

Original Research Article

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

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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.

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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). common feature in these patients.⁵ Few studies also take in consideration 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 $0.019^{"} \times 0.025^{"}$ 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 C₂ 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

Parameter	Group	Value	Mean	N	Std. Deviation	Std. Error Mean
	Truin Dlash	Pre	80.58	12	2.065	0.596
CNIA An ala	I WIII DIOCK	Post	79.17	12	1.946	0.562
SINA Aligie	Forsus	Pre	79.08	12	1.676	0.484
	FOISUS	Post	79.17	12	1.697	0.490
	Twin Plack	Pre	74.08	12	2.539	0.733
SNR Angle	I WIII DIOCK	Post	76.92	12	2.539	0.733
SIND Aligie	Forsus	Pre	73.67	12	3.367	0.972
	Torsus	Post	74.58	12	3.288	0.949
	Twin Plack	Pre	79.67	12	6.933	2.001
Effective Iwin	I WIII DIOCK	Post	79.08	12	7.038	2.032
Maxillary Length	Formus	Pre	85.08	12	7.141	2.061
Lengui	FOISUS	Post	85.17	12	7.120	2.055
	Twin Plack	Pre	93.25	12	8.433	2.434
Mandibular	I WIII DIOCK	Post	97.42	12	8.393	2.423
Length	Formus	Pre	102.58	12	5.616	1.621
Lengui	FOISUS	Post	104.58	12	5.616	1.621
	Twin Block	Pre	110.33	12	2.146	0.620
VEN Angla	I WIII DIOCK	Post	114.08	12	2.065	0.596
I EN Aligie	Formus	Pre	109.50	12	3.606	1.041
	FOISUS	Post	111.58	12	2.937	0.848
	Twin Plack	Pre	20.00	12	4.221	1.219
EMDA Angla	I WIII DIOCK	Post	22.67	12	3.725	1.075
FWITA Aligle	Forsus	Pre	20.75	12	2.633	0.760
	1.01808	Post	22.75	12	2.667	0.770

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

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

Paired Differences							C :-			
Parameter		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		t	df	(2-tailed)	Result
					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	Twin Block	.583	.669	.193	.159	1.008	3.023	11	0.012	S
Length	Forsus	083	.669	.193	508	.341	432	11	0.674	NS
Effective Mandibular	Twin Block	-4.167	1.697	.490	-5.245	-3.089	-8.507	11	0.000	S
Length	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

Derive the section of t	Parameter	Group	Values	Mean	Ν	Std.	Std. Error Mean
Twin Block Pre 10.50 12 2.8.12 0.8.12 Length Forsus Pre 15.00 12 2.045 0.590 Soft Palate Twin Block Pre 16.58 12 2.275 0.657 Soft Palate Twin Block Pre 7.67 12 1.614 0.466 Soft Palate Forsus Pre 9.42 12 1.611 0.379 Depth of Twin Block Pre 9.42 12 3.417 1.003 Nasopharynx Forsus Pre 9.42 12 3.467 1.001 Nasopharynx Forsus Pre 2.000 12 3.467 1.001 Nasopharynx Forsus Pre 2.017 12 5.289 1.527 Hight of Orsu 2.037 12 2.049 0.677 Oropharynx Forsus Pre 6.75 12 2.058 0.737 Depth of Twin Block Pre <						Deviation	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		Twin Block	Pre	10.50	12	2.812	0.812
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$\begin{split} & \text{Ports} & \text{Port} & 20.17 & 12 & 5.289 & 1.527 \\ & \text{Pre} & 22.17 & 12 & 2.918 & 0.842 \\ & \text{Port} & 22.17 & 12 & 2.918 & 0.842 \\ & \text{Port} & 22.17 & 12 & 2.918 & 0.842 \\ & \text{Port} & 22.17 & 12 & 2.091 & 0.889 \\ & \text{Port} & 24.00 & 12 & 2.594 & 0.749 \\ & \text{Port} & 24.00 & 12 & 2.678 & 0.773 \\ & \text{Port} & 24.00 & 12 & 2.678 & 0.773 \\ & \text{Port} & 6.75 & 12 & 1.658 & 0.479 \\ & \text{Port} & 6.75 & 12 & 2.309 & 0.667 \\ & \text{Port} & 9.03 & 12 & 2.309 & 0.667 \\ & \text{Port} & 9.03 & 12 & 2.309 & 0.667 \\ & \text{Port} & 9.03 & 12 & 2.309 & 0.667 \\ & \text{Port} & 9.03 & 12 & 2.309 & 0.667 \\ & \text{Port} & 9.03 & 12 & 2.309 & 0.667 \\ & \text{Port} & 13.33 & 12 & 3.750 & 1.082 \\ & \text{Port} & 15.00 & 12 & 2.045 & 0.590 \\ & \text{Port} & 15.00 & 12 & 2.045 & 0.590 \\ & \text{Port} & 15.30 & 12 & 4.428 & 1.278 \\ & \text{Port} & 13.67 & 12 & 4.376 & 1.263 \\ & \text{Port} & 13.67 & 12 & 4.376 & 1.263 \\ & \text{Port} & 13.00 & 12 & 2.296 & 0.663 \\ & \text{Port} & 13.00 & 12 & 2.296 & 0.663 \\ & \text{Port} & 13.00 & 12 & 2.296 & 0.663 \\ & \text{Port} & 13.00 & 12 & 2.296 & 0.663 \\ & \text{Port} & 13.00 & 12 & 2.296 & 0.663 \\ & \text{Port} & 9.05 & 12 & 1.314 & 0.379 \\ & \text{Port} & 9.05 & 12 & 1.314 & 0.379 \\ & \text{Port} & 9.05 & 12 & 1.314 & 0.379 \\ & \text{Port} & 9.05 & 12 & 1.314 & 0.379 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.429 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.429 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.429 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.331 \\ & \text{PPWT3} & \begin{array}{c} \text{Pre} & 3.83 & 12 & 1.193 & 0.345 \\ & \text{Port} & 0.05 & 12 & 1.488 & 0.313 \\ & \text{Port} & 0.05 & 12 & 1.488 & 0.329 \\ & \text{Port} & 0.05 & 12 & 1.488 & 0.329 \\ & \text{Port} & 0.05 & 12 & 1.488 & 0.544 \\ & \text{Port} & 0.05 & 12 & 1.488 & 0.544 \\ & \text{Port} & 0.05 & 12 & 1.488 & 0.544 \\ & \text{Port} & 0.05 & 12 & 1.488 & 0.544 \\ & \text{Port} & 0.05 & 12 & 1.488 & 0.544 \\ & \text{Port} & 0.05 & 12 & 1.488 & 0.544 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.429 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.429 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.429 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.429 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.429 \\ & \text{Port} & 0.05 & 12 & 1.485 & 0.429 $	Nasopharynx	Forsus	Pre	20.00	12	5.560	1.605
$\begin{split} & \begin{array}{c c c c c c c c c } & \begin{tabular}{ c c c c c c } & \begin{tabular}{ c c c c c c c } & \begin{tabular}{ c c c c c c c c c c c c c c c c c c c$		101303	Post	20.17	12	5.289	1.527
Height of Nasopharynx Forsus Forsus Port Post 22.25 12 3.079 0.889 Nasopharynx Forsus Post 24.00 12 2.594 0.749 Depth of Oropharynx Twin Block Pre 6.75 12 1.658 0.479 Oropharynx Forsus Pre 6.75 12 2.309 0.667 Oropharynx Forsus Pre 10.50 12 2.309 0.667 Oropharynx Forsus Pre 10.50 12 2.812 0.812 Hypopharynx Forsus Pre 15.00 12 2.045 0.590 Hypopharynx Forsus Pre 15.00 12 2.045 0.590 Hypopharynx Forsus Pre 13.67 12 4.428 1.278 PPWT1 Forsus Pre 13.00 12 2.132 0.615 Porst 13.67 12 4.376 1.263 1.263 PPWT2 F		Twin Block	Pre	22.17	12	2.918	0.842
Nasopharynx Forsus Pre Post 24.00 12 2.594 0.749 Depth of Oropharynx Presus Pre Post 6.75 12 1.658 0.479 Depth of Oropharynx Forsus Preve 6.75 12 2.099 0.667 Depth of Mypopharynx Forsus Preve 9.33 12 2.309 0.667 Depth of Mypopharynx Twin Block Preve 10.50 12 2.812 0.812 Depth of Mypopharynx Forsus Preve 15.00 12 2.045 0.590 Pewt1 Forsus Preve 11.83 12 4.428 1.263 PPWT1 Forsus Preve 13.00 12 2.132 0.615 Post 14.00 12 2.295 0.663 1.263 PPWT2 Forsus Preve 7.17 12 2.250 0.649 Post 0.313 12 1.314 0.372 Pumt3 Forsus Prevet	Height of	I WIII DIOCK	Post	22.25	12	3.079	0.889
Post 24.08 12 2.6.78 0.773 Depth of Oropharynx Twin Block Pre 6.75 12 1.658 0.479 Oropharynx Forsus Pre 6.75 12 2.309 0.667 Oropharynx Forsus Pre 0.53 12 2.309 0.667 Depth of Forsus Pre 10.50 12 2.812 0.812 Depth of Forsus Pre 15.00 12 2.045 0.590 Hypopharynx Forsus Pre 15.00 12 2.432 0.278 Hypopharynx Forsus Pre 15.00 12 2.435 0.590 Post 14.00 12 2.435 0.637 12 4.376 1.263 PPWT1 Forsus Pre 9.50 12 1.314 0.379 Post 14.00 12 2.296 0.663 PPWT2 Twin Block Pre 9.50 12 1.	Nasopharynx	Forsus	Pre	24.00	12	2.594	0.749
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		TOISUS	Post	24.08	12	2.678	0.773
Depth of Oropharynx Forsus Post Post 8.67 12 2.309 0.667 Oropharynx Forsus Pore 7.58 12 2.021 0.583 Depth of Hypopharynx Forsus Pre 10.50 12 2.812 0.812 Depth of Hypopharynx Twin Block Pre 10.50 12 2.812 0.812 Depth of Hypopharynx Twin Block Pre 15.00 12 2.045 0.590 Post 16.58 12 2.275 0.657 Pre 13.00 12 2.132 0.615 Pre 13.00 12 2.296 0.663 Pre 90st 14.00 12 2.290 0.643 Pre 9.50 12 1.314 0.379 Pre 9.50 12 1.314 0.372 Pre 9.50 12 1.314 0.372 Pre 9.33 12 1.985 0.284 Pre		Twin Block	Pre	6.75	12	1.658	0.479
Oropharynx Forsus Pre Post 7.58 12 2.021 0.583 Depth of Hypopharynx Twin Block Pre 10.50 12 2.812 0.812 Depth of Hypopharynx Forsus Pre 13.33 12 3.750 1.082 PWT1 Forsus Pre 15.00 12 2.045 0.590 PWT1 Forsus Pre 11.83 12 4.428 1.278 PWT1 Forsus Pre 13.67 12 4.376 1.263 PWT2 Forsus Pre 13.00 12 2.132 0.615 PWT2 Forsus Pre 9.50 12 2.296 0.663 PWT2 Twin Block Post 8.25 12 2.491 0.719 PWT2 Forsus Pre 9.50 12 1.485 0.429 PWT3 Forsus Pre 5.33 12 1.75 0.512 PWT4 Forsus Pre <td>Depth of</td> <td>I WIII DIOCK</td> <td>Post</td> <td>8.67</td> <td>12</td> <td>2.309</td> <td>0.667</td>	Depth of	I WIII DIOCK	Post	8.67	12	2.309	0.667
Post 9.33 12 2.309 0.667 Depth of Hypopharynx Twin Block Pre 10.50 12 2.812 0.812 Hypopharynx Forsus Pre 13.33 12 2.750 0.821 Hypopharynx Forsus Pre 15.00 12 2.045 0.590 PWT1 Forsus Pre 11.83 12 4.428 1.278 PWT1 Forsus Pre 13.67 12 4.428 1.263 PWT1 Forsus Pre 71.300 12 2.296 0.663 PWT2 Forsus Pre 7.17 12 2.250 0.649 PWT2 Forsus Pre 9.50 12 1.314 0.379 PWT3 Forsus Pre 9.50 12 1.314 0.372 PWT3 Forsus Pre 3.33 12 1.314 0.372 PWT3 Forsus Pre 3.63 12 1.63	Oropharynx	Forsus	Pre	7.58	12	2.021	0.583
Depth of Hypopharynx Twin Block Post Pre Post 10.50 12 2.812 0.812 Hypopharynx Forsus Post 13.33 12 3.750 1.082 Hypopharynx Forsus Post 16.58 12 2.045 0.590 PWT1 Forsus Pre 11.83 12 4.428 1.263 PPWT1 Forsus Pre 13.67 12 4.376 1.263 PPWT2 Forsus Post 13.00 12 2.132 0.615 PPWT2 Forsus Pre 7.17 12 2.250 0.649 PPWT2 Forsus Pre 9.50 12 1.314 0.379 PWT3 Forsus Post 10.25 12 1.485 0.429 PWT3 Forsus Pre 5.33 12 1.775 0.512 PWT4 Forsus Pre 3.67 12 9.85 0.284 PWT4 Forsus Pre </td <td></td> <td>TOISUS</td> <td>Post</td> <td>9.33</td> <td>12</td> <td>2.309</td> <td>0.667</td>		TOISUS	Post	9.33	12	2.309	0.667
Depth of Hypopharynx Forsus Post Pre 13.33 12 3.750 1.082 Hypopharynx Forsus Pre 15.00 12 2.045 0.590 Post 16.58 12 2.275 0.657 PWT1 Twin Block Pre 11.83 12 4.428 1.278 PWT1 Forsus Pre 13.00 12 2.132 0.615 Post 14.00 12 2.296 0.663 PWT2 Forsus Pre 7.17 12 2.491 0.719 PPWT2 Forsus Pre 9.50 12 1.314 0.379 PWT3 Forsus Pre 9.53 12 1.288 0.372 PWT3 Forsus Pre 5.33 12 1.985 0.284 PPWT4 Forsus Pre 3.67 12 1.084 0.313 PPWT4 Pre 3.67 12 1.985 0.284 POSt <td></td> <td rowspan="2">Twin Block</td> <td>Pre</td> <td>10.50</td> <td>12</td> <td>2.812</td> <td>0.812</td>		Twin Block	Pre	10.50	12	2.812	0.812
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Depth of		Post	13.33	12	3.750	1.082
PWT1 Post 16.58 12 2.275 0.657 PPWT1 Twin Block Pre 11.83 12 4.428 1.278 PPWT1 Forsus Pre 13.67 12 4.376 1.263 PPWT2 Forsus Pre 13.00 12 2.132 0.615 PPWT2 Twin Block Pre 7.17 12 2.250 0.649 PPWT2 Forsus Pre 9.50 12 1.314 0.719 Post 10.25 12 1.485 0.429 Post 10.25 12 1.485 0.429 Post 10.25 12 1.485 0.429 Post 5.33 12 1.775 0.512 Post 5.33 12 1.985 0.284 Post 6.08 12 1.084 0.315 Post 6.08 12 1.985 0.284 Post 4.83 12 1.267	Hypopharynx	Forsus	Pre	15.00	12	2.045	0.590
$\begin{array}{c c c c c c c c } & \begin{tabular}{ c c c c } & \begin{tabular}{ c c c c } & \ Pre & \ Pr$		TOISUS	Post	16.58	12	2.275	0.657
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		Twin Block	Pre	11.83	12	4.428	1.278
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			Post	13.67	12	4.376	1.263
PPWT2 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 Porsus Post 0.025 12 1.314 0.379 Post 10.25 12 1.485 0.429 PWT3 Twin Block Pre 4.25 12 1.288 0.372 PPWT3 Twin Block Pre 5.33 12 1.775 0.512 Post 5.33 12 1.084 0.313 0.345 Post 6.08 12 1.084 0.313 PWT4 Pre 3.83 12 1.084 0.313 PWT4 Post 4.83 12 1.267 0.366 Post 4.75 12 1.138 0.329 PWT5 Pre 4.08 12 1.240 0.358 Post 5.50 12	11 W 11	Forsus	Pre	13.00	12	2.132	0.615
$\begin{array}{c c c c c c c c } & \begin{tabular}{ c c c c } & \begin{tabular}{ c c c c } & \ Pre & \ Pr$		TOISUS	Post	14.00	12	2.296	0.663
PPWT2 Post 8.25 12 2.491 0.719 Forsus Pre 9.50 12 1.314 0.379 PPWT3 Forsus Pre 4.25 12 1.485 0.429 PWT3 Twin Block Pre 4.25 12 1.288 0.372 PPWT3 Forsus Pre 5.33 12 1.775 0.512 PPWT3 Forsus Pre 5.33 12 9.85 0.284 Post 6.08 12 1.084 0.313 PWT4 Forsus Pre 3.83 12 1.193 0.345 PPWT4 Forsus Pre 3.67 12 9.85 0.284 Post 4.75 12 1.138 0.329 PWT5 Forsus Pre 4.08 12 1.240 0.358 PPWT5 Forsus Pre 4.03 12 1.138 0.544 POSt 5.50 12 <t< td=""><td></td><td>Twin Block</td><td>Pre</td><td>7.17</td><td>12</td><td>2.250</td><td>0.649</td></t<>		Twin Block	Pre	7.17	12	2.250	0.649
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		I WIII DIOCK	Post	8.25	12	2.491	0.719
Post 10.25 12 1.485 0.429 PPWT3 Twin Block Pre 4.25 12 1.288 0.372 PPWT3 Forsus Post 5.33 12 1.775 0.512 Post 5.33 12 .985 0.284 Post 6.08 12 1.084 0.313 PWT4 Pre 3.83 12 1.193 0.345 PWT4 Forsus Pre 3.67 12 .985 0.284 PWT4 Forsus Pre 3.67 12 .985 0.366 PWT4 Forsus Pre 3.67 12 .985 0.284 Post 4.75 12 1.138 0.329 0.284 Post 5.50 12 1.883 0.544 0.313 PWT5 Forsus Pre 4.03 12 1.155 0.333 PWT6 Forsus Pre 4.00 12 .739 0.2	11 W 12	Forsus	Pre	9.50	12	1.314	0.379
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		101303	Post	10.25	12	1.485	0.429
PPWT3 Post 5.33 12 1.775 0.512 PWT3 Forsus Pre 5.33 12 .985 0.284 Post 6.08 12 1.084 0.313 PWT4 Twin Block Pre 3.83 12 1.193 0.345 PWT4 Forsus Pre 3.67 12 .985 0.284 Post 4.83 12 1.103 0.345 Post 4.83 12 1.267 0.366 Post 4.75 12 .985 0.284 Post 4.75 12 .138 0.329 PWT5 Forsus Pre 4.08 12 1.240 0.358 PPWT5 Forsus Pre 4.33 12 1.155 0.333 PPWT6 Forsus Pre 4.00 12 .739 0.213 PPWT6 Forsus Pre 4.25 12 1.357 0.392 Post </td <td></td> <td>Twin Block</td> <td>Pre</td> <td>4.25</td> <td>12</td> <td>1.288</td> <td>0.372</td>		Twin Block	Pre	4.25	12	1.288	0.372
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	ΡΡ ₩/Τ3	I WIII DIOCK	Post	5.33	12	1.775	0.512
Post 6.08 12 1.084 0.313 PPWT4 Twin Block Pre 3.83 12 1.193 0.345 PPWT4 Forsus Post 4.83 12 1.267 0.366 Porsus Pre 3.67 12 985 0.284 Post 4.75 12 1.138 0.329 PWT5 Twin Block Pre 4.08 12 1.240 0.358 PPWT5 Forsus Pre 4.33 12 1.155 0.333 PPWT6 Forsus Pre 4.00 12 1.784 0.515 PPWT6 Twin Block Pre 4.00 12 .739 0.213 PPWT6 Forsus Pre 4.25 12 1.485 0.429 Forsus Pre 4.25 12 1.357 0.392 Post 5.00 12 1.414 0.408	11 W15	Forsus	Pre	5.33	12	.985	0.284
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		101303	Post	6.08	12	1.084	0.313
PPWT4 Post 4.83 12 1.267 0.366 Porus Pre 3.67 12 .985 0.284 Post 4.75 12 1.138 0.329 PWT5 Twin Block Pre 4.08 12 1.240 0.358 PPWT5 Forsus Pre 4.03 12 1.883 0.544 Post 5.50 12 1.883 0.544 Post 5.50 12 1.784 0.515 Post 5.50 12 1.784 0.515 Post 5.50 12 1.485 0.429 Post 5.50 12 1.485 0.429 PPWT6 Forsus Pre 4.25 12 1.357 0.392 Post 5.00 12 1.414 0.408 0.408		Twin Block	Pre	3.83	12	1.193	0.345
Forsus Pre 3.67 12 .985 0.284 Post 4.75 12 1.138 0.329 PWT5 Twin Block Pre 4.08 12 1.240 0.358 PPWT5 Forsus Pre 4.03 12 1.883 0.544 PPWT5 Forsus Pre 4.33 12 1.155 0.333 PPWT6 Forsus Pre 4.00 12 .739 0.213 PPWT6 Forsus Pre 4.25 12 1.485 0.429 Post 5.00 12 1.414 0.408	DDWTA	I WIII DIOCK	Post	4.83	12	1.267	0.366
Post 4.75 12 1.138 0.329 PPWT5 Twin Block Pre 4.08 12 1.240 0.358 PPWT5 Post 5.50 12 1.883 0.544 Forsus Pre 4.33 12 1.155 0.333 PPWT6 Twin Block Pre 4.00 12 .739 0.213 PPWT6 Forsus Pre 4.25 12 1.485 0.429 Forsus Pre 4.25 12 1.357 0.392 Post 5.00 12 1.414 0.408	11 W 14	Forsus	Pre	3.67	12	.985	0.284
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		101303	Post	4.75	12	1.138	0.329
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		Twin Block	Pre	4.08	12	1.240	0.358
Forsus Pre 4.33 12 1.155 0.333 Post 5.50 12 1.784 0.515 PPWT6 Pre 4.00 12 .739 0.213 PPWT6 Forsus Pre 4.25 12 1.485 0.429 Forsus Pre 4.25 12 1.357 0.392 Post 5.00 12 1.414 0.408	DDW/T5	I WIII DIOCK	Post	5.50	12	1.883	0.544
Post 5.50 12 1.784 0.515 PPWT6 Twin Block Pre 4.00 12 .739 0.213 PPWT6 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	11 W 15	Formus	Pre	4.33	12	1.155	0.333
PPWT6 Twin Block Pre 4.00 12 .739 0.213 PPWT6 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		Forsus	Post	5.50	12	1.784	0.515
PPWT6 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		Twin Block	Pre	4.00	12	.739	0.213
Forsus Pre Post 4.25 12 1.357 0.392 1.110 1.1	DDW/T6	I WIII DIUCK	Post	4.75	12	1.485	0.429
Post 5.00 12 1.414 0.408	11 10	Forme	Pre	4.25	12	1.357	0.392
		FUISUS	Post	5.00	12	1.414	0.408

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)

Paired Differences									G*- ()	
Parameter	Group	Mean	Std. Deviation	Std. Error Mean	95% Co Interva Diffe		df	sig. (2- tailed)	Result	
					Lower	Upper	Т			
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

Table 4: Twin Block	(Group A) and Forsus (Group E) Pre-treatment vs.	Post treatment com	parison (j	paired t-test)
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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 1.750 mm (p=0.004), 1.583 mm (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.

Parameter	Group	Ν	Mean	Std. Deviation	Std. Error Mean
SNA Angle	Twin Block	12	1.42	0.996	.288
SNA Aligie	Forsus	12	.25	0.452	.131
SND Angle	Twin Block	12	2.83	1.030	.297
SNB Angle	Forsus	12	.92	0.669	.193
Effective Maxillary	Twin Block	12	.58	0.669	.193
Length	Forsus	12	.42	0.515	.149
Effective Mandibular	Twin Block	12	4.17	1.697	.490
Length	Forsus	12	2.00	1.651	.477
VEN Angle	Twin Block	12	3.75	0.965	.279
I EN Aligie	Forsus	12	2.08	0.900	.260
WAngle	Twin Block	12	3.25	1.055	.305
w Aligie	Forsus	12	1.67	0.985	.284
EMDA Angle	Twin Block	12	2.67	0.985	.284
Finit A Aligie	Forsus	12	2.00	1.206	.348

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.

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

Denometer	t-test for Equality of Means						
rarameter	T df		Sig. (2-tailed)	Mean Difference	Std. Error Difference	Kesun	
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	Ν	Mean	Std. Deviation	Std. Error Mean
Soft Palate Length	Twin Block	12	2.83	1.850	.534
Soft I alate Length	Forsus	12	1.58	1.240	.358
Soft Palata Thickness	Twin Block	12	-1.08	0.900	.260
Soft Falate Thickness	Forsus	12	67	1.155	.333
Donth of Negonhamuny	Twin Block	12	.25	0.452	.131
Depth of Nasopharynx	Forsus	12	.17	0.577	.167
Height of Naconhamany	Twin Block	12	.08	0.289	.083
Height of Nasopharylix	Forsus	12	.08	0.900	.260
Donth of Oronhomeny	Twin Block	12	1.92	1.443	.417
Depth of Oropharynx	Forsus	12	1.83	1.528	.441
Donth of Hunonhomany	Twin Block	12	2.83	1.850	.534
Depth of Hypopharylix	Forsus	12	1.58	1.240	.358
	Twin Block	12	1.83	1.115	.322
PPWII	Forsus	12	1.00	1.206	.348
DDW/T2	Twin Block	12	1.08	0.793	.229
PPW12	Forsus	12	.75	0.622	.179
DDW/T2	Twin Block	12	1.08	1.165	.336
FFW15	Forsus	12	.75	0.622	.179
	Twin Block	12	.83	0.577	.167
PPW14	Forsus	12	1.17	1.030	.297
DDW/T75	Twin Block	12	1.42	1.832	.529
PPW13	Forsus	12	1.17	1.337	.386
DDW/T/	Twin Block	12	.75	1.545	.446
rrw 10	Forsus	12	.75	1.215	.351

Fable 8: Twin Block vs. Forsus	(Group A vs.)	Group B)com	parison using t-te	est of Equality of Means
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	t-test for Equality of Means								
Parameter	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)

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



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)

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 al⁸ 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 al⁸ and Jena et al¹⁴ whereas Mohamad et al¹⁰ 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 al¹¹ 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 al¹⁵ 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 parameters 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.

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