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Comparison of Dental Effects of Forsus Fatigue Resistant Device and Powerscope Treatment – A Cephalometric Study

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ABSTRACT

Objectives- To evaluate and compare the dentoalveolar effects of Forsus Fatigue Resistant Device and Powerscope Class II Corrector.
Materials and method- Lateral cephalograms of 48 (pre-treatment and post treatment) class II patients in the post peak age group were taken and divided into three groups according to the treatment administered for correcting class II malocclusion with retrognathic mandible . 12 patients were treated as control group, 12 treated with Forsus Fatigue Resistant Device and 12 treated with Powerscope Class II Corrector. The dental analysis was done using Pancherz cephalometric analysis.
Results- Cephalometric analysis revealed that in both the appliances, maxillary central incisors were extruded, retruded, and distally tipped. Contrarily, intrusion, protrusion, and labial tipping were observed in the mandibular central incisors. Distal movement and intrusion of the maxillary first molars and mesial movement and extrusion of the mandibular first molars were the other dental alterations. Overjet and overbite decreased, and a Class I molar relationship were attained in both treatment groups.
Conclusion- Both the appliances were effective in the treatment of Class II malocclusion and revealed nearly same alterations in the dental parameters.

Keywords
Forsus appliance, Powerscope appliance, cephalometry, Dental

Introduction

Class II malocclusion is one of the most frequently seen malocclusion and one of the feature is retrognathic mandible. Skeletal class II malocclusion can be treated with various appliances. Growth modulation can be bought about in growing individuals by these apliances. [1]
Appliances used for mandibular retrognathism in growing individuals are myofuctional appliances namely activator, bionator, twim block, etc.[2] whereas fixed functional appliance are most commonly used in post pubertal individuals namely herbst, jasper jumper, RITTO appliance, eureka spring, bite jumper, Forsus FRD, etc.They are tooth borne appliances thus, brings about dentoalveolar changes as well as skeletal changes, most common dentoalveolar change is lower incisor proclination.[3]
Forsus Nitinol Flat Spring was introduced in 2001, which was later modified by Bill Vogt to Forsus fatigue resistant device (Forsus FRD).[4] Forsus fatigue resistant device is semi rigid telescopic spring which is placed bilaterally in the patient's mouth. The spring rod produces a force of 200g bilaterally to bring the mandible forward and also restricts the maxillary growth.[5] After levelling and aligning the upper and lower arch, appliance is used. The appliance also limits lateral movement of the mandible.[6]
Powerscope class II corrector was developed in 2014 by Andrew Hayes. It has an internal Niti spring which delivers 260g of continuous force. This appliance has greater range of motion, patient acceptance, and installation is simple. It has a wire to wire attachment eliminating the need for headgear tube. It is an effective way to correct retrognathic mandible.[7]
In Pancherz analysis, alteration of occlusion is seen in sagittal and vertical direction.8 It consists of two components which are sagittal and vertical analysis. Sagittal analysis include 11 linear variables whereas vertical has six linear and four angular variables.[8] The purpose of the present study was to make a qualitative evaluation on lateral cephalograms Of dental changes contributing to Class II correction with Forsus and Powerscope appliance treatment.

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Methodology

The treatment sample consisted of 36 subjects, consecutively treated with Forsus FRD, Powerscope and Control group treated with class II elastics. Cephalograms are obtained from the archives of Department of Orthodontics and Dentofacial Orthopaedics. 72 cephalograms (Pre treatment and Post functional appliance therapy – T1 And T2) were collected . Since the names or the photographers of subjects included in the study were not required, hence informed consent was not necessary.

The selection criteria for treated subjects were patients in post peak growth period (Fishman's skeletal maturity assessment), normal or mildly prognathic maxillae (SNA : 83±5), retrognathic mandible (SNB : less than 78), horizontal or normal growth pattern (Jarabak ratio : 66 and above), Angle's Class II molar relationship, overjet more than 5mm and permanent dentition. Exclusion criteria included craniofacial anomalies, prior history of orthodontic treatment or orthognathic surgery, any systemic diseases, periodontally compromised patients and history of facial or dental trauma.

The specific protocols for the fixed functional appliances were followed which includes proper diagnosis, VTO, assessing the growth status of the patients, treatment planning and appliance selection.

Dental changes occurring during the fixed functional treatment were evaluated cephalometrically on lateral cephalograms in centric occlusion. Pre and post treatment cephalograms were analysed. Lateral cephalograms of the patients were hand traced at single sitting in the same manner. Cephalograms were traced and landmark location is verified by the same investigator. Pancherz analysis was carried out in pre-treatment and posttreatment cephalograms and the values were tabulated.[8]

Statistical analysis was done on Microsoft Excel was used to compile the data. The means and standard deviations of the measured values were obtained using the One Way ANOVA test.. Post Hoc Tukey test was done to determine whether there was a significant difference among the three groups. All statistical analysis was performed using Statistical Package for Social Sciences software package. (SPSS for Windows - Version 20.0)

Result

Comparison of pre-treatment overjet (is\olp-ii\olp) between the three groups as in table 1 shows that difference was statistically insignificant

Comparison of pretreatment molar relation (ms\olp-mi\olp) between the three groups as in table 1 that difference was statistically significant.Posthoc Tukey tests comparing control and Forsus groups as in table 2 shows a mean difference of -1.64167* and is statistically significant with a p value of 0.011. Comparing CONTROL and POWERSCOPE groups shows a mean difference of -1.78333* and is statistically significant with a p value of 0.006. Comparing Forsus and Powerscope groups shows a mean difference of -0.14167 and is not statistically significant

Comparison of pretreatment maxillary incisor, mandibular incisor, maxillary molar and mandibular molar between the three groups as in table 1 shows that difference was statistically insignificant.

Table 1- Comparison of pre treatment dental values between three groups

	GROUPS	**N**	**Mean**	**Std. Deviation**	**Statistics/ mean squares**	**df2(welch) / F(Anova)**	**P VALUE**
Pretreatment overjet (is\ olp-ii\olp)	CONTROL	12	6.3583	1.58083	6.719	1.748	0.19
	FORSUS	12	7.4667	2.02814			
	POWERSCOPE	12	7.7833	2.21845			

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	Total	36	7.2028	2.00221			
Pretreatmentmolar relation (ms\olp-mi\olp)	CONTROL	12	3.2917	1.34331	11.791	6.958	**0.003**
	FORSUS	12	4.9333	1.42084			
	POWERSCOPE	12	5.075	1.1226			
	Total	36	4.4333	1.50713			
Pretreatment maxillary incisor (is\olp)	CONTROL	12	88.9333	9.90402	89.284	0.994	0.381
	FORSUS	12	84.8333	10.12498			
	POWERSCOPE	12	90	8.30115			
	Total	36	87.9222	9.47662			
Pretreatment mandibular incisor (ii\olp)	CONTROL	12	82.575	9.81012	98.23	1.217	0.309
	FORSUS	12	77.45	8.98701			
	POWERSCOPE	12	82.2167	8.07655			
	Total	36	80.7472	9.04125			
Pretreatment maxillary molar (ms\olp)	CONTROL	12	57.175	6.51322	66.142	1.584	0.22
	FORSUS	12	54	6.59201			
	POWERSCOPE	12	58.5833	6.27344			
	Total	36	56.5861	6.56798			
Pretreatment	CONTROL	12	53.8833	6.53867	105.864	2.273	0.119

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mandibular molar (mi/olp)	FORSUS	12	48.9833	6.6528			
	POWERSCOPE	12	54.3417	7.26216			
	Total	36	52.4028	7.06907			

Table 2 – Post hoc test for pretreatment values comparing the control, forsus and powerscope groups.

Dependent Variable	**(I) group**	**(J) group**	**Mean Difference (I-J)**	**Std. Error**	**P VALUE**
Pretreatment molar relation (ms\olpmi\olp)	CONTROL	FORSUS	-1.64167*	0.53143	**0.011**
		POWERSCOPE	-1.78333*	0.53143	**0.006**
	FORSUS	POWERSCOPE	-0.14167	0.53143	0.962

Comparison of posttreatment overjet, maxillary and mandibular incisors between the three groups as in table 3 shows that difference was statistically insignificant

Comparison of posttreatment molar relation (ms\olp-mi\olp) between the three groups as in table 3 shows that difference was statistically significant. Posthoc Tukey tests As shown in table 4 comparing control and Forsus groups shows a mean difference of 1.47500* and was statistically significant with a p value of 0.011. Comparing control and Powerscope groups shows a mean difference of 1.65833* which was statistically significant with a p value of 0.004. Comparing Forsus and Powerscope groups shows a mean difference of 0.18333 and was not statistically significant

Comparison of posttreatment maxillary molar (ms\olp) between the three groups as in table 3 shows that difference was statistically Significant with a test value of 4.913 and p value of 0.014.Posthoc Tukey tests as in table 4 comparing control and Forsus groups shows no statistical significance. Comparing control and Powerscope groups shows a mean difference of -1.95833 and is not statistically significant. Comparing Forsus and Powerscope groups shows a mean difference of -8.00000* and is statistically significant with a p value of 0.014.

Comparison of posttreatment mandibular molar (mi/olp) between the three groups shows as in table 3 that difference was statistically Significant .Posthoc Tukey tests comparing control and Forsus groups shows a mean difference of 4.9 and is not statistically significant with a p value of 0.173. Comparing control and Powerscope groups shows a mean difference of -3.61667 and is not statistically significant with a p value of 0.374. Comparing Forsus and Powerscope groups shows a mean difference of -8.51667* and is statistically significant with a p value of 0.008.

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Table 3- Comparison of post treatment dental values between three groups

	GROUPS	N	Mean	Std. Deviation	Statistics/ mean squares	df2(welch) / F(Anova)	P VALUE
posttreatment overjet (is\ olp-ii\olp)	CONTROL	12	2.5833	0.70946	0.062	0.168	0.846
	FORSUS	12	2.4583	0.48516			
	POWERSCOPE	12	2.5833	0.61324			
	Total	36	2.5417	0.59492			
Posttreatment molar relation (ms\olpmi\olp)	CONTROL	12	-3.2083	0.93367	9.919	7.214	**0.003**
	FORSUS	12	-4.6833	1.20592			
	POWERSCOPE	12	-4.8667	1.34119			
	Total	36	-4.2528	1.36497			
posttreatment maxillary	CONTROL	12	78.975	5.04239	3.575	20.078	0.074
	FORSUS	12	81.1667	10.16977			

	GROUPS	N	Mean	Std. Deviation	Statistics/ mean squares	df2(welch) / F(Anova)	P VALUE
posttreatment overjet (is\ olp-ii\olp)	CONTROL	12	2.5833	0.70946	0.062	0.168	0.846
	FORSUS	12	2.4583	0.48516			
	POWERSCOPE	12	2.5833	0.61324			
	Total	36	2.5417	0.59492			
	FORSUS	12	-4.6833	1.20592			

incisor (is\olp)	POWERSCOPE	12	86.65	8.38402			
	Total	36	82.2639	8.56181			
posttreatment	CONTROL	12	76.475	5.16124	3.387	20.155	0.084
	FORSUS	12	78.875	10.20304			

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mandibular incisor (ii\olp)	POWERSCOPE	12	84.0667	8.50714			
	Total	36	79.8056	8.61165			
posttreatment maxillary molar (ms\olp)	CONTROL	12	56.7917	6.43661	208.674	4.913	**0.014**
	FORSUS	12	50.75	6.23589			
	POWERSCOPE	12	58.75	6.86394			
	Total	36	55.4306	7.20927			
posttreatment mandibular molar (mi/olp)	CONTROL	12	60	6.38863	219.248	5.148	**0.011**
	FORSUS	12	55.1	6.30858			
	POWERSCOPE	12	63.6167	6.8665			
	Total	36	59.5722	7.25824			

Table 4 – Post hoc test for post treatment values comparing the control, forsus and powerscope groups.

Posttreatment molar relation (ms\olpmi\olp)	CONTROL	FORSUS	1.47500*	0.4787	**0.011**
		POWERSCOPE	1.65833*	0.4787	**0.004**
	FORSUS	POWERSCOPE	0.18333	0.4787	0.923
posttreatment mandibular molar (mi/olp)	CONTROL	FORSUS	4.9	2.66418	0.173
		POWERSCOPE	-3.61667	2.66418	0.374
	FORSUS	POWERSCOPE	-8.51667*	2.66418	**0.008**

Comparison of difference overjet (is\olp-ii\olp) between the three groups shows that difference was statistically insignificant.
Comparison of difference molar relation (ms\olp-mi\olp) between the three groups as in table 5 shows that difference was statistically significant with a test value of 20.379 and p value of <0.001.Posthoc Tukey tests as in table 6 comparing control and Forsus groups shows a mean difference of 5.90000* and was statistically significant with a p value of <0.001. Comparing control and Powerscope groups shows no statistical significance. Comparing Forsus and Powerscope groups shows a mean difference of -7.02500* and was statistically significant with a p value of <0.001.
Comparison of difference maxillary and mandibular incisor between the three groups as in table 5 shows that difference is statistically insignificant.
Comparison of difference maxillary molar (ms\olp) between the three groups As in table 5 shows that difference was statistically significant with a test value of 7.766 and p value of 0.002.Posthoc Tukey tests as in table 6 comparing control and Forsus groups shows a mean difference of -5.00000* and was statistically significant with a p value of 0.001. Comparing control and Powerscope groups shows a mean difference of -2.58333 and is not statistically

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significant with a p value of 0.12. Comparing Forsus and Powerscope groups shows a mean difference of 2.41667 and was not statistically significant with a p value of 0.153.
Comparison of difference mandibular molar (mi/olp) between the three groups as in table 5 shows that difference was statistically significant with a test value of 16.615 and p value of 0.046.Posthoc Tukey tests as in table 6 comparing control and Forsus groups was not statistically significant with a p value of 0.081. Comparing control and Powerscope groups was not statistically significant. Comparing Forsus and Powerscope groups was not statistically significant.

Table 5- Comparison of difference in dental values between three groups

	GROUPS	**N**	**Mean**	**Std. Deviation**	**Statistics/ mean squares**	**df2(welch) / F(Anova)**	**P VALUE**
difference overjet (is\olp-ii\olp)	CONTROL	12	3.775	1.33221	9.142	2.361	0.11
	FORSUS	12	5.1917	2.09782			
	POWERSCOPE	12	5.3667	2.33212			
	Total	36	4.7778	2.0427			
incisor (is\olp)	POWERSCOPE	12	2.075	3.44598			
	Total	36	2.8167	4.09156			
	FORSUS	12	0.6	2.07408			
difference mandibular incisor (ii\olp)	CONTROL	12	2.875	4.24588	20.262	0.968	0.39
	FORSUS	12	0.825	5.72747			
	Total	36	4.9083	4.35335			
	POWERSCOPE	12	0.4667	3.46104			
	Total	36	1.3889	4.57145			
	FORSUS	12	1.3333	4.20678			
difference maxillary molar (ms\olp)	CONTROL	12	-4.0833	4.21487	75.028	7.766	**0.002**
	FORSUS	12	0.9167	2.53012			
	POWERSCOPE	12	-1.5	2.19504			
	Total	36	-1.5556	3.66017			
difference mandibular molar (mi/olp)	CONTROL	12	-8.825	5.7479	3.712	16.615	**0.046**
	FORSUS	12	-4.3167	1.62359			
	POWERSCOPE	12	-6.375	6.15469			
	Total	36	-6.5056	5.15851			

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Table 6 – Post hoc test fordifference in values comparing the control, forsus and powerscope groups

difference molar relation (ms\olpmi\olp)	CONTROL	FORSUS	5.90000*	1.27446	**≤0.001**
		POWERSCOPE	-1.125	1.27446	0.655
	FORSUS	POWERSCOPE	-7.02500*	1.27446	**≤0.001**
difference maxillary molar (ms\olp)	CONTROL	FORSUS	-5.00000*	1.26896	**0.001**
		POWERSCOPE	-2.58333	1.26896	0.12
	FORSUS	POWERSCOPE	2.41667	1.26896	0.153
difference mandibular molar (mi/olp)	CONTROL	FORSUS	-4.50833	2.02148	0.081
		POWERSCOPE	-2.45	2.02148	0.455
	FORSUS	POWERSCOPE	2.05833	2.02148	0.571

Discussion

OVERJET

On analysis of the occlusal parameters the overjet decreased in Forsus and Powerscope treated cases. Overjet reduction of 5.2mm mean difference was seen in Powerscope treated cases and 5.0mm mean difference in Forsus treated cases both statistically significant. The overjet reduction was achieved due to mesial movement of mandibular molar and by lower incisor proclination.

Jasper el al (1995)[9] and Heinig et al (2001)[10] in their clinical studies stated a significant decrease in overjet in Class II malocclusion using Jasper Jumper and Forsus appliances.

POSITION OF MAXILLARY INCISORS

Lingual tipping of maxillary incisors were observed in Forsus with a mean difference of 3.6 and in Powerscope with a mean difference of 3.5 both statistically significant. Similar values were indicated in both the appliance. The lingual tipping could be attributed to the clockwise rotation of the occlusal plane due to the head gear effect acting in the maxillary molar region.

Similar interpretation was seen in the study for the correction of Class II malocclusion using Jasper Jumper appliance by Jasper et al (1995)[9]

POSITION OF MANDIBULAR INCISORS

The mandibular incisor proclination in Class II correction treated with Forsus appliance is statistically insignificant with a mean difference of 1.42 when compared to Powerscope treated cases having a mean difference of 1.8 is statistically significant. This significance may be attributed to the large amount of mesial movement of the mandibular molar with lower incisor proclination in Powerscope treated cases when compared to both the distal movement of maxillary molar and mesial movement of mandibular molar in Forsus treated cases.

Kucukkeles et al (2007)[11] in his study stated that the increase in occlusal plane to SN plane inclination is related to the protrusion and intrusion of the lower incisors.

POSITION OF MAXILLARY MOLAR

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Forsus treated Class II malocclusion revealed distal movement of maxillary molars with a significant mean difference of 3.25mm compared to Powerscope treated cases having a non-significant mean difference of 0.16mm.
"Head gear effect" is seen in relation to maxillary molar area producing intrusion of the upper molars and clockwise rotation of the occlusal plane. Similar findings is seen in the studies conducted by Jasper et al (1995)[9] and Pancherz et al (1993)[12] related fixed functional appliances.
POSITION OF MANDIBULAR MOLAR
Mesial movement of mandibular molars were significant both in Forsus and Powerscope treated cases with a mean difference of 6.1mm and 9.2mm respectively contributing to their class II molar corrections.
Similar results were seen in earlier fixed functional appliances studies. Buschang at al (1994)[13] in his study about the evaluation of changes brought about by Jasper Jumper stated that the mandibular molar extrusion was seen which was not significant but was indicated due to the compensation of maxillary molar intrusion and clockwise rotation of the occlusal plan.

CONCLUSION

The purpose of this study was to cephalometrically evaluate the dental changes occurring in Class II cases treated with Forsus Fatigue Resistant Device and Powerscope Class II Corrector device.
The two dimensional cephalometric evaluation has its limitations and there is no literature till date evaluating the efficacy between the two appliances. Thus, the results of this research must be used cautiously in relation to other clinical findings.
The following results were obtained:

1. Head gear effect is seen more in the Forsus treated cases which is both desirable and undesirable depending on the case selected.
2. Skeletal changes indicated is more due to the anterior positioning of the pogonion, thus increase in mandibular length is not significant in both the appliances.
3. Forward positioning of mandible is due to the relocation of the articular point at the condylar region in both the appliances.
4. Patient compliance is more for Powerscope due to incorporated lateral movement of the jaw which is restricted in Forsus.
5. Dislodgement of appliance was seen higher in case of Powerscope due to its two point wire to wire application compared to Forsus having molar tube to wire application.

Forsus FRD and Powerscope Class II corrector are both efficient in the correction of Class II malocclusion. The dentoalveolar changes contribute to the forward positioning of the mandible and by improving the facial esthetics of the patient.
The appliance selection can be done based on the appropriate analysis of the case keeping in mind the merits and de-merits of the either appliance.

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