ORIGINAL ARTICLE

Treatment effects of fixed functional appliance Powerscope in patients with class II malocclusion

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Abstract: *Introduction:* Fixed functional appliances are devices which are fixed and effective 24 hours a day with minimal patient compliance which is a major advantage of fixed functional appliance. PowerScope is the latest innovation in Class II Correction which is a direct derivative of the Herbst Type II appliance. *Material and Methods:* 10 Patients with Class II Malocclusion Who Required Orthodontic Treatment were selected from the department of orthodontics and dentofacial orthopaedics, Al-Ameen Dental College and Hospital, Vijaypura for the study. Lateral cephalograms prior to the commencement of the treatment were recorded of 10 patients. Further, lateral cephelograms were taken prior to placement and after removal of PowerScope. The cephalograms were compared on Set of 33 cephalometric parameter divided into sagittal, vertical and angular measurements followed by statistical analysis with matched paired T test to determine the significance *Result:* In this study, mean and standard deviation of all the cephalometric values for before placing the powerscope and after removal of powerscope were compared out of all the 33 set of cephalometric Values, sagittal parameter *Olp- Pg* was statistically highly significant with p=<0.0001 show the position of mandibular base (Olp-Pg) came forward. *Molar relation* was statistically highly significant showing correction from class II to class I molar relation. Angular parameter *ANB* was statistically significant with p=0.001 shows skeletal mandibular advancement in relation to maxilla. *Conclusion:* PowerScope could be one of the best treatment options for class II correction, especially in noncompliant patients with a drastic improvement in soft tissue profile and aesthetic appearance.

Keywords: PowerScope, Mandibular Advancment, Cephalometric evaluation.

List of abbreviations used:

Olp-Apt	Occlusal line perpendicular to A point	Ar-Go-Me	Gonial angle
Olp-Pg	Occlusal point perpendicular to pogonion	SNA	The angle formed by SN and NA lines
Olp-Co	Occlusal Point Perpendicular To Condylion	ANB	The angle formed by NA and NB
Co-Apt	Condylion to A point	SNL-NL	The angle formed by SN line and maxillary plane
Co-Gn	Condylion to Gnathion	SNL-ML	The angle formed by SN line and mandibular plane
Is-Olp	Sagital Linear Position of maxillary incisor	SNL-OL	The angle formed by SN line and occlusal plane
Ii-Olp	Sagittal linear position of mandibular incisor	Is/NL	Maxillary centeral incisor inclination
Ms-Olp	Sagital Linear Position of maxillary 1st molar	Ii/ML	Mandibular centeral incisor inclination
Mi-Olp	Sagittal Linear Position Of Mandibular 1st molar	Ns	Not significant
Ol-Apt	Occlusal plane to A Point	HSIG	Highly significant
Ans-Me	Lower Anterior Facial Height	SIG	Significant
Is-NL	Vertical linear position of maxillary incisors	T1	Before placing of PowerScope
Ii-ML	Vertical linear position of mandibular incisors	T2	After removal of PowerScope
Msc-ML	Vertical linear position of maxillary 1st molar		
Mic-ML	Vertical linear position of mandibular 1st molar		
N-S-Ar	Saddle angle		
S-Ar-Go	Articular angle		

Introduction

Class II malocclusion is frequently encountered in orthodontics. Approximately 32.8% of the population between the ages 10-15 years has an Orthodontic malocclusion according to the epidemiological study done by Armed Forces Medical Services in 2012 [1]. There are many different dental and skeletal combinations that can create a Class II malocclusion. However, mandibular retrusion is one of the most common characteristics [2]. The early functional appliances were removable in nature and dependent on patients compliance for effectiveness [3].

Thus, many clinicians use compliance-free interarch appliances in order to correct Class II malocclusions. In patients, who have not yet crossed the adolescent growth spurt, removable functional appliance such as activator, bionator, Twin block, and Frankel may be used. If the patient reports after the pubertal growth spurt or during the late stages of puberty fixed functional appliances such as fixed twin block, Jasper jumper, Herbst, Universal bite jumper, Ritto appliance, Eureka Spring, and Forsus fatigue resistant device (FRD) would be a better choice considering the patient compliance [2].

All of these appliances can improve Class II malocclusions, but each one has advantages and disadvantages. However, some side effects from these fixed inter-arch appliances may be lower incisor proclination [4-9] and upper molar tipping.[9] Examples of appliances that can be used simultaneously with fixed treatment are the PowerScope, Forsus and (MARA) Mandibular Anterior Repositioning Device. Hence the study is undertaken to study the cephalometric changes with PowerScope in conjunction with comprehensive orthodontic treatment.

Aim and objectives: To evaluate the efficacy of fixed Intermaxillary Device (PowerScope) to correct class II malocclusions Cephalometrically.

Material and Methods

Clinical study: The study was conducted in the department of Orthodontics and Dentofacial Orthopaedics. In order to evaluate the efficacy of fixed intermaxillary device (PowerScope) to correct class II Malocclusion cephalometrically.

Criteria for Selection: 10 patients with Class II malocclusion who required orthodontic treatment were selected from the department of Orthodontics, Al-Ameen Dental College and Hospital, Vijayapur for the study. The selection criteria for the case included those having class II malocclusion with retrognathic mandible, class II skeletal base defined by ANB$\geq 4^0$, all patients with average to horizontal growth pattern and positive VTO.

Method of study: 10 Patients with Class II Malocclusion, In the Age Range Of 12-20 years were selected from the Department Of Orthodontics. Lateral Cephalogram were taken prior to the commencement of the treatment. Further, Later Lateral Cephalograms were taken prior to placement and after removal of Power Scope. (Ethical clearance was obtained from the Al-Ameen dental college and hospital institutional committee)

Appliance design: Power Scope is delivered as a one size fits all appliances preassembled with attachment nuts for quick and easy chair side application. The appliance allows intermaxillary and socket joint to maximize the lateral movements improving patient comfort. The appliance consists of a telescopic mechanism consisting of inner shaft/push rod, middle and outer tubing, between middle tubing and outer tubing. There is a nickel-titanium (NiTi) spring delivering constant 260g force (fig.1 [10]).

Fig-1: Appliance design
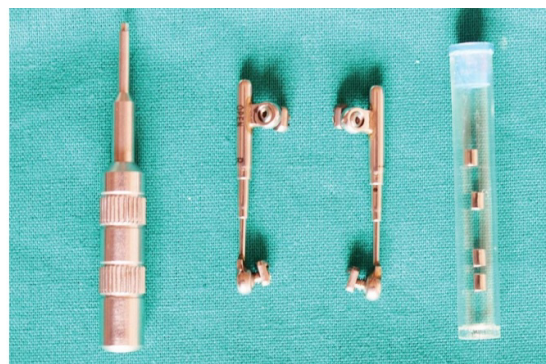
Appliance insertion: Unlike other Class II correctors, there was no need for assembly, taking measurements or appliance manipulation. The appliance allows wire-to-

wire installation with attachments placed mesial to the first molar in the maxillary arch and distal to the canine of the mandibular arch generating a horizontal directed force. This could also yield a slight intrusive force component to maxillary molars.

Appliance activation: Activation dot marking for visual reference is provided at the push rods of the appliance (right and left) which helps us to determine if the appliance is activated or not. If the dot mark is exposed, it indicates the appliance is inactive and to reactivate the appliance crimpable shims are added to the shaft.

Procedure: A nonextraction approach was planned using MBT 0.022" slot preadjusted appliance. After levelling and aligning, PowerScope was chosen to advance the mandible into a Class I relationship followed by finishing and detailing. Treatment was started using 0.016" NiTi in both arches followed by 0.019 x 0.025 HANT wire. Leveling and alignment was completed in 7 month time period and 0.019 x 0.025 stainless steel wire was placed in both the arches. This was followed by mandibular advancement using PowerScope appliance. A 5° labial root torque was given in mandibular archwire to prevent the flaring of the lower anterior. Since the appliance was anchored onto the orthodontic wire, few debonding of lower canine bracket was observed during the treatment with PowerScope appliance. Overall treatment was uneventful.

Cephalometric tracing was done on 0.003 inches thick acetate tracing paper followed by analysis using the above mentioned parameters. The measurement for each angular variable was performed by using a cephalometric protractor and was measured to the nearest 0.5°. Analysis of the sagittal skeletal and dental changes was recorded along the occlusal plane (OLs) and to the occlusal plane perpendicular (Olp) from the first cephalogram, which formed the reference grid. The grid was then transferred to subsequent cephalograms by superimposing on the mid-sagittal cranial structure. Cephalometric values were then recorded in a tabulated pattern for both before placing PowerScope (T1) and after removal of PowerScope (T2) as shown table-1 to 3.

Table-1: Sagittal		
Parameters	**T1**	**T2**
Olp-Apt	83mm	77mm
Olp-Pg	78mm	77mm
Olp-Co	10mm	12mm
Co-Apt	95mm	96mm
Co-Gn	115mm	115mm
Is-Olp	89mm	88mm
Wits Appraisal	8mm	3mm
Cogn-Coapt	20mm	24mm
Ii-Olp	80mm	84mm
Overjet	10mm	4mm
Ms-Olp	63mm	59mm
Mi-Olp	57mm	61mm
Molar Relationship	Class II	Class I

Table-2: Vertical		
Parameter	T1	T2
Ol-Apt	24mm	22mm
Ans-Me	74mm	74mm
Is-NL	32mm	31mm
Ii-ML	49mm	45mm
Overbite	6mm	2mm
Msc-NL	28mm	30mm
Mic-ML	39mm	37mm
Facial Axis Angle	4^0	6^0
Saddle Angle	126^0	124^0
Articular Angle	140^0	145^0
Gonial angle	126^0	125^0

Table-3: Angular		
Parameter	**T1**	**T2**
SNA	85^0	81^0
SNB	74^0	75^0
ANB	9^0	6^0
SNL-NL	9^0	10^0
SNL-ML	35^0	35^0
SNL-OL	23^0	20^0
Is/NL	110^0	110^0
Ii/ML	100^0	115^0
Inter-Incisal Angle	124^0	114^0

Matched Paired t test: The t-test gives an indication of how separate two sets of measurements are, allowing you to determine whether something has changed and there are two distributions, or whether there is effectively only one distribution.

The *matched-pair 1-lest* (or *paired 1-test* or *paired samples t-test* or *dependent 1-test)* is used when the data from the two groups can be presented in pairs, for example where the same people are being measured in before-and-after comparison or when the group is given two different tests at different times.

Results

In this study, Mean and standard deviation of all the cephalometric values for before placing the PowerScope (T_1) and After Removal of PowerScope (T_2) were compared. Out of all the 33 set of cephalometric values, Sagittal Parameter *Olp – Pg* was statistically Highly Significant with p=<0.0001 shows the position of the mandibular base (Olp-Pg) came forward.

Sagittal Parameter *wits appraisal* was statistically significant with p=0.001 shows significant change in the position of the maxilla relative to the mandible along the functional occlusal plane.

Sagittal parameter *Overjet* was statistically highly significant with p=<0.001 shows the positive overjet correction. Sagittal parameter *Mi. - Olp* was statistically significant with p=0.002 shows significant forward movement of mandibular molar.

Sagittal parameter *Molar relation* was statistically highly significant showing correction from Class II to Class I molar relation. Angular parameter SNB was statistically highly significant with p=0.0001shows relative skeletal mandibular advancement.
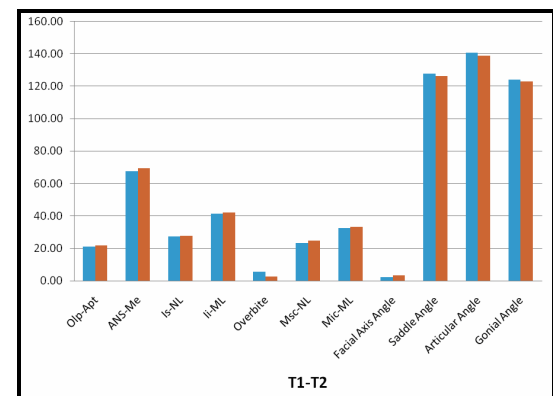
Angular parameter ANB was statistically significant with p=0.001 shows skeletal mandibular advancement in relation to maxilla.

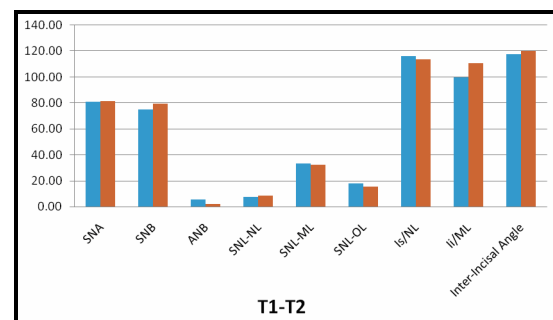*Statistical Analysis:* Mean and standard deviation of all the variables are shown in graphs 1, 2, 3.

Graph-1: Sagittal
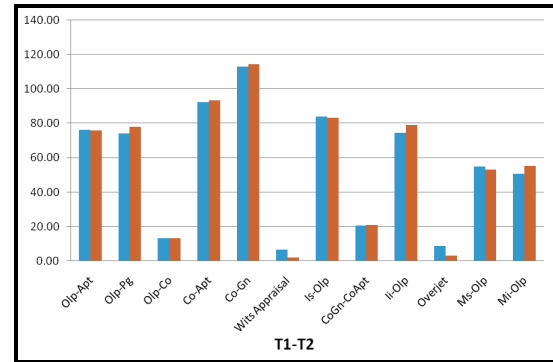
Graph-2: Vertical

Graph-3: Angular

Discussion

Among all malocclusion, Class II malocclusion presents a constant challenge to the orthodontists. Many treatment approaches and various appliances have been endeavoured for correcting the Class II malocclusion which can be as a result of skeletal abnormalities.

Class II malocclusions due to mandibular retrusion are most commonly treated with functional orthodontic appliances. A functional appliance creates orthopaedic force directed at the mandibular condyle.

These appliances produce skeletal correction by initiating remodeling changes at the mandibular condyle and glenoid fossa as well as, repositioning the mandibular condyle in the glenoid fossa and autorotation of the mandibular bone. They can be of two types - removable or fixed appliances. Among fixed functional appliance, PowerScope has been added to the inventory recently by American Orthodontics [10].

In the present study, several factors are discussed as following:

Appliance Design: The PowerScope is a fixed one-piece appliance available in one size suiting all Class II patients when compared to the ones used until now. One piece concept prevents the dislodgment of the appliance on various jaw movements. Moreover, the size selection, ordering the appliance, and delay in receiving the appliance could be all avoided as the appliance is unisized.

Customization of the appliance could be done with the help of crimpable shims supplied along with PowerScope armamentarium. The appliance allows the quick and easy wire-to-wire installation preventing bond failures of bracket and buccal tube. The ball and socket joint at the two ends of the appliance allows excellent jaw movements reducing much of patient discomfort [10].

Cephalogram: On comparing the cephalometric outcomes, a considerable improvement in skeletal, dental, and soft tissue parameters was observed at the end of PowerScope treatment. In the present study, 10 patients were treated consecutively, utilizing identical appliance and force system. A limitation of this study is that the sample was collected retrospectively.

The methodology used increase the potential selection and proficiency biases of the study. Registration of the cephalograms was undertaken by the same examiner in order to reduce method error. The reference grid used in the evaluation of the sagittal changes made it possible to evaluate the skeletal and dental changes that occurred in the maxilla and mandible along the occlusal plane (OLs). Since all before placing the PowerScope and after removal of PowerScope, sagittal

measurements were made with reference to the same reference plane (before treatment occlusal plane perpendicular (Olp), downward and backward rotation of the occlusal plane (OLs) which occurred during treatment would not affect the reference grid and bias the results.

Sagittal changes: Dean A Heinrichs et al found the net overjet correction with an average treatment time of 27.8 months was 4.7 mm 8 Heinig and Goz found a 4.7-mm reduction in overjet with the Forsus Flat Spring (3M Unitek) [11]. Karacay et al. found a 3.7-mm reduction in net overjet with the Forsus NiTi Flat Spring relative to an untreated control group [12].

Jones et al. found a 3.2-mm reduction in overjet with the Forsus FRD for 2.7 years of treatment, and the changes were similar to treatment with intermaxillary elastics with a 2.8-mm reduction in overjet [6]. Franchi et al. reported a 5.5-mm reduction in net overjet relative to an untreated control group [7]. These with FRD for 2.3 years after completion of comprehensive treatment showed no significant sagittal changes but mainly dentoalveolar changes [13-14].

Dentoalveolar Changes: The overjet correction was also partially contributed by dentoalveolar changes. Dean A Heinrichs et al reported retraction of maxillary incisors by 1.5 mm and a forward movement of the mandibular incisors by 1.3 mm was reported [8], Karacay et al. found a 1.4-mm net retraction of the maxillary incisor and a 2.2-mm net protrusion of the lower incisor with the Forsus NiTi Flat Spring [12]. Franchi et al. reported significant retrusion of the upper incisors (1.5 mm) and proclination of the mandibular incisors (2.5 mm) [7].

In this study, a retraction of the maxillary incisors by 0.9 mm and a forward movement of the mandibular incisors by 4.5 mm were noted. This is probably a side effect of the telescoping coaxial spring which has a tendency to procline the lower incisors similar to intermaxillary elastics. The molar relationship was improved significantly. Dean A Heinrichs et al reported improvement of

3.6mm with Forsus Fatigue Resistant Device [8]. Heinig and Goz [11] and Jones et al [6] found a molar relationship improvement of 3.9 and 3.2 mm, respectively, without a control group. Other studies with the Herbst appliance reported an improvement ranging from 2.4 to 4.6 mm [15-19].

In the present study the molar relationship was improved by a total of 4.6mm. The change in molar relationship was contributed by changes in apical base as described above as well as a distal movement of the maxillary molars by 1.5mm and a mesial movement of the mandibular molars by 4.6 mm. Heinig and Goz found a 1.1 mm of distal maxillary molar movement and 1.7 mm of mesial mandibular molar movement with the Forsus NiTi Flat Spring [11].

Karacay et al. found a 1.97 mm of distal maxillary molar movement and 1.75 mm of mesial mandibular molar movement compared to a control group. 48 Other studies with the Herbst appliance showed a range of 0.4 to 1.5 mm of distal maxillary molar movement and – 0.3 to 1 6 mm of mesial mandibular molar movement [16-19].

However, a controlled clinical trial following patients treated with FRD for 2.3 years after completion of comprehensive treatment showed no significant sagittal changes but mainly dentoalveolar changes. For the incisors, the maxillary incisor (Is-NL) was found to extrude by 0.3 mm and the mandibular incisor (Ii-NL) by 0.8 mm. Karacay et al. measured 3.1 mm of net mandibular incisor intrusion [12].

Angular Changes: The overbite was found to decrease with treatment 3.0 mm. This was accompanied by a slight increase in lower facial height by 1.8 mm. However, the palatal plane by SNL-NL= 0.6°, mandibular plane SNL-ML= 0.6°, and occlusal plane by SNL-OLs=2.9° all showed changes which were not statistically significant. This is similar to reductions in the palatal plane and mandibular plane were reported for the Forsus NiTi Flat Spring and Forsus FRD.

Karacay et al [12] reported a net increase of 2.81° for the occlusal plane with the Forsus NiTi Flat Spring. Heinig and Goz [11] found a 4.2° increase in the occlusal plane, which was slightly larger than the increase found in this study. This may be due to the fact that there are different definitions of where to measure the functional occlusal plane and may explain the differences between the studies. Change in SNA angle (0.6°) was observed all throughout the treatment. A mandibular advancement was clearly evident as SNB angle increased by 4.5° and a 3.7° reduction in ANB angle and 4.6 mm advancement of BO in Wits appraisal was observed.

The treatment could thus accomplish a well-balanced face with a pleasant smile. The results were stable and extremely satisfying for both the clinician as well as the patients.

Anchorage: In this study anchorage was provided by first and second molar banding, Transpalatal arch, V - bend and 5° labial root torque in mandibular archwire.

Drawbacks and Limitations: The PowerScope despite of having numerous advantages over other fixed functional appliances, it still has certain drawbacks if which could overcome may result in more desirable results. In the study 5° labial root torque was given in mandibular archwire to prevent flaring of lower incisors. But still slight proclination was observed. Debonded canine brackets were a common problem. Sliding of device in MBT 0.18 slot was observed. Unlike Forsus where the desired advancement is incorporated at once, in PowerScope it's done step wise by adding shims.

The limitations of PowerScope are that it cannot be used in patients with increased proclination and vertical growers. It is also difficult to maintain posterior hygiene.

Conclusion

10 patients with Class II malocclusion who required orthodontic treatment were selected from the Department Of Orthodontics and Dentofacial Orthopaedics Al-Ameen Dental College and Hospital, Bijapur for the study. Lateral Cephalograms were taken prior to the commencement of the treatment. Later Lateral Cephalograms were taken prior to the placement and after the removal of PowerScope. The cephalograms were

compared on a set of 33 cephalometric parameters divided into sagittal, vertical and angular measurements followed by statistical analysis with matched paired t test to determine the significance.

In this study, Mean and standard deviation of all the cephalometric values for before placing the PowerScope and after removal of PowerScope were compared. Out of all the 33 set of cephalometric values, Sagittal Parameter Olp – Pg was statistically Highly Significant with p=<0.0001 shows the position of the mandibular base (OLp-Pg) came forward.

Sagittal parameter Wits Appraisal was statistically Significant with p=0.001 shows significant change in the position of the maxilla relative to the mandible along the functional occlusal plane. Sagittal Parameter Overjet was statistically Highly Significant with p=<0.001 shows the positive overjet correction. Molar relation was statistically Highly Significant showing correction from Class II to Class I molar relation. Angular Parameter SNB was statistically

Highly Significant with p=0.0001shows relative skeletal mandibular advancement. Angular Parameter ANB was statistically Significant with p=0.001shows skeletal mandibular advancement in relation to maxilla.

This study illustrates many of the technical qualities and drawbacks of the treatment effects of a fixed intermaxillary device PowerScope to correct class II malocclusions. Patients will be very well benefited by treatment using Class II correctors such as PowerScope. Excellent results can be achieved by limiting the side effects, minimizing the need for patient compliance,- and avoiding appliance breakage.

PowerScope could be one of the best treatment options for Class II correction, especially in noncompliant patients with a drastic improvement in the soft tissue profile and aesthetic appearance of the patient by the sagittal forward displacement of mandible ensuring excellent long-term stable results.

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