ASSESSMENT OF OROPHARYNGEAL AIRWAY DIMENSIONS IN SKELETAL CLASS II CASES TREATED WITH TWIN BLOCK APPLIANCE

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Severe mandibular deficiency has been linked to reduced oropharyngeal airway (OAW) dimensions.[1] Decreased space between the cervical column and the mandibular corpus may lead to posteriorly postured tongue and soft palate, increasing the chances of impaired respiratory function during the day, and possibly causing nocturnal problems as well, such as snoring, upper airway resistance syndrome (UARS), and obstructive sleep apnea syndrome (OSAS).[2]

An increase in OAW dimensions in growing patients with mandibular deficiency may have some major benefits in terms of craniofacial growth and function. Treatment with functional appliance leads to significant alterations in tongue position and significantly increases the extent of oropharyngeal space.

The present study intends to evaluate the changes in oropharyngeal airway dimensions in growing patients who have skeletal Class II patterns with retrognathic mandibles treated with Twin Block functional appliance.

Aims & Objectives

The study was conducted with the following aims and objectives:

1. To assess the changes in the oropharyngeal airway (OAW) dimensions in individuals with retrognathic mandible treated with Twin Block functional appliance to correct the skeletal Class II during the growth period.
2. To evaluate the skeletal changes after the treatment with Twin Block appliance and to relate the changes with oropharyngeal airway.

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Materials and Methods

This study was conducted in order to evaluate the changes in oropharyngeal airway dimensions in growing patients who have skeletal Class II patterns with retrognathic mandibles treated with Twin Block functional appliance.

lateral cephalograms, hand wrist radiographs, case history records and clinical records of 20 skeletal Class II growing children treated with Twin Block functional appliance were taken.

Inclusion criteria:

1. Angle Class II molar relationship with mandibular retrognathism.
2. ANB > 4 degrees.
3. Overjet > 5mm.
4. Significant growth potential at the beginning of the treatment period (before MP_{3cap} period).
5. Treatment by Twin Block appliance with both pre and post treatment records.

Exclusion criteria:

1. No known Respiratory problems.
2. No obvious naso-oropharyngeal obstruction.
3. No surgical upper airway operations before or during the treatment.

Method of collection of data:

The individuals fulfilling the above criteria were requested to participate in the study. The selected individuals were explained about the procedures and

with their consent standardized pre and post treatment lateral cephalograms of each individual subject were obtained.

Hand wrist radiographs were obtained and analyzed for the growth potential at the beginning of the treatment (before MP_{3cap} period).

Cephalometric analysis:

The lateral cephalograms were made under standardized conditions with the Frankfort horizontal plane kept parallel to the floor and the midfacial plane kept in a vertical position using the Planmeca PM 2002 cc Proline radiographic machine.

Landmarks:

The following landmarks and planes were traced on the lateral cephalograms :

1. Sella Turcica (S) - The center of the pituitary fossa.
2. Nasion (N) - The most anterior point of the fronto-nasal suture in the median line.
3. Anterior nasal spine (ANS) - The most anterior point on the maxilla at the level of the palate.
4. Posterior nasal spine (PNS) - The most posterior point at the sagittal plane on the bony hard palate.
5. Menton (Me) – The most inferior point on the symphysis of the mandible
6. Gonion (Go) – The point on the contour of the mandible determined by bisecting the angle formed by the mandibular and ramal planes.
7. Gnathion (Gn) – The most anterior-inferior point of the chin.
8. Point A – The point at the deepest midline concavity on the maxilla between the anterior nasal spine and prosthion.
9. Point B – The point at the deepest midline concavity on the mandibular symphysis between infradentale and pogonion.
10. Condylion (Co) – The most superior posterior point on the head of the mandibular condyle.

Planes:

1. Sella Nasion plane – Anteroposterior extent of anterior cranial base (S-N)
2. Mandibular plane – Tangent to gonion and lowest point of the symphysis

(Go-Me)

Skeletal measurements used in the study

Angular measurements:

The following angular measurements were made

1. Sagittal maxillary position (SNA)
2. Sagittal mandibular position (SNB)
3. Sagittal intermaxillary relation (ANB)
4. Mandibular plane angle (SN MP)

Linear measurements:

The following linear measurements were made

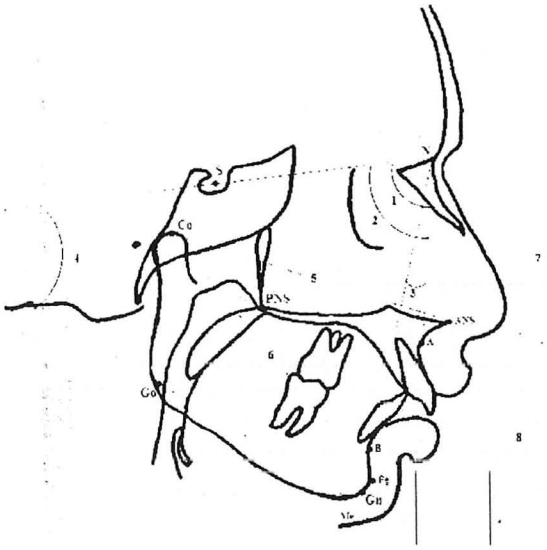
1. Maxillary unit length (MxUL)
2. Mandibular unit length (MdUL)
3. Sagittal intermaxillary unit length discrepancy (ULD–MdUL-MxUL)
4. Ratio of upper and lower facial height (UFH/LFH)

Oropharyngeal Airway (OAW) measurements:

1. Superior posterior airway space (SPAS): Smallest distance between the posterior border of the soft palate and the posterior pharyngeal wall.
2. Middle airway space (MAS): Smallest distance between the posterior border of the tongue and the posterior pharyngeal wall, through the tip of the soft palate
3. Inferior airway space (IAS): Smallest distance between the posterior border of the tongue and the posterior pharyngeal wall.

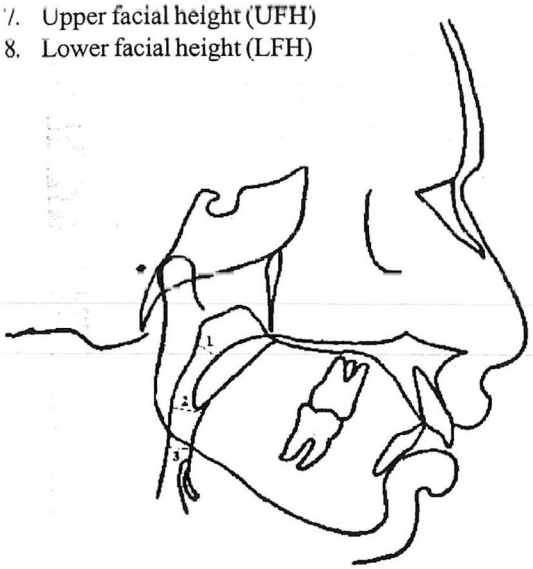
Statistical analysis:

The data obtained was statistically evaluated using paired *t*-test.



Linear and angular measurements on cephalogram

1. Sagittal maxillary position (SNA)
2. Sagittal mandibular position (SNB)
3. Sagittal intermaxillary relation (ANB)
4. Mandibular plane angle (SNMP)
5. Maxillary unit length (MxUL)
6. Mandibular unit length (MdUL)
7. Upper facial height (UFH)
8. Lower facial height (LFH)



Oropharyngeal Airway (OAW) measurements

1. Superior posterior airway space (SPAS)
2. Middle airway space (MAS)
3. Inferior airway space (IAS)

Results

Data obtained were analyzed using Statistical Package for Social Sciences (Windows version 11.5, SPSS Inc., Chicago, Illinois, USA). Paired t test was used to assess difference in the amount of change in the different variables between the pre-treatment and post-treatment. Significance was determined at the 0.05 (significant), 0.01 (highly significant), and 0.001 (very highly significant) levels of confidence.

The data collected presented with the following findings:

Angular Skeletal measurements

Sagittal maxillary position (SNA): The mean value for SNA pre-treatment was found to be 82.50^0 with SD of 4.07173^0; whereas mean value for SNA post treatment was found to be 82.35^{0}with SD of 4.18047^0. The difference in mean value for SNA pre-treatment and post- treatment was found to be not significant (p=0.594).

Sagittal mandibular position (SNB): The mean value for SNB pre-treatment was found to be 75.35^0 with SD of 3.99045^0; whereas mean value for SNB post-treatment was found to be 77.70^{0}with SD of 3.94502^0. The difference in mean value for SNB pre-treatment and post- treatment was found to be very highly significant (p<0.001).

Sagittal intermaxillary relation (ANB): The mean value for ANB pre-treatment was found to be 7.15^0 with SD of 1.53125^0; whereas mean value for ANB post-treatment was found to be 4.65^0 with SD of 1.63111^0. The difference in mean value for ANB pre-treatment and post- treatment was found to be very highly significant (p<0.001).

Mandibular plane angle (SN MP): The mean value for SN-MP pre-treatment was found to be 33.1250^0 with SD of 6.39670^0; whereas mean value for SN-MP post-treatment was found to be 33.450^0 with SD of

5.9668^0. The difference in mean value for SN-MP pre-treatment and post- treatment was not found to be significant (p=0.590)

Linear Skeletal measurements

Maxillary unit length (MxUL): The mean value for MxUL pre-treatment was found to be 95.75mm with SD of 3.68318mm; whereas mean value for MxUL post-treatment was found to be 96.05mm with SD of 3.74131mm. The difference in mean value for MxUL pre-treatment and post- treatment was not significant (p–0.424).

Mandibular unit length (MdUL): The mean value for MdUL pre-treatment was found to be 107.75mm with SD of 3.5mm; whereas mean value for MdUL post-treatment was found to be 113.2mm with SD of 3.6685mm. The difference in mean value for MdUL pre-treatment and post- treatment was found to be very highly significant (p<0.001).

Sagittal intermaxillary unit length discrepancy (ULD– MdUL-MxUL): The mean value for ULD pre-treatment was found to be 12.00mm with SD of 3.42591mm; whereas mean value for ULD post-treatment was found to be 17.15mm with SD of 3.56555mm. The difference in mean value for ULD pre-treatment and post- treatment was found to be very highly significant (p<0.001).

Upper Facial Height (UFH): The mean value for UFH pre-treatment was found to be 49.275mm with SD of 2.97124mm; whereas mean value for UFH post-treatment was found to be 50.55mm with SD of 2.91051mm. The difference in mean value for UFH pre-treatment and post- treatment was found to be very highly significant (p<0.001).

Lower Facial Height (LFH): The mean value for LFH pre-treatment was found to be 60.625mm with SD of 4.10992mm; whereas mean value for LFH post-treatment was found to be 64.425mm with SD of 3.61384mm. The difference in mean value for LFH pre treatment and post- treatment was found to be very highly significant (p<0.001).

Ratio of upper and lower facial height (UFH/LFH): The mean value for pre-treatment UFH/LFH (ratio) was found to be 81.6045% with SD of 7.14962%; whereas mean value for post-treatment UFH/LFH was found to be 78.6740% with SD of 6.05753%. The difference in mean value for UFH/LFH pre-treatment and post- treatment was found to highly significant (p<0.002).

Dental measurement

Overjet: The mean value pre-treatment overjet was found to be 9.9750mm with SD of 2.13045mm; whereas mean value of post-treatment overjet was found to be 3.1250mm with SD of 1.7386mm. The difference in mean value of pre-treatment and post treatment overjet was found to be very highly significant (p<0.001).

Oropharyngeal Airway (OAW) measurements

Superior posterior airway space (SPAS): The mean value for SPAS pre-treatment was found to be 10.0250mm with SD of 2.91311mm; whereas mean value for SPAS post-treatment was found to be 12.1500mm with SD of 2.91141mm. The difference in mean value for SPAS pre-treatment and post-treatment was found to be very highly significant (p<0.001).

Middle airway space (MAS): The mean value for MAS pre treatment was found to be 11.2750mm with SD of 3.05422mm; whereas mean value for MAS post-treatment was found to be 13.6750mm with SD of 3.06197mm. The difference in mean value for MAS pre-treatment and post- treatment was found to be very highly significant (p<0.001).

Inferior airway space (IAS): The mean value for IAS pre-treatment was found to be 9.0750mm with SD of 2.11059mm; whereas mean value for IAS post-treatment was found to be 11.4000mm with SD of 2.80788mm. The difference in mean value for IAS pre-treatment and post- treatment was found to be very highly significant (p<0.001).

No significant changes in skeletal and oropharyngeal airway measurements were observed between males and females.

Paired Samples Statistics Oropharyngeal Airway (OAW) measurements

Variable	N	Mean	Std. Deviation	Std. Error Mean
SPAS Pre-Tt	20	10.0250	2.91311	.65139
SPAS Pre-Tt	20	12.1500	2.91141	.65101
MAS Pre-Tt	20	11.2750	3.05422	.68295
MAS Post-Tt	20	13.6750	3.06197	.68468
IAS Pre-Tt	20	9.0750	2.11059	.47194
IAS Post-Tt	20	11.4000	2.80788	.62786

Paired Samples Test Oropharyngeal Airway (OAW) measurements

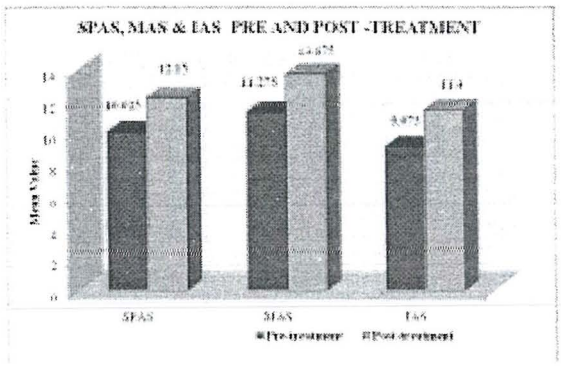
Variable	Paired Differences		t	P
	Mean	Std. Deviation		
SPAS Pre-Tt – SPAS Post-Tt	-2.1250	1.09874	-8.649	<0.001Vhs
MAS Pre-Tt – MAS Post-Tt	-2.4000	1.55259	-6.913	<0.001Vhs
IAS Pre-Tt – IAS Post-Tt	-2.3250	2.27269	-4.575	<0.001 vhs

Group Statistics Oropharyngeal Airway (OAW) measurements

Variable	Sex	N	Mean	Std. Deviation	Std. Error Mean
SPASPre-treatment	Male	9	8.7778	2.72845	.90948
	Female	11	11.0455	2.76093	.83245
SPASPost- treatment	Male	9	11.3889	2.93447	.97816
	Female	11	12.7727	2.87544	.86698
MASPre- treatment	Male	9	10.3333	3.25000	1.08333
	Female	11	12.0455	2.79691	.84330
MASPost- treatment	Male	9	13.4444	3.58333	1.19444
	Female	11	13.8636	2.73030	.82322
IASPre- treatment	Male	9	8.7778	2.03272	.67757
	Female	11	9.3182	2.23912	.67512
IASPost- treatment	Male	9	12.1667	3.33541	1.11181
	Female	11	10.7727	2.26234	.68212

Independent Samples Test Oropharyngeal Airway (OAW) measurements

Variables	t-test for Equality of Means	
	T	Sig. (2-tailed)
SPAS Pre- treatment	-1.837	.083
SPAS Post- treatment	-1.061	.303
MAS Pre- treatment	-1.267	.221
MAS Post- treatment	-.297	.770
IAS Post- treatment	-.559	.583
IAS Post- treatment	1.111	.281



Comparison of pre-treatment and post-treatment OAW

Discussion

Decreased space between the cervical column and the mandibular corpus may lead to posteriorly postured tongue and soft palate, increasing the chances of impaired respiratory function.

An increase in OAW dimensions in growing patients with mandibular deficiency may have some major benefits in terms of craniofacial growth and function. If increase in these dimensions result in an increase in OAW capacity and thereby better daytime and nocturnal respiratory function, the possible effect of an impaired OAW function as an etiological factor for abnormalities in facial structures might be reduced and might even modify the vertical and/or sagittal growth pattern of the craniofacial complex.

The Twin-block (TB) appliance, originally developed by Clark, is a widely used functional appliance for the management of Class II malocclusion. Narrowing of the pharyngeal airway appears to be improved by mandibular advancement during the first few months of Twin Block treatment. Long-term observation after treatment confirms that the increase in upper pharyngeal width is maintained and lip competence is also achieved consistently during Twin Block treatment [4]

In the present study 20 individuals (9 males and 11 females), in the age group of 11 to 14 years ,were selected as per inclusion criteria.On comparison of pre-treatment and post-treatment cephalograms, change in sagittal maxillary position (SNA) was found to be not significant in this study.

On comparison of pre-treatment and post treatment cephalograms, change in sagittal mandibular position (SNB) and sagittal intermaxillary relation (ANB) was found to be very highly significant in our studyOn comparison of pre-treatment and post-treatment cephalograms, change in Maxillary unit length (MxUL), was found to be statistically not significant. Change in Mandibular unit length (MdUL) and Sagittal intermaxillary unit length discrepancy (ULD= MdUL-MxUL) was found to be very highly significant. Similar results were found in the studies conducted by M. Murat Özbek et al[3] and Christine M. Mills et al.[5] Highly significant increases in mandibular length was also observed in a study conducted by DeVincenzo.[6]

Increase in Upper Facial Height (UFH) and Lower Facial Height (LFH) was found to be very highly significant. Change in Ratio of upper and lower facial height (UFH/LFH) was found to be highly significant . These observations are in accordance with the study conducted by M. Murat Özbek et al.[3]

On comparison of pre-treatment and post-treatment cephalograms, increase in Oropharyngeal Airway (OAW) measurements, such as Superior posterior airway space (SPAS), Middle airway space (MAS) and Inferior airway space (IAS) was found to be very highly significant . These observations are in accordance with the study conducted by M. Murat Özbek et al.[3] Significant increase in oropharyngeal space was also observed in the study conducted by S Yassaei et al,[7]and Shiroh Isono et al[8]

No significant sex/gender difference was observed in Oropharyngeal Airway (OAW) measurements.

Conclusion

On comparison of pre-treatment and post-treatment cephalograms, increase in Oropharyngeal Airway (OAW) measurements, such as Superior posterior airway space (SPAS), Middle airway space (MAS) and Inferior airway space (IAS) was found to be very highly significant.

Our results clearly suggest the existence of a relationship between functional orthopedic treatment and increases in OAW dimensions in certain skeletal Class II growing subjects. However, it would be premature to arrive at general clinical conclusions. Further studies are needed to evaluate if increasing OAW dimensions by means of functional orthopedic treatment in cases with skeletal Class II pattern and mandibular deficiency will prove to have favorable outcomes, such as modification of growth pattern of the craniofacial structures and/or a reduced chance of having impaired respiratory function in short- and long-term.

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