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Effect of twin block and forsus on Pharyngeal airway dimensions: A comparative study

Raksha K Rajput[1,*], Hitesh Dhakad[2], Suchita Daokar[3]

[1]*Dept. of Orthodontics, YCMM & RDF's Dental College & Hospital, Ahmednagar, Maharashtra, India*
[2]*Dept. of Orthodontics, KBH's MGV Dental college & Clinical Orthodontic Practitioner, Nashik, Maharashtra, India*
[3]*Dept. of Orthodontics, CSMSS Dental College & Hospital, Aurangabad, Maharashtra, India*

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ABSTRACT

Objective: The objective of this study was to evaluate and compare the effects of Twin Block and Forsus on the Posterior Airway Passage (PAP) and Posterior pharyngeal wall Thickness (PPWT) in the treatment of Class II division 1 malocclusion.

Materials and Methods: This was a 2-arm parallel, randomized controlled trial. A total of 24 Class II division 1 malocclusion patients indicated for treatment with functional appliances were randomized and equally divided among Twin Block and Forsus (3M Unitek Corp, Monrovia, Calif) groups. Skeletal changes, PAP changes and PPWT were compared using Twin Block and Forsus. Block randomization was determined by a computer-generated random number table. Blinding was performed for both participants and data analyser. 24 patients were analysed and statistical analysis were carried out using Student's t-test and T test of Equality of Means (P <0.05).

Results: Significant increase in oropharyngeal and hypopharyngeal dimensions with no dimensional changes of nasopharynx, dimensional changes in soft palate thickness and length, and decompensatory action in thickness in the posterior pharyngeal wall was seen with both the appliances. On intergroup comparison insignificant results were observed between both the appliances indicating similar effect on PAP and PPWT.

Conclusions: Both Twin Block and Forsus are effective in improving PAP and PPWT while correcting Class II malocclusion.

1. Introduction

Class II malocclusion is one of most common malocclusion seen in clinical orthodontic practice.[1] Patients with Class II malocclusion exhibit maxillary prognathism, mandibular retrognathism, or both. The most common component is mandibular retrognathism. Balter held the tongue to be the culprit for mandibular retrognathism. Retrognathic mandible leads to backward position of the tongue which pushes the soft palate posteriorly and decreases the dimension of the upper airway.[2] Consuquently resulting in the decreased distance between cervical column and the mandibular corpus causing posteriorly positioning of the tongue and soft palate, increasing the chances of impaired respiratory function during the day and possibly causing nocturnal problems such as snoring, upper airway resistance syndrome (UARS) and obstructive sleep apnea (OSA) syndrome.[3,4]

In children and adolescents cases having Sleep Disorder Breathing (SDB) the mandible is placed in retrognathic relation to the cranial base, thus causing narrowing of the pharyngeal airway passage (PAP), which is seen as a

* *Corresponding author.*
E-mail address: rajputraksha6@gmail.com (R. K. Rajput).

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common feature in these patients.[5] Few studies also take in considerartion that retrognathic mandibles is responsible for narrow PAP and many anatomical adaptations in the PAP among such subjects.[2,6,7]

Among the different types of appliances, used for correction of deficient mandible the Twin Block and Forsus Fatigue Resistant Device are most commonly used. The effects of various functional appliances on pharyngeal spaces are studied separately.[8,9] Studies have been conducted showing that Twin Block has more of the skeletal effects whereas Forsus which bring about more dentoalveolar changes.[10] Increase in the pharyngeal dimensions and tongue area with both the appliances is reported. However, research related with comparison of the effect of the most commonly used functional appliances i.e. Forsus and Twin Block appliances on the pharyngeal airway dimensions are lacking.

Hence, this study was undertaken to compare the changes produced by the Forsus and Twin Block on the pharyngeal airway dimension and posterior pharyngeal wall thickness.

2. Materials and Methods

The present study was a prospective, double-blind, randomized clinical study conducted in the Department of Orthodontics and Dentofacial Orthopedics.

Sample size was calculated with a type 1 error frequency of 5% and power of the statistical test set at 80%. 12 patients were enrolled in each group.

Total of 94 patients taken over from the OPD, out of which 45 patients were selected based on clinical examinations and further sent for radiographic investigations.

Inclusion criteria were as follows:

1. Growing cases having CVMI stage till 5 with skeletal Class II division 1 malocclusion.
2. Horizontal growth pattern
3. Overjet of 4-10 mm
4. Retrognathic mandible
5. Complete set of permanent dentition excluding third molars exhibiting positive VTO

(Subjects not meeting the inclusive criteria were excluded). After examining lateral cephalograms of these 45 subjects, 24 patients who fulfilled inclusion criterias were selected for the study.

2.1. In Vivo study

The lateral cephalograms of the subjects were grouped accordingly (gender and age equity)-

Group A (Twin block) & Group B (Forsus). Each group consisted of 12 subjects. Lateral cephalograms were contrived to compare the effectiveness of Twin block appliance and Forsus appliance on the pharyngeal airway passage, posterior pharyngeal width thickness in skeletal Class II division 1 subjects.

2.2. Randomization and allocation concealment

Informed consent was taken and the subjects were enrolled by the researchers. Block randomisation was done to distribute the participants equally into two groups based on gender. Block sizes of 2,4,6 were used. The sequence of the block sizes generated by the computer was 4,6 then 2. First block, was numbered from 1 to 4, the second block were numbered 1 to 6 and in the third block from 1 to 2. Based on the randomisation list generated they were allotted to either group A or group B. Same list were used to allotte the female participants to the group.

2.3. Interventions

Both the participants of Twin Block and Forsus appliance treatment groups were under treatment by the single examiner.

2.3.1. Bite registration for fabrication of Twin block appliance (Group A patients)

Twin Block appliance was delivered with all the instructions to the subjects belonging to Group A after construction with edge to edge bite registration.

2.3.2. Fixed orthodontic treatment for installation of Forsus appliance in Group B patients

After full mouth strap-up, Forsus-fixed functional appliance was installed with hook placement distal to canine in the lower jaw onto a continuous 0.019" × 0.025" stainless steel (SS) archwire.

The follow up of patients were done every 4-week intervals for a period of 6 months and appliances were activated as needed.

2.4. Cephalometric analysis

Pre (T1-before starting) and post treatment (T2- after removal of the functional appliance) lateral cephalometric radiographs were taken on the same machine with standardized head position and were traced and analyzed manually by the same operator.

The mean of the three readings of each patient were taken to overcome the tracing errors. Blinding of participants in each group was done. Similarly investigator (Cephalometric analysis) and statistician were blinded with regard to the group to which lateral cephalograms belonged. Various reference planes, linear and angular parameters used for the evaluation of maxillary and mandibular position in relation to the anterior cranial base, growth pattern of the mandible, PAP dimensions and PPWT were traced as follows (Figure 1).

1. Skeletal tissue analysis-
   (a) SNA angle
   (b) SNB angle
   (c) Effective maxillary length (Co-A)
   (d) Effective mandibular length (Co-Gn)
   (e) Yen angle (Inner angle between point S, M and G)
   (f) FMPA (Angle between FH plane (Po-Or) and Mandibular plane (Go- Me))
2. Pharyngeal airway dimensions analysis –
   (a) Soft palate length (linear distance from uvula to PNS)
   (b) Soft palate thickness (Maximum thickness of soft palate)
   (c) Depth of nasopharynx (linear distance from ptm to upper pharyngeal wall)
   (d) Height of nasopharynx (shortest distance from PNS to Ba-N plane)
   (e) Depth of oropharynx (Linear distance from Uvula to Middle pharyngeal wall)
   (f) Depth of hypopharynx (Linear distance from vallecula to lower pharyngeal wall)
3. Posterior Pharyngeal Wall Thickness –
   (a) PPWT 1 (distance from the intersection point palatal plane and anterior tangent of C_2 vertebra to intersection point of palatal plane and posterior pharyngeal wall).
   (b) PPWT 2 (distance from intersection point of line parallel to palatal plane passing through MSP and the posterior pharyngeal wall to the intersection point of same line extended posteriorly and anterior tangent of C_2 vertebra).
   (c) PPWT 3 (distance from intersection point of line parallel to palatal plane passing through uvula and the posterior pharyngeal wall to the intersection point of same line extended posteriorly and anterior tangent of C_2 vertebra).
   (d) PPWT 4 (distance from the intersection point of the mandibular plane and posterior pharyngeal wall to the intersection to the intersection point of mandibular plane and anterior tangent of C_2 vertebra).
   (e) PPWT 5 (distance from the intersection point of line parallel to the mandibular plane passing through the superior-anterior point of C_3 vertebra and the posterior pharyngeal wall to the superior-anterior point of C_3 vertebra).
   (f) PPWT 6 (distance from the intersection point of line parallel to mandibular plane passing through the interior anterior point of C_3 vertebra and the posterior pharyngeal wall to inferior point of C_3 cervical vertebra).

Monthly follow-up of the 24 subjects was done.

All the parameters were measured at T1 and T2 and were statistically analyzed.

2.5. Statistical analysis

All statistical analyses were performed with software package SPSS (for Windows 7, version 16.0, SPSS). Pre versus post treatment values were analyzed with paired t-test. T test of Equality of Means was used for performing the inter group comparison of various parameters. A 'p' value of less than 0.05 was considered as statistically significant.

3. Results

3.1. Skeletal parameters

In Group A, statistically significant increase was seen with SNB angle from 74.08° to 76.92° (p=0.000), effective mandibular length- 93.25mm to 97.42mm (p=0.000), YEN angle- 110.33° to 114.08° (p=0.000), FMP angle- 20.00° to 22.67° (p=0.000). However, SNA angle showed statistically significant decrease from 80.58° to 79.17°(p=0.000) and effective maxillary length (p=0.012) In Group B, significant increase in SNB angle from 73.67° to 74.58° (p= 0.001), effective mandibular length from 102.58mm to 104.58 mm (p=0.001), YEN angle from 109.50° to 111.58° (p=0.000), FMP angle from 20.75° to 22.75° (p=0.000) was observed. No significant difference was seen in SNA angle (p=0.586), effective maxillary length (p=0.674) after the treatment (Tables 1 and 2)

Inter group comparison between Twin Block and Forsus showed significant difference with SNA (p=0.001), SNB angle (p=0.000), effective mandibular length (p=0.004) and YEN angle (p=0.000) indicating Twin Block having greater skeletal changes than Forsus whereas no significant results were found with effective maxillary length (p=0.501), FMP angle (p=0.152)(Tables 7 and 8).

3.2. Soft plate dimensions

In Group A, significant increase in soft palate length from 10.50mm to 13.33 mm (p=0.000) and decrease in soft palate thickness (p=0.002) from 7.67mm to 6.58mm was observed. Similarly, in Group B significant increase in soft palate length from 15.00mm to 16.58mm (p=0.001) and decrease in soft palate thickness (p=0.017) from 7.67mm to 6.58mm was observed.

Intergroup comparison, showed no significant difference in soft palate length and thickness (p=0.065) and (p=0.335) respectively.

3.3. Pharyngeal airway dimension

In group A, the pre and post-treatment cephalograms showed increase in the depth of oropharynx and hypopharynx with a mean value of -1.917mm (p=0.001) and -2.833mm (p=0.000) respectively. However, depth and

Table 1: Pre-treatment & post treatment values ofSkeletal Parameters after using Twin Block (Group A) and Forsus (Group B)

Parameter	Group	Value	Mean	N	Std. Deviation	Std. Error Mean
SNA Angle	Twin Block	Pre	80.58	12	2.065	0.596
		Post	79.17	12	1.946	0.562
	Forsus	Pre	79.08	12	1.676	0.484
		Post	79.17	12	1.697	0.490
SNB Angle	Twin Block	Pre	74.08	12	2.539	0.733
		Post	76.92	12	2.539	0.733
	Forsus	Pre	73.67	12	3.367	0.972
		Post	74.58	12	3.288	0.949
Effective Maxillary Length	Twin Block	Pre	79.67	12	6.933	2.001
		Post	79.08	12	7.038	2.032
	Forsus	Pre	85.08	12	7.141	2.061
		Post	85.17	12	7.120	2.055
Effective Mandibular Length	Twin Block	Pre	93.25	12	8.433	2.434
		Post	97.42	12	8.393	2.423
	Forsus	Pre	102.58	12	5.616	1.621
		Post	104.58	12	5.616	1.621
YEN Angle	Twin Block	Pre	110.33	12	2.146	0.620
		Post	114.08	12	2.065	0.596
	Forsus	Pre	109.50	12	3.606	1.041
		Post	111.58	12	2.937	0.848
FMPA Angle	Twin Block	Pre	20.00	12	4.221	1.219
		Post	22.67	12	3.725	1.075
	Forsus	Pre	20.75	12	2.633	0.760
		Post	22.75	12	2.667	0.770

Table 2: Twin Block (Group A) and Forsus (Group B)Pre-treatment vs. Post treatment comparison (paired t-test)

Parameter		Paired Differences					t	df	Sig. (2-tailed)	Result
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper				
SNA Angle	Twin Block	1.417	.996	.288	.784	2.050	4.926	11	0.000	S
	Forsus	-.083	.515	.149	-.411	.244	-.561	11	0.586	NS
SNB Angle	Twin Block	-2.833	1.030	.297	-3.488	-2.179	-9.530	11	0.000	S
	Forsus	-.917	.669	.193	-1.341	-.492	-4.750	11	0.001	S
Effective Maxillary Length	Twin Block	.583	.669	.193	.159	1.008	3.023	11	0.012	S
	Forsus	-.083	.669	.193	-.508	.341	-.432	11	0.674	NS
Effective Mandibular Length	Twin Block	-4.167	1.697	.490	-5.245	-3.089	-8.507	11	0.000	S
	Forsus	-2.000	1.651	.477	-3.049	-.951	-4.195	11	0.001	S
YEN Angle	Twin Block	-3.750	.965	.279	-4.363	-3.137	-13.457	11	0.000	S
	Forsus	-2.083	.900	.260	-2.655	-1.511	-8.016	11	0.000	S
FMPA Angle	Twin Block	-2.667	.985	.284	-3.292	-2.041	-9.381	11	0.000	S
	Forsus	-2.000	1.206	.348	-2.766	-1.234	-5.745	11	0.000	S

Table 3: Pre-treatment & post treatment values of pharyngeal airway dimensions and posterior pharyngeal wall thickness after using twin block (Group A) and forsus (Group B)

Parameter	Group	Values	Mean	N	Std. Deviation	Std. Error Mean
Soft Palate Length	Twin Block	Pre	10.50	12	2.812	0.812
		Post	13.33	12	3.750	1.082
	Forsus	Pre	15.00	12	2.045	0.590
		Post	16.58	12	2.275	0.657
Soft Palate Thickness	Twin Block	Pre	7.67	12	1.614	0.466
		Post	6.58	12	1.311	0.379
	Forsus	Pre	9.42	12	1.621	0.468
		Post	8.58	12	1.311	0.379
Depth of Nasopharynx	Twin Block	Pre	13.00	12	3.717	1.073
		Post	13.25	12	3.467	1.001
	Forsus	Pre	20.00	12	5.560	1.605
		Post	20.17	12	5.289	1.527
Height of Nasopharynx	Twin Block	Pre	22.17	12	2.918	0.842
		Post	22.25	12	3.079	0.889
	Forsus	Pre	24.00	12	2.594	0.749
		Post	24.08	12	2.678	0.773
Depth of Oropharynx	Twin Block	Pre	6.75	12	1.658	0.479
		Post	8.67	12	2.309	0.667
	Forsus	Pre	7.58	12	2.021	0.583
		Post	9.33	12	2.309	0.667
Depth of Hypopharynx	Twin Block	Pre	10.50	12	2.812	0.812
		Post	13.33	12	3.750	1.082
	Forsus	Pre	15.00	12	2.045	0.590
		Post	16.58	12	2.275	0.657
PPWT1	Twin Block	Pre	11.83	12	4.428	1.278
		Post	13.67	12	4.376	1.263
	Forsus	Pre	13.00	12	2.132	0.615
		Post	14.00	12	2.296	0.663
PPWT2	Twin Block	Pre	7.17	12	2.250	0.649
		Post	8.25	12	2.491	0.719
	Forsus	Pre	9.50	12	1.314	0.379
		Post	10.25	12	1.485	0.429
PPWT3	Twin Block	Pre	4.25	12	1.288	0.372
		Post	5.33	12	1.775	0.512
	Forsus	Pre	5.33	12	.985	0.284
		Post	6.08	12	1.084	0.313
PPWT4	Twin Block	Pre	3.83	12	1.193	0.345
		Post	4.83	12	1.267	0.366
	Forsus	Pre	3.67	12	.985	0.284
		Post	4.75	12	1.138	0.329
PPWT5	Twin Block	Pre	4.08	12	1.240	0.358
		Post	5.50	12	1.883	0.544
	Forsus	Pre	4.33	12	1.155	0.333
		Post	5.50	12	1.784	0.515
PPWT6	Twin Block	Pre	4.00	12	.739	0.213
		Post	4.75	12	1.485	0.429
	Forsus	Pre	4.25	12	1.357	0.392
		Post	5.00	12	1.414	0.408

Table 4: Twin Block (Group A) and Forsus (Group B) Pre-treatment vs. Post treatment comparison (paired t-test)

Parameter	Group	Paired Differences						df	Sig. (2-tailed)	Result
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference					
					Lower	Upper	T			
Soft Palate Length	Twin Block	-2.833	1.850	.534	-4.009	-1.658	-5.304	11	0.000	S
	Forsus	-1.583	1.240	.358	-2.371	-.795	-4.423	11	0.001	S
Soft Palate Thickness	Twin Block	1.083	.900	.260	.511	1.655	4.168	11	0.002	S
	Forsus	.833	1.030	.297	.179	1.488	2.803	11	0.017	S
Depth of Nasopharynx	Twin Block	-.250	.452	.131	-.537	.037	-1.915	11	0.082	NS
	Forsus	-.167	.577	.167	-.533	.200	-1.000	11	0.339	NS
Height of Nasopharynx	Twin Block	-.083	.289	.083	-.267	.100	-1.000	11	0.339	NS
	Forsus	-.083	.900	.260	-.655	.489	-.321	11	0.754	NS
Depth of Oropharynx	Twin Block	-1.917	1.443	.417	-2.834	-1.000	-4.600	11	0.001	S
	Forsus	-1.750	1.658	.479	-2.804	-.696	-3.656	11	0.004	S
Depth of Hypopharynx	Twin Block	-2.833	1.850	.534	-4.009	-1.658	-5.304	11	0.000	S
	Forsus	-1.583	1.240	.358	-2.371	-.795	-4.423	11	0.001	S
PPWT1	Twin Block	-1.833	1.115	.322	-2.542	-1.125	-5.698	11	0.000	S
	Forsus	-1.000	1.206	.348	-1.766	-.234	-2.872	11	0.015	S
PPWT2	Twin Block	-1.083	.793	.229	-1.587	-.580	-4.733	11	0.001	S
	Forsus	-.750	.622	.179	-1.145	-.355	-4.180	11	0.002	S
PPWT3	Twin Block	-1.083	1.165	.336	-1.823	-.343	-3.223	11	0.008	S
	Forsus	-.750	.622	.179	-1.145	-.355	-4.180	11	0.002	S
PPWT4	Twin Block	-1.000	.853	.246	-1.542	-.458	-4.062	11	0.002	S
	Forsus	-1.083	.996	.288	-1.716	-.450	-3.767	11	0.003	S
PPWT5	Twin Block	-1.417	1.832	.529	-2.581	-.253	-2.679	11	0.021	S
	Forsus	-1.167	1.337	.386	-2.016	-.317	-3.023	11	0.012	S
PPWT6	Twin Block	-.750	1.545	.446	-1.732	.232	-1.682	11	0.121	NS
	Forsus	-.750	1.215	.351	-1.522	.022	-2.138	11	0.056	NS

height of nasopharynx did not show any significant change after the mandibular advancement (p=0.082),(p=0.339) respectively.

Significant increase in depth of oropharynx and hypopharynx after the treatment with a mean value of 1.750mm (p=0.004), 1.583mm (p=0.001) was also seen in Group B. Similar to Twin Block results, Forsus appliance also showed no significant change in depth and height of nasopharynx (p=0.339),(p=0.754) respectively.

Comparison between Twin Block and Forsus results, showed no significant difference in all the parameters indicating similar effect of both the appliances on pharyngeal airway dimensions.

3.4. Posterior pharyngeal wall thickness (PPWT)

Both Group A and Group B, pre & post-treatment findings showed significant increase in PPWT at all level as a result of decompensation – PPWT1 (p= 0.000 and 0.015), PPWT 2 (p=0.001 and 0.002), PPWT 3 (p=0.008 and 0.002), PPWT 4(p=0.002 and 0.003), PPWT 5 (p=0.021 and 0.012) respectively except PPWT 6 where there was no change (p=0.121 and 0.056) respectively.

Intergroup comparison showed no significant difference between both the appliances.

Table 5: Twin Block vs. Forsus (Group A vs. Group B) comparison of mean difference of Skeletal parameter (pre-treatment and post treatment mean) values.

Parameter	Group	N	Mean	Std. Deviation	Std. Error Mean
SNA Angle	Twin Block	12	1.42	0.996	.288
	Forsus	12	.25	0.452	.131
SNB Angle	Twin Block	12	2.83	1.030	.297
	Forsus	12	.92	0.669	.193
Effective Maxillary Length	Twin Block	12	.58	0.669	.193
	Forsus	12	.42	0.515	.149
Effective Mandibular Length	Twin Block	12	4.17	1.697	.490
	Forsus	12	2.00	1.651	.477
YEN Angle	Twin Block	12	3.75	0.965	.279
	Forsus	12	2.08	0.900	.260
W Angle	Twin Block	12	3.25	1.055	.305
	Forsus	12	1.67	0.985	.284
FMPA Angle	Twin Block	12	2.67	0.985	.284
	Forsus	12	2.00	1.206	.348

Table 6: Twin block vs. Forsus (Group A vs. Group B) comparison using t-test ofequality of means

Parameter	t-test for Equality of Means					Result
	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	
SNA Angle	3.694	22	0.001	1.167	.316	S
SNB Angle	5.408	22	0.000	1.917	.354	S
Effective Maxillary Length	.684	22	0.501	.167	.244	NS
Effective Mandibular Length	3.170	22	0.004	2.167	.683	S
YEN Angle	4.374	22	0.000	1.667	.381	S
FMPA Angle	1.483	22	0.152	.667	.449	NS

Table 7: Twin Block vs. Forsus (Group A vs. Group B)comparison of mean difference of Pharyngeal Airway Dimensions and PosteriorPharyngeal Wall Thickness (pre treatment and post treatment mean) values.

Parameter	Group	N	Mean	Std. Deviation	Std. Error Mean
Soft Palate Length	Twin Block	12	2.83	1.850	.534
	Forsus	12	1.58	1.240	.358
Soft Palate Thickness	Twin Block	12	-1.08	0.900	.260
	Forsus	12	-.67	1.155	.333
Depth of Nasopharynx	Twin Block	12	.25	0.452	.131
	Forsus	12	.17	0.577	.167
Height of Nasopharynx	Twin Block	12	.08	0.289	.083
	Forsus	12	.08	0.900	.260
Depth of Oropharynx	Twin Block	12	1.92	1.443	.417
	Forsus	12	1.83	1.528	.441
Depth of Hypopharynx	Twin Block	12	2.83	1.850	.534
	Forsus	12	1.58	1.240	.358
PPWT1	Twin Block	12	1.83	1.115	.322
	Forsus	12	1.00	1.206	.348
PPWT2	Twin Block	12	1.08	0.793	.229
	Forsus	12	.75	0.622	.179
PPWT3	Twin Block	12	1.08	1.165	.336
	Forsus	12	.75	0.622	.179
PPWT4	Twin Block	12	.83	0.577	.167
	Forsus	12	1.17	1.030	.297
PPWT5	Twin Block	12	1.42	1.832	.529
	Forsus	12	1.17	1.337	.386
PPWT6	Twin Block	12	.75	1.545	.446
	Forsus	12	.75	1.215	.351

Table 8: Twin Block vs. Forsus (Group A vs. Group B)comparison using t-test of Equality of Means

Parameter	t-test for Equality of Means					
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Result
Soft Palate Length	1.944	22	0.065	1.250	.643	NS
Soft Palate Thickness	-.986	22	0.335	-.417	.423	NS
Depth of Nasopharynx	.394	22	0.698	.083	.212	NS
Height of Nasopharynx	0.000	22	1.000	0.000	.273	NS
Depth of Oropharynx	.137	22	0.892	.083	.607	NS
Height of Oropharynx	1.944	22	0.065	1.250	.643	NS
PPWT1	1.758	22	0.093	.833	.474	NS
PPWT 2	1.407	22	0.174	.417	.296	NS
PPWT3	.875	22	0.391	.333	.381	NS
PPWT4	-.978	22	0.339	-.333	.341	NS
PPWT5	.382	22	0.706	.250	.655	NS
PPWT6	0.000	22	1.000	0.000	.567	NS

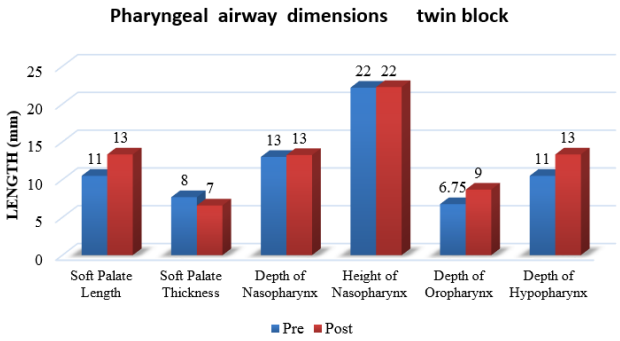

Fig. 1: Comparison of mean of pharyngeal airway dimensions in pre-treatment and post treatment of Twin Block (Group A)

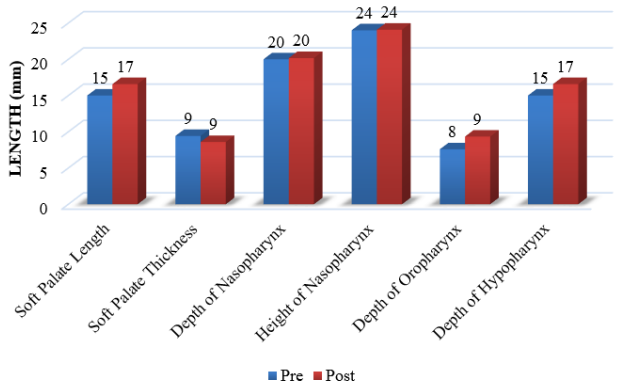

Fig. 2: Comparison of mean of pharyngeal airway dimensions in pre-treatment and post treatment of forsus (Group B)

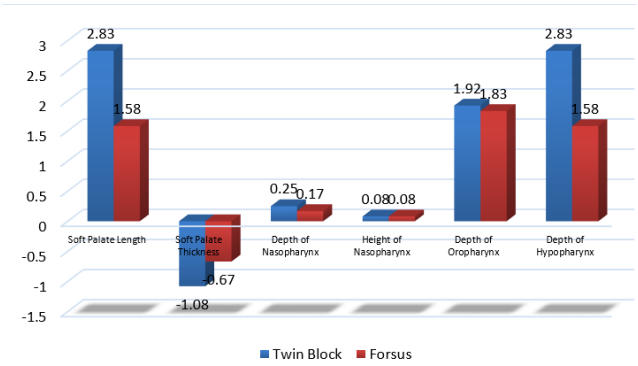

Fig. 3: Twin block (Group A) vs. Forsus (Group B) comparison of mean difference of pharyngeal airway dimensions.

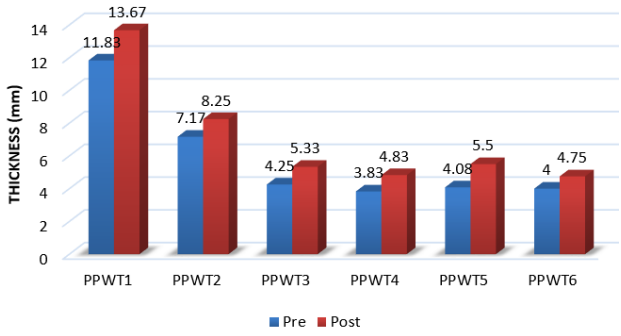

Fig. 4: Comparison of mean of posterior pharyngeal wall thickness in pre-treatment and post treatment of twin block (Group A)

4. Discussion

In clinical orthodontic practice, Class II malocclusion is one of most common malocclusion seen exhibiting either maxillary prognathism, mandibular retrognathism, or both.[1] Mandibular retrognathism is one of the causes for impaired respiration by narrowing the pharyngeal airway which can lead to nocturnal problems such as snoring, upper airway resistance syndrome (UARS), and obstructive sleep apnea (OSA) syndrome.[3,4]

Various Removable and Fixed Functional appliances are used for correcting retrognathic mandible. Twin Block and Forsus Fatigue Resistant Device among various types of

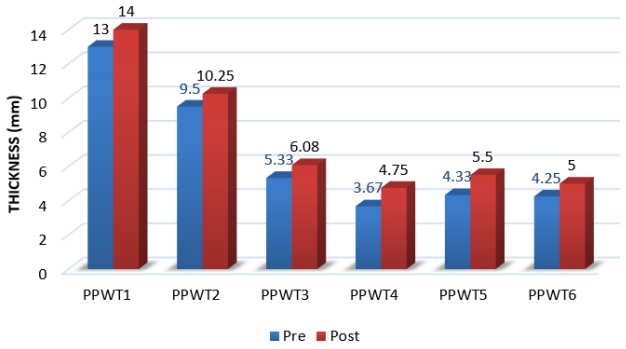

Fig. 5: Comparison of mean of posterior pharyngeal Wall Thickness in pre-treatment and post treatment of forsus (Group B)

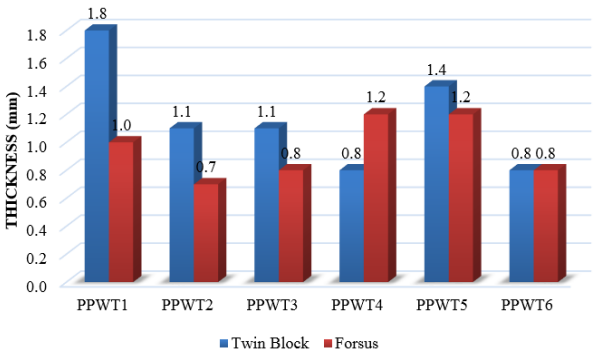

Fig. 6: Twin block (Group A) vs. Forsus (Group B) comparison of mean difference of posterior pharyngeal wall thickness

appliances are most commonly used for the correction of class II malocclusion.

In the present study, effects of Twin Block and Forsus on skeletal parameters, Pharyngeal airway passage and Posterior pharyngeal wall thickness has been observed and comparison between both the appliances is also done.

4.1. Skeletal Parameters

The significant skeletal changes that has been obtained from our study is mandibular advancement. However, this advancement is due to change in both mandibular length and effective mandibular length seen with both the appliances. A similar observations was made by Ghodke et al[8] and Vinoth et al.[11] SNB angle showed change in pre and post treatment values of Twin Block and Forsus. This observation of our study is in accordance with those of Biday S.et al,[12] Vinoth et al,[11] Elfeky et al,[13] Ghodke et al[8] and Jena et al[14] whereas Mohamad et al[10] found no significant change in the SNB angle after Forsus treatment. No significant difference was noted between both the appliances. There was also increase in YEN and FMPA angle following treatment with both the appliances.

Although the change in effective maxillary length was not significant, reduced SNA angle value at the end of treatment is mostly due to the inhibition in anterior development of the maxilla and posterior repositioning from cranial base, thus called as “head-gear effect” of the functional appliances which is seen with the Twin Block appliance. This result is in accord with the conclusion of Vinoth et al[11] study. Even though mandible changed its position and length, there is no significant change in SNA angle with Forsus. This result showed significant difference between both the appliances in SNA angle.

4.2. Pharyngeal airway dimensions

In our study, we found increase in the length and reduction in the thickness changes in the soft palate following Twin Block & Forsus treatment. Statistical evaluation found the effect to be significant. As the mandible is repositioned anteriorly it creates traction of the tongue in anterior direction away from the soft palate, leading to changes in the soft palate length & thickness.

In height and depth of nasopharynx result was found to be statistically non significant indicating no change in depth of nasopharynx by both Twin Block and Forsus. The results of our study for depth of nasopharynx are in accordance with the results of Li et al[15] and Elfeky et al.[13] They observed an increase in nasopharyngeal volume and a more circular shape in cross section of the post Twin Block group, but there was no statistical difference observed after comparing to the control group. They have explained these findings to effect of normal development.

Significant increase in depth of oropharynx and hypopharynx was observed post treatment with both the appliances in this study. Mandibular advancement by the functional appliances resulted in the the forward relocation of the tongue and increased the depth of oropharynx and hypopharynx. The results are in agreement with the findings of Jeena et al[14] and Ghodke et al.[8]

Intergroup comparison of all the paramenters of pharyngeal airway dimensions when done using t- test of equality of means showed statistically insignificant difference ($p = 0.065$, $p = 0.335$, $p = 0.698$, $p = 1.000$, $p = 0.892$, $p = 0.065$) indicating similar effect of both the appliances on pharyngeal airway.

4.3. Posterior pharyngeal wall thickness (PPWT)

In our study we have found significant increase in PPWT in pre & post –treatment records in Group A and Group B. The observation from treatment results of both the appliances can be attributed to the fact that in cases of mandibular retrusion in class II patients, the backward position of the tongue pushes the soft palate posteriorly decreasing the dimension of the upper airway. The upper airway tries to maintain the patency by reducing the posterior pharyngeal

wall thickness, thus compensating for the retrognathic mandible.

Following the functional appliance treatment, the mandible is relocated anteriorly followed by the forward posture of the tongue. As the upper airway now attends its patency, the compensatory adaptation is reduced and the posterior pharyngeal wall attains its normal thickness.

The findings of this study were in contrast with the findings of Ghodke et al. They found no changes in posterior pharyngeal wall thickness with Twin Block treatment, however they have found that the posterior pharyngeal wall thickness in Control group (cases of untreated Class II with retrognathic mandible) remained less in the nasopharynx, oropharynx and the hypopharynx.

5. Conclusion

Thus to summarize our results, following observations can be made:

1. Twin Block & Forsus leads to mandibular advancement.
2. Twin Block appliances have a significant restraining effect on maxilla.
3. The forward repositioning of the mandible, leads to increase in oropharyngeal and hypopharyngeal dimensions. No dimensional changes of nasopharynx were seen.
4. The anterior repositioning of mandible is followed by the tongue leading to dimensional changes in soft palate thickness and length.
5. Decompensatory action is seen in thickness in the posterior pharyngeal wall, which has shown to increase following both Twin Block & Forsus therapy.
6. Insignificant difference between both appliance in all the parameters.

6. Source of Funding

None.

7. Conflicts of Interest

There are no conflicts of interest.

References

1. Proffit WR, Fields HW, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the NHANES III survey. *Int J Adult Orthodon Orthognath Surg*. 1998;13(2):97–106.
2. Graber TM, Neumann B. Bionator. In: Removable Orthodontic Appliances. 2nd edn. Philadelphia: WB Saunders; 1984. p. 357–75.
3. Jena AK, Singh SP, Utreja AK. Sagittal mandibular development effects on the dimensions of the awake pharyngeal airway passage. *Angle Orthod*. 2010;80(6):1061–7. doi:10.2319/030210-125.1.
4. Schafer ME. Upper Airway Obstruction and Sleep Disorders in Children with Craniofacial Anomalies. *Clin plast Surg*. 1982;9(4):555–67. doi:10.1016/S0094-1298(20)31948-9.
5. Flemons WW, Douglas NJ, Kuna ST, Rodenstein DO, Wheatley J. Access to diagnosis and treatment of patients with suspected sleep apnea. *Am J Respir Crit Care Med*. 2004;169(6):668–72.
6. Arens R, Marcus CL. Pathophysiology of upper airway obstruction: a developmental perspective. *Sleep*. 2004;27(5):997–1019.
7. Kirjavainen M, Kirjavainen T. Upper airway dimensions in Class II malocclusion: effects of headgear treatment. *Angle Orthod*. 2007;77(6):1046–53.
8. Ghodke S, Utreja AK, Singh SP, Jena AK. Effects of twin-block appliance on the anatomy of pharyngeal airway passage (PAP) in class II malocclusion subjects. *Prog Orthod*. 2014;15(1):68. doi:10.1186/s40510-014-0068-3.
9. Ozdemir F, Ulkur F, Nalbantgil D. Effects of fixed functional therapy on tongue and hyoid positions and posterior airway. *Angle Orthod*. 2014;84(2):260–4. doi:10.2319/042513-319.1.
10. Mahamad IK, Neela PK, Mascarenhas R, Husain BA. A comparision of Twin-block and Forsus (FRD) functional appliance-a cephalometric study. *IJO*. 2012;23(3):49–58.
11. Vinoth SK, Thomas AV, Nethravathy R. Cephalomteric changes in airway dimensions with twin block therapy in growing Class II patients. *J Pharm Bioallied Sci*. 2013;5(Suppl 1):25–9.
12. Biday S, Chaudhari CV, Ramkrishna S. Skeletal And Dentoalveolar Changes Seen In Class II Div 1 Mal-Occlusion Cases Treated With Twin Block Appliance-A Cephalometric Study. *IOSR J Dent Med Sci*. 2014;13(1). doi:10.9790/0853-13180509.
13. Elfeky H, Fayed MM. Three-dimensional effects of twin block therapy on pharyngeal airway parameters in Class II malocclusion patients. *J World Fed Orthodontists*. 2015;4(3):114–9.
14. Jena AK, Singh SP, Utreja AK. Effectiveness of twin-block and Mandibular Protraction Appliance-IV in the improvement of pharyngeal airway passage dimensions in Class II malocclusion subjects with a retrognathic mandible. *Angle Orthod*. 2013;83(4):728–34. doi:10.2319/083112-702.1.
15. Li L, Wu W, Yan G, Liu L, Liu H, Li G, et al. Analogue simulation of pharyngeal airflow response to Twin Block treatment in growing patients with Class II1 and mandibular retrognathia. *Scientific Rep*. 2016;6(1):1–7.

Author biography

Raksha K Rajput, Senior Lecturer

Hitesh Dhakad, Senior Lecturer

Suchita Daokar, Professor & Associate HOD

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