY FACIAL TYPE

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In discussing the effects of adenoids on the development of the face and dentition, it is important to note their influence on the mode of breathing and to relate this to specific facial types and dentition. This study, therefore, assumed that the ability to adapt to individual's neuromuscular complex is various. And tried to investigate the effects of reduced nasal respiratory function on the development of dentition by facial type. This paper is based on children patients with enlarged adenoids and comparing them to data taken from a control group with normal respiratory function.

Among the three facial types, the most statistical significant difference was observed from dolichofacial type between experimental and control group. In dolichofacial type, the experimental group showed labioversion of upper incisor, decrease in the width of upper arch, increase in overjet, increase in the rate of cross-bite, and increase in the height of palatal vault.

No significant difference was observed between the two groups in the inclination of upper and lower incisors in mesofacial type, but the experimental group was observed to show decrease in the width of upper arch and increase in the height of palatal vault.

On the other hand, in brachyfacial type, no significant difference was observed between the two groups in dentition variables except showing linguoversion of upper incisor.

The results, which were observed in dolichofacial type, consist with Nordlund's theory of Compression.

Key words : Nasal breathing dysfunction, Adenoid obstruction, Facial types, Dentition

Respiration and mastication are biologically inseparable. The nasal cavity just happens to be formed by essentially the two parts of the maxilla which also happen to be the basal structure for the upper teeth and most of the upper jaw. The lower limits of the nasal cavity happen to be the upper limits of the oral cavity.

What affects one affects the other. It would appear that normal nasal breathing is conductive to normal growth of the maxilla and normal development of the occlusion of the teeth.[33]

The effects of reduced nasal respiratory function on the development of the facial skeleton and dentition is a question which has aroused that interest of many researchers during the last 100 years.

As early as 1872, Tomes[38] reported that children who were mouthbreathers often had narrow dental arches which were sometimes U-shaped.

It is generally recognized that morphology such as a narrow upper dental arch, posterior cross bite and high V-shaped palate sometimes are seen in connection with pathological conditions which cause long-term obstruction of the nasopharyngeal airway.[10,31,37]

However, studies of the relationship between mouth breathing, malocclusion and craniofacial morphology have yielded conflicting results.

In a recent study, the following characteristics were present in chronic mouth breathers: a narrow upper jaw, retroclined upper and lower incisors, normal palatal vault height, a tendency to have or the presence of a crossbite, a tendency to have an open bite and a normal anteroposterior relationship between the upper and lower jaws.[18,19,20,21)]

The presence of a narrow upper jaw and/or a crossbite agrees with earlier findings. However, the retroclined incisors, the lack of a class II malocclusion and normal palatal vault height contradict earlier findings. The open bite tendency has seldom been mentioned.

In discussing the effects of adenoids on the development of the face and dentition, it is important to note their influence on the mode of breathing and to relate this to specific facial types and dentition.[21,31,36,37)] This study, therefore, assumed that the ability to adapt to individual's neuromuscular complex is various. And tried to investigate the effects of reduced nasal respiratory function on the development of dentition by facial type. This paper is based on children patients with enlarged adenoids and comparing them to data taken from a control group with normal respiratory function.

SAMPLES AND METHODS

SAMPLES

The experimental group(the patients) were all children(above IIIa in Hellman's dental age) who attended the otorhinolaryngology department of Youngnam University Hospital and were judged to present indications for adenoidectomy.

Patients were divided into three facial types according to Ricketts's VERT(amount of vertical growth) index, such as meso facial, bracky facial, and dolicho facial type. And selected 20 patients in each type as experimentals.

The control group was made up to equivalent with the age(above IIIa in Hellman's dental age), sex and number of the adenoidectomy children. The controls were confined to children who are attending at E-elementary school in order to make it easier for these children to participate in this study.

Further selection criteria for the controls were that they had no history of obstructed nasal breathing, that they had never undergone adenoidectomy or received orthodontic treatment. The controls were also grouped according to the size of the experimentals

Five · measurements were used to determine the facial type:

① The facial axis angle: This angle is formed by the intersection of the basionnasion line and the facial axis (a line from PT point to cephalometric nathion). The clinical norm is 90° ± 3°

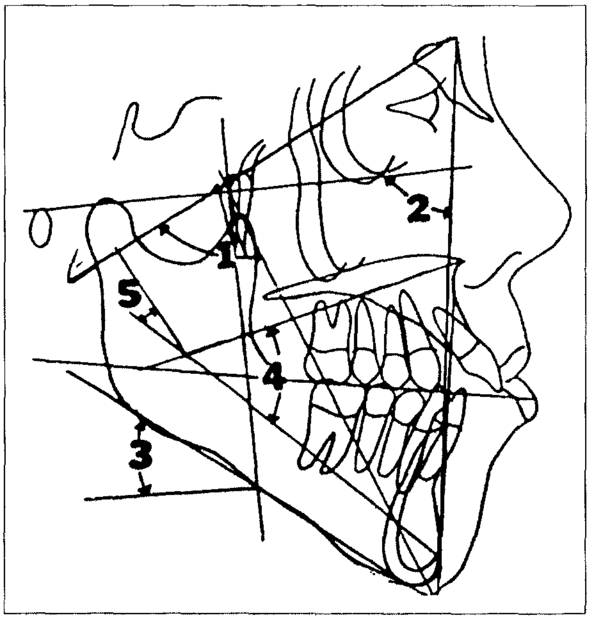

Figure 1. Five Measurements to Describe the Face

Table 1. Norm and Clinical Deviation of Five Measurements

MEASUREMENT	NORM AGE 9	CLINICAL DEV.	MEAN CHANGE PER YEAR
1. Facial Axis	90°	±3°	No Change with Age
2. Facial(Angle)Depth	87°	±3°	Change=+1° Every 3 Year
3. Mandibular Plane	26°	±6°	Change=-1° Every 3 Year
4. Lower Facial Height	47°	±4°	No Change
5. Mandibular Arc	26°	±4°	Increase1/2° Per Year

Table 2. Relation of Five Measurements to Facial Type

Measurement	More than 1 cd below norm	Within 1 cd of norm	More than 1 cd above norm
Facial Axis	D	M	B
Facial (Angle) Depth	D	M	B
Mandibular Plane Angle	B	M	D
Lower Facial Height	B	M	D
Mandibular Arc	D	M	B

M=Mesofacial B=Brachyfacial D=Dolichofacial cd=clinical deviation

Table 3. The Relationship between VERT and Facial Pattern

VERT						
Facial Pattern	Severe Dolicho	Dolicho	Mild Dolicho	Mesofacial	Brachy	Severe Brachy
Clinical Deviation	-2.0	-1.0	-0.5	0	0.5	1.0

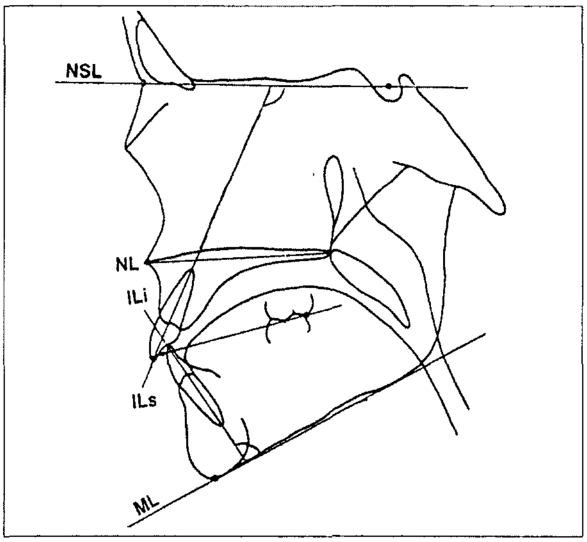

Fig 2. Reference lines and measurements on lateral cephalometric radiographs

ILi : Lower incisal line - the axis of the lower central incisor
ILs : Upper incisal line - the axis of the upper central incisor
ML : Mandibular line - the tangent to the lower border of the mandible
NSL: Nasion - Sella line
OL : Occlusal line - the line through the midpoint of the distance between the incisal edges of the upper and lower central incisors and the distobuccal cusp of the first upper molar

② Facial depth: This measurement is the angle formed by the intersection of the facial plane and the Frankfort Horizontal plane. The norm for a nine old year child is 87° ± 3° . This angle increases 1° every 3 years as the mandible grows forward.

③ Mandibular plane angle: The mandibular plane angle is formed by the intersection of the mandibular plane and the Frankfort Horizontal plane. The norm for this angle at age 9 is 26° ± 4 ° . This angle decreases. 1° every 3 years until maturity.

④ Lower facial Height: This is the angle formed by the intersection of a line from anterior nasal spine to X1 point and the corpus axis(X1-PM). The norm is 47° with a clinical deviation of 4° .

⑤ Mandibular Arc: The mandibular arc is the angle formed by the intersection of the condylar axis(DC-X1) and the distal extrapolation of the corpus axis. The norm for a nine year old child is 26° ± 4° and decreases approximately 0.5° per year with growth.

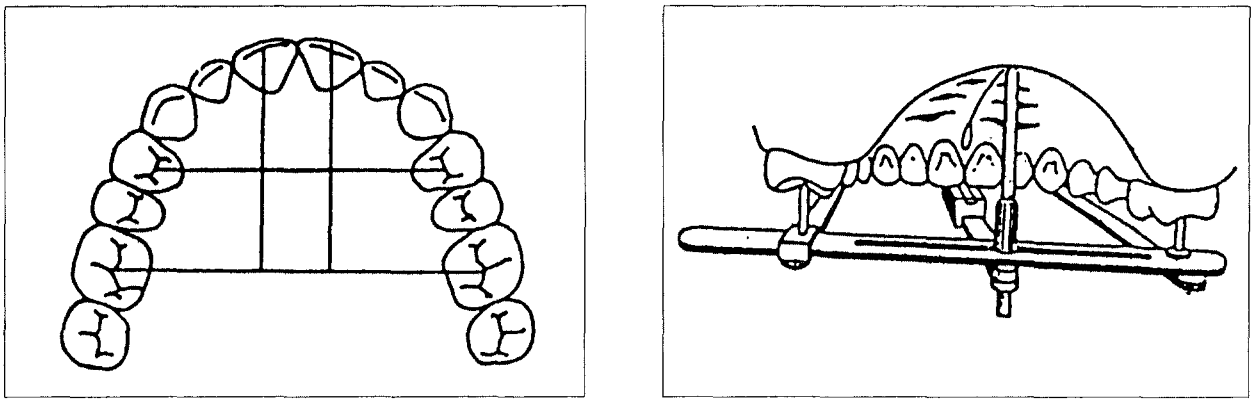

Fig. 3. Reference for measurements on the casts

METHODS

(1) Cephalometric Study

Individual cephalogram was taken with the conventional method. Five angular measurements in the lateral cephalometric radiographs were used(Fig. 2)

(2) Measurements on the Casts

Impressions of the upper and lower dental arches were taken in alginate material and plaster models made. A wax record in maximum intercuspidation was also taken. 15 measurements were made on the model(Fig. 3, Table 4)

RESULTS

The means and standard deviations, for both groups by facial type, were calculated. The t-test was performed to compare the difference in various dentition variables between Experimentals and Controls by facial type.

Dolicho facial type(Table 5)

① The values of the Occlusal Plane(OL/ML) and Upper incisor inclination(ILs/NSL) are higher in experimentals than in controls. The differences were statistically significant($P < 0.05$ and $P < 0.005$, respectively).

② There was a significant difference in Interincisal angle(ILs/ILi) between experimentals and controls($P < 0.005$). ILs/ILi in experimentals is smaller than in controls.

③ Dentition variables, which show significant difference through cast analysis, are Intermolar width of upper and Interpremolar width of upper($P < 0.005$ and $P < 0.05$, respectively). These are wider in controls than in experimentals.

Table 4. The measurement variables

Variable No	Variable	Unit
01	OL/ML	degree
02	OL/NSL	degree
03	ILs/NSL	degree
04	ILs/ILi	degree
05	ILi/ML	degree
06	Arch width 6-6 upper	mm
07	Arch width 6-6 lower	mm
08	Arch width 4-4 upper	mm
09	Arch width 4-4 lower	mm
10	Arch length upper	mm
11	Arch length lower	mm
12	Overjet	mm
13	Overbite	mm
14	Cross bite	No 0, Yes 1
15	Height of palatal vault	mm
16	Space difference upper	mm
17	Space difference lower	mm
18	Lower arch width 6-6 Upper arch width 6-6	%
19	Lower arch width 4-4 Upper arch width 4-4	%
20	Height of palatal vault Upper arch width 6-6	%

Table 5. Mean and standard deviation of dentition variable by experimental and control Dolichofacial type

	variables	Experimental Dolicho- n=20 Mean±S.D	Control Dolicho- n=20 Mean±S.D	P-value
01	OL/ML	20.98±3.92	17.36±3.39	P<0.05
02	OL/ML	21.95±3.37	21.22±1.98	N.S
03	ILs/NSL	109.48±3.12	106.12±1.72	P<0.05
04	ILs/ILi	115.38±3.80	120.56±2.82	P<0.005
05	ILi/ML9	4.36±4.80	94.01±3.16	N.S
06	Arch width 6-6 upper	46.43±1.22	47.99±1.01	P<0.005
07	Arch width 6-6 lower	41.98±2.58	42.02±2.03	N.S
08	Arch width 4-4 upper	35.73±1.89	37.07±1.97	P<0.05
09	Arch width 4-4 lower	31.20±2.13	31.72±2.32	N.S
10	Arch length upper	29.15±2.40	29.76±2.06	N.S
11	Arch length lower	23.35±2.03	23.58±2.92	N.S
12	Overjet	3.12±1.62	1.81±0.28	P<0.005
13	Overbite	1.82±2.04	2.21±0.31	
14	Crossbite - O 89.2% - 1 10.8%			
15	Hight of palatal vault	16.35±2.01	14.36±0.86	P<0.001
16	Space difference upper	-2.52±3.53	0.00	
17	Space difference lower	-2.30±2.99	0.00	
18	Upper arch width 6-6 / Lower arch width 6-6	90.39±3.12	91.26±2.41	N.S
19	Lower arch width 4-4 / Upper arch width 4-4	86.54±5063	87.22±4.06	N.S
20	Height of palatal vault / Upper arch width 6-6	35.27±4.66	37.79±4.58	P<0.05

④ Overjet and Height of palatal vault shows higher value in experimentals than in controls. And the differences were also statistically significant($P < 0.05$ and $P < 0.001$ respectively).

⑤ Rate of Cross-bite tendency was high with 10.8%.

Meso facial Type(Table 6)

① There was a significant difference in Interincisal angle(ILs/ILi) with $P < 0.05$. ILs/ILi in experimental is larger than in controls.

② Dentition variables, which shows significant difference through cast analysis, are Intermolar and Interpremolar width of upper(Both are $P < 0.05$).

③ Height of palatal shows higher value in experimentals than in controls. And the differences were also statistically significant($P < 0.05$).

④ Rate of Cross-bite was tendency as high as 7.2%.

Brachy facial Type(Table 7)

① There were significant differences in ILs/NSL and ILs/ILi between two groupes(both are $P < 0.05$). These values in experimentals are smaller than in controls.

② Cast analysis did not show any statistical significant differences between two groups

DISCUSSION

The relationship between the development of occlusion and nasorespiratory function has been debated for at least a century. Prior to 1930, many individuals were convinced that mouthbreathing affected the development of the oral apparatus.[8,28] However, during the 1930's and 1940's, the serial studies of Broadbent[4] and Brodie[5] suggested "constancy" of the growth pattern, providing a theory

Table 6. Mean and standard deviation of dentition variables by experimental and control Mesofacial type

	variables	Experimental Meso- n=20 Mean±S.D	Control Meso- n=20 Mean±S.D	P-value
01	OL/ML	16.00±3.09	14.92±1.82	N.S
02	OL/ML	21.01±3.58	20.24±1.24	N.S
03	ILs/NSL	108.53±3.12	106.22±1.70	P<0.005
04	ILs/ILi	118.23±4.02	123.51±2.41	N.S
05	ILi/ML9	94.27±2.89	94.84±2.41	N.S
06	Arch width 6-6 upper	47.52±1.95	48.22±1.72	P<0.05
07	Arch width 6-6 lower	42.01±2.66	43.28±2.79	N.S
08	Arch width 4-4 upper	36.13±2.25	37.28±1.66	P<0.05
09	Arch width 4-4 lower	32.28±1.98	32.98±2.06	N.S
10	Arch length upper	28.70±2.72	29.16±2.41	N.S
11	Arch length lower	24.59±2.03	24.01±1.98	N.S
12	Overjet	2.06±1.93	1.86±1.02	N.S
13	Overbite	2.14±1.39	1.98±0.47	N.S
14	Crossbite - O 92.8% - 1 7.2%			
15	Hight of palatal vault	15.72±2.31	14.31±0.86	P<0.005
16	Space difference upper	-2.00±4.27	0.00	N.S
17	Space difference lower	-0.08±3.33	0.00	N.S
18	Upper arch width 6-6 Lower arch width 6-6	89.49±2.71	90.08±1.72	N.S
19	Lower arch width 4-4 Upper arch width 4-4	87.35±3.96	86.98±3.88	N.S
20	Height of palatal vault Upper arch width 6-6	32.69±2.52	32.97±2.19	N.S

of facial growth strongly influenced by genetic factors. The work of Lundstorm[22] and Goldstein[11] further implicated the role of heredity and the pendulum swung from theories of environmentally influenced patterns of facial growth to the immutability of genetically determined growth patterns. That there is a relationship between the nose and the mouth would seem obvious on both a functional and neurologic basis.[24] The nasal and oral regions are supplied by divisions of the same fifth cranial nerve, as both respiration and mastication evolved simultaneously from the branchial arch system.

In discussing the effects of reduced nasal breathing due to adenoids on the development of the face and dentition, it is important to note their influence on the mode of breathing and to relate this to specific facial type and dentition.

Siebenmann[36] maintained that a high palate was commonly found in individuals with a narrow nose and small nasopharyngeal volume. Therefore, adenoids often caused mouthbreathing in these individuals.

Ricketts[30,31] also demonstrated that the absolute size of the adenoid mass was not as significant as its size relative to the size of the nasopharynx.

Subtelny[37] found, in a longitudinal study on the change in configuration of the adenoids with age, that adenoids do not cause mouth breathing unless they occupy a major portion of the nasopharynx.

Among the three facial types, the most statistical significant difference was observed from dolichofacial type between experimental and control group. In dolichofacial type, the experimental group showed labioversion of upper incisor, decrease in the width of upper arch, increase in overjet, increase in the rate of cross-bite, and increase in the height of palatal vault.

No significant difference was observed between the

Table 7. Mean and standard deviation of dentition variables by experimental and control Brachyfacial type

	variables	Experimental Brachy- n=20 Mean±S.D	Control Brachy- n=20 Mean±S.D	P-value
01	OL/ML	12.73±3.92	14.76±2.88	N.S
02	OL/ML	19.78±3.21	20.21±2.16	N.S
03	ILs/NSL	104.10±2.96	106.02±2.61	P<0.05
04	ILs/ILi	121.88±2.19	123.17±1.96	P<0.05
05	ILi/ML9	92.43±4.21	94.12±2.11	N.S
06	Arch width 6-6 upper	48.97±1.98	48.92±1.81	N.S
07	Arch width 6-6 lower	43.66±1.76	43.01±2.01	N.S
08	Arch width 4-4 upper	37.43±2.12	38.07±2.78	N.S
09	Arch width 4-4 lower	32.94±2.76	33.20±3.21	N.S
10	Arch length upper	28.41±1.95	29.26±4.16	N.S
11	Arch length lower	23.58±3.89	24.06±3.01	N.S
12	Overjet	2.11±1.75	1.92±1.26	
13	Overbite	2.61±1.38	2.43±2.26	N.S
14	Crossbite - 0 92.8% - 1 7.2%			
15	Hight of palatal vault	15.46±2.10		
16	Space difference upper	-0.30±2.72	0.00	N.S
17	Space difference lower	-0.40±2.19	0.00	N.S
18	Upper arch width 6-6 / Lower arch width 6-6	90.13±3.93	91.76±2.94	N.S
19	Lower arch width 4-4 / Upper arch width 4-4	85.47±4.11	86.12±3.76	N.S
20	Height of palatal vault / Upper arch width 6-6	31.71±3.01	30.76±2.98	N.S

two groups in the inclination of upper and lower incisors in mesofacial type, but the experimental group was observed to show decrease in the width of upper arch and increase in the height of palatal vault.

On the other hand, in brachyfacial type, no significant difference was observed between the two groups in dentition variables except showing linguoversion of upper incisor.

The results, which were observed in dolichofacial type, consist with Nordlund's[26] theory of Compression.

By disturbing the balance between the tongue and cheek musculature, it was thought that the alveolar process in the premolar and molar regions became compressed medially, driving the upper anterior segment forward.

Bentzen[2] stated that the detrimental effects of mouth breathing were not limited to narrow dental arches, but also included underdevelopment of the nasal cavity and maxilla. They thought that the height of palatal vault increased due to inactivity. And this reduced growth of the nasal cavity. This theory of inactivity is also mentioned by Nordlund and, like theory of compression, is recognized by many today.

On the other hand, the results in brachyfacial are totally different from theory of compression. However, linguoversion of upper incisor is consistent with Linder-Aronson's[18-21] study which suggested orbicular oris muscle pressure due to mouth breathing is cause of linguoversion.

As many author[1,17] have believed that the pattern of facial growth influenced by genetic and environmental factors, and those influences are various according to their degree, duration and onset.

Although there is same degree of nasal breathing dysfunction, the ability of individual's neuro-muscular adaptation and dentitional adaptation for nasal breathing dysfunction(one of environmental factors) is different by facial type.

Therefore, the study of neuro-muscular change during long-term adaptation to oral respiration should be considered for further study.

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