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Sexual dimorphism in hypopharyngeal airway space and effective length of mandible with twin block appliance therapy: A prospective study

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ABSTRACT

Objectives: To evaluate changes in hypopharyngeal airway space and effective length of mandible in skeletal Class II patients following Twin Block Appliance (TBA) therapy. Further, the study also aims to compare the post functional changes being observed between males and females.
Materials and Methods: This is a prospective study on 15 Pre-adolescents (08 males and 07 females; mean age: 10.75 ± 0.91years) who underwent functional jaw orthopaedics with TBA. Lateral cephalogram at Pre treatment stage (T1) and post functional phase of TBA (T2) were obtained. The cephalometric parameters were measured and paired t test was done for comparison of pre and post functional changes.
Results: The mean period of functional phase of TBA therapy was 18 ± 02 months. The cephalometric changes post functional jaw orthopaedics were statistically insignificant when compared males Vs females ($P > 0.05$). However, mean increase of in the effective length of mandible and hypopharyngeal space (T2-T1) was 4.0± 1.16 mm and 1.47±0.57 mm respectively, which were statistically highly significant ($P<0.5$).
Conclusions: 1. TBA therapy in skeletal Class II patients significantly increases the effective mandibular length and hypo-pharyngeal space post functional phase; 2. No significant differences were observed between males and females with respect to post functional cephalometric changes in mandibular length and hypopharyngeal space.

1. Introduction

Skeletal Class II malocclusion due to retrognathic mandible is one of the most common orthodontic malocclusion that accounts for about a third of all subjects seeking orthodontic treatment.[1,2] Numerous treatment modalities are available for the management of skeletal Class II malocclusion such as functional jaw orthopaedics (FJO), headgears, intermaxillary elastics and camouflage by conventional fixed appliance with tooth extraction. Functional jaw orthopaedics is most commonly used treatment modality for pre-adolescent patients. Individually, many studies[3–9] have found changes in effective mandibular length and hypopharyngeal space following FJO. However, when studies were grouped and analyzed together in systematic reviews and meta-analysis, controversies appear. Systematic review conducted by Cozza et al.[10] have found no statistically or clinically significant differences between groups treated with functional appliances and controls, while in systematic review conducted by Marsico et al.[11] have observed statistically significant changes. Very few studies had evaluated the effect of sexual dimorphism on changes in hypopharyngeal airway space and maxilla-mandibular dimensions following FJO.

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The aim of this study was to evaluate changes in hypopharyngeal airway space and effective length of mandible in skeletal Class II patients following Twin Block Appliance (TBA) therapy. Further, the study also aims to compare the post functional changes being observed between males and females.

2. Materials and Methods

This prospective study was conducted at secondary care Govt hospital and all the patients who required mandibular advancement with functional jaw orthopaedics duly fulfilling the inclusion criteria were selected and this prospective study was approved by institutional ethical committee (PR/02/15).

The inclusion criteria selected were skeletally Class II malocclusion (ANB= 4° to 8°), CVMI stage III,[12] sella nasion to mandibular plane (Go-Gn) less than 32°, and exclusion criteria like prognathic maxilla, proclined maxillary incisors (U1 to NA >30°), proclined mandibular incisors (IMPA >100°), tooth size arch length discrepancy > 6mm, history of orthodontic treatment and craniofacial anomalies & systemic disorders affecting growth and development. Pre-treatment records including lateral cephalogram were recorded (T1). All the patients (n=15) selected as sample were delivered TBA. The maximum and minimum durations for which the appliance was continued 20 months and 16 months respectively with mean duration of functional phase being 18 ± 02 months.

Post-functional lateral cephalograms were taken (T2) for measurement and evaluation of cephalometric data. Lateral cephalograms were traced manually by one examiner on a standard cellulose acetate paper of 8”x10” size and 0.003” thickness by using a hard 3H pencil under standard illumination. Cephalograms were traced by the same investigator with a standard technique.

The cephalometric parameters were measured on the pre and post functional lateral cephalograms (Table 1).

2.1. Statistical analysis

The statistical analysis was performed using statistical package for social sciences (SPSS Inc., Chicago, IL, version 26.0 for Windows). All the data were recorded on a MS Excel. For comparison between T1 and T2, paired t-tests were conducted with level of significance at 0.05. Reliability of the measured data was assessed by repeating cephalometric measurements for 10% randomly selected cephalograms after a gap of 30 days by same examiner. The intra observer bias has been evaluated using Dahlberg formula and the differences were found to be non significant. Statistical significance level was set at 5%.

3. Results

The sample of 15 Pre-adolescents (08 males and 07 females) with mean age of 10.75 ± 0.91 years who underwent functional jaw orthopaedics with TBA was analyzed. All the patients (n=15) selected as sample were delivered TBA. The maximum and minimum durations for which the TBA was continued 20 months and 16 months respectively with mean duration of functional phase being 18 ± 02 months.

The mean changes in various cephalometric parameters from pre-treatment to post-functional phase are as shown in Table 2. There were significant increased in the effective length of mandible, maxillomandibular differential and hypopharyngeal space by 4.0±1.195 mm, 3.8±1.424 mm and 1.47±0.516 mm respectively. There was also a significant decrease in the ANB angle by 3.6±1.056°. The effective maxillary length did not show any significant changes.

There were no statistically significant changes in the all the cephalometric parameters after TBA when compared between male and female as shown in Table 3.

There were no dropouts and all the patients included in sample were completed their functional phase of TBA.

4. Discussion

This prostective study evaluated the changes effective mandibular length, maxillomandibular differential and hypopharyngeal space between male and female. In In the literature,[13] Adrenarche reaches a critical level at about age of 10 years. It had been mentioned juvenile acceleration is more prominent in girls because of the greater adrenal component of their early sexual development but in the present study, no significant changes were found when compared between males and females.

There was statistically significant increased in effective mandibular length by 4.0±1.195 mm. Toth and McNamara[14] found 3.0 mm increase in effective mandibular length after Twin-block therapy, Lund and Sandler[15] found increased in mandibular growth by 2.4mm, Mills and McCulloch[16] found increased in effective length of the mandible by 4.2 mm. Although Villegas AS et al.[17] in their systematic review and meta analysis reported average 1.53 mm increased in effective mandibular length with functional appliance. The increase in effective mandible length may be the combined effect of full expression of patient’s normal genetic growth potential as the twin block provides favourable environment and accelerate the growth of mandible and it may be effect of condylar-fossa remodelling and forward positioning of the mandible. It was not possible to determine whether the increase in effective mandibular length (Co-Gn) was due to an increase in mandibular length or a repositioning of the mandible.

Further, there was also significant increase in hypopharyngeal space by 1.47±0.516 mm and similarly

Table 1: The following Cephalometric parameters were evaluated:

S.No.	Cephalometric parameters
1.	ANB
2.	Effective length of maxilla (Co-A)*
3.	Effective length of mandible (Co-Gn)*
4.	Maxillo-mandibular differential
5.	Hypopharyngeal space*

*Co-A (Condylion to point A); Co-Gn (Condylion to gnathion); Maxillo-mandibular differential (Co-A subtracted from Co-Gn); hypopharyngeal space (point of intersection of the posterior border of the tongue and the inferior border of the mandible to the closest point on the posterior pharyngeal wall).

Table 2: Mean changes in pre-treatment and post-funtional cephalometric parameters are:

S.No	Cephalomeric parameters	T1		T2		T2-T1		P Value
		Mean	SD	Mean	SD	Mean	SD	
1.	ANB	6.20	1.424	2.60	0.737	-3.600	1.056	.000*
2.	Effective length of maxilla (Co-A)	79.00	5.318	79.27	5.535	0.267	0.594	.104
3.	Effective length of mandible (Co-Gn)	95.47	6.346	99.47	6.402	4.000	1.195	.000*
4.	Maxillo-mandibular differential	16.47	3.204	20.27	3.535	3.800	1.424	.000*
5.	Hypopharyngeal space	8.47	0.990	9.93	0.884	1.467	0.516	.000*

* Statistically significant

Table 3: II: Mean changes in cephalometric parameters between male and female

S.No.	Parameters		Levene's test for equality of variance		t-test for equality of means				
			F	Sig	t	Df	Sig (2-tailed)	Mean diff	SE
1.	ANB Diff	Equal variances assumed	1.381	.261	.574	13	.576	.32143	.55989
		Equal variances not assumed			.593	11.779	.564	.32143	.54203
2.	Effective mandibular diff	Equal variances assumed	4.286	.059	0.000	13	1.000	0.00000	.64194
		Equal variances not assumed			0.000	11.016	1.000	0.00000	.61721
3.	Effective Maxillary diff	Equal variances assumed	.939	.350	-.112	13	.912	-.03571	.31867
		Equal variances not assumed			-.115	12.406	.910	-.03571	.31067
4.	Maxillomandibular diff	Equal variances assumed	.299	.594	.140	13	.891	.10714	.76438
		Equal variances not assumed			.142	12.996	.889	.10714	.75565
5.	Hypopharyngeal diff	Equal variances assumed	.084	.777	-1.890	13	.081	-.46429	.24564
		Equal variances not assumed			-1.883	12.517	.083	-.46429	.24658

Jena et al.[18] reported that Twin Block appliance significantly improve the pharyngeal air space. Kannan et al[19] found significant increase in the oropharynx and hypopharynx following Twin Block appliances. However, contradictory to our result, Li J et al.[20] in his systematic review found weak evidence that functional appliances can increase Orpharyngeal Airway Volumes, Nasopharyngeal Airway Volumes and Minimal Cross-sectional Area.

In the studiesmentioned above, effects of functional therapy on effective mandibular length and pharyngeal spaces were assessed in the sample which were consists of both male and female and effect of sexual dimorphism was not evaluated following TB appliance therapy. The present study evaluated the effects of sexual diamorphism on the changes in effective mandibular length and hypopharyngeal airway but the changes were not significant when compared between male and female.

5. Conclusion

Functional jaw orthopaedics with the Twin-block appliances appeared to be effective in management of skeletal Class II malocclusion due to retrognathic mandible. The conclusions from this prospective study are;

1. TBA therapy in skeletal Class II patients significantly increases the effective mandibular length and hypopharyngeal space post functional phase by by 4.0±1.195 mm and 1.47±0.516 mm respectively.

2. No significant differences were observed between males and females with respect to post functional cephalometric changes in mandibular length and hypophryngeal space.

6. Source of Funding

None.

7. Conflict of Interest

None.

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