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Efficacy of Powerscope Appliance for Class II Correction by Lateral Cephalogram - A Clinical Study.

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ABSTRACT

Introduction: Fixed functional appliance (FFA) is most commonly used for Class II correction which requires minimal patient compliance. PowerScope provides one of the best non extraction treatment options for non-compliant patients. This appliance addresses the critical needs of an orthodontist, including patient comfort and acceptance, extensive range of motion, and simple installation.

Objectives of study: This study was conducted to evaluate the clinical efficiency of PowerScope appliance by assessing skeletal, dentoalveolar, and soft-tissue changes and condyle-glenoid fossa relationship after using the appliance.

Methodology: Twenty patients of mean age of 16years with post pubertal growth period, who reported to the Department of Orthodontics and Dentofacial Orthopedics, have been treated for Class II malocclusion (extraction and nonextraction) and treated with Powerscope appliance were selected for the study. Selected patients pretreatment and post treatment lateral cephalogram were taken.

Results: The study revealed statistically significant changes in dentoalveolar and soft-tissue parameters after using PowerScope appliance and also significant changes in condyle-glenoid fossa relationship after using PowerScope appliance.

Conclusion: PowerScope was clinically efficient in the correction of Class II malocclusion in noncompliant patients. Hence, based on this study, we can conclude that PowerScope partly corrects by skeletal movement and mostly by dentoalveolar movement with a significant improvement in facial profile.

Key words: Class II correction, PowerScope appliance.

INTRODUCTION

Fixed functional appliance (FFA) is most commonly used for Class II correction which requires minimal patient compliance. However, orthodontists cannot always rely on patient cooperation. Noncompliance has been a concern in orthodontics for more than 40 years. [1] So, as time passed, Fixed functional appliances (FFAs) evolved and can be grouped into different categories based on their mode of action. Patients with Class II division 1 malocclusion can exhibit maxillary protrusion, mandibular retrusion, or both, together with abnormal dental relationship problems and facial esthetic disorders. [2] These malocclusions can be treated with orthodontic and orthopedic appliance if maxilla is to be corrected and for mandibular retrusion with Myofunctional appliance(activator, Balter's bionator, Twinblock, Frankel) during active growth period.[3] While during deceleration stages of growth, use of Fixed Fixed Functional Appliance such as (Herbst, Jasper jumper, mandibular anterior repositioning appliance Forsus Nitinol Flat Spring, Forsus FRD, PowerScope) was commonly prescribed to the patient.[4]

The first-fixed (stationary) functional appliance was introduced by Emil Herbst in 1905. It is still popular today but has some disadvantages, such as limitation of lateral mandibular movements (inflexible) and obstruction of oral hygiene maintenance. [2]

Evolution of different FFAs over the years has led to the introduction of newer FFAs. A number of fixed appliances have gained popularity in recent years to help achieve better result in noncompliant patients. One of such innovations is PowerScope, [5] which is hybrid appliance for the correction of mild skeletal Class II in noncompliance patients.

PowerScope (figure 1) is the latest innovation in Class II correction. This appliance addresses critical needs of the orthodontist, including patient comfort and acceptance, extensive range of motion, and simple installation. [6]

Dr. Andy Hayes worked in conjunction with the American

Orthodontics to develop PowerScope. PowerScope also has the advantage of permitting lateral movements due to exclusive ball and socket joints and typical telescopic mechanism is also an advanced feature; unlike other Class II correctors, there is no need for assembly measuring or appliance manipulation[6].PowerScope 2 is delivered as a one -size-fit all appliances pre-assembled with attachment nuts for quick and easy chairside application . The appliance is a 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 . This wire-to-wire device delivers unmatched patient comfort and eliminates the need for headgear tubes or special band assemblies. [6]

Therefore, the present study determines condyle – glenoid fossa relationship using Lateral Cephalogram before and after treatment with Power Scope.

The aim of this study was to evaluate the skeletal, dentoalveolar, soft-tissue changes and also alteration in the CON-GF relationship before and after treatment with PowerScope appliance in treating Class II malocclusion.

METHODOLOGY

Source of Data:

Pretreatment and posttreatment Lateral cephalogram of 20 patients collected from Department of Orthodontics & Dentofacial Orthopedics of 13-20 years age group with mean age of 16years with post pubertal growth period, have been treated for Class II malocclusion (extraction and nonextraction) and delivered PowerScope appliance were selected for the study.

This study was conducted to determine the skeletal, dentoalveolar, soft-tissue changes and location of condyle in glenoid fossa after using PowerScope appliance in the treatment of Class II malocclusion with normal maxilla and deficient mandible cases.

Inclusion Criteria

1. Convex profile
2. Retrognathic or deficient mandible with skeletal Class II malocclusion with normal maxilla
3. Post pubertal growth period
4. Minimal crowding
5. Positive visual treatment objectives.

Exclusion Criteria

1. Patients with neuromuscular disease
2. Patients with TMJ problems
3. Patients with cleft lip and cleft palate
4. Patients with skeletal open bite.

Materials

Armamentarium:

1. MBT™ bracket prescription (0.022-inch slot
2. PowerScope Kit (American Orthodontics) (Figure 1)
3. Ligature ties
4. Pretreatment and Post treatment lateral cephalogram

Figure 1. PowerScope Kit

Study Design

All patients included in this study exhibited Class II skeletal and Class II dental malocclusion, deficient mandible, minimal crowding and were treated with MBT™ bracket prescription (0.022-inch slot).Leveling and aligning was carried out with 0.014” NiTi, 0.016” NiTi, 0.017” × 0.025” NiTi, 0.019” × 0.025” NiTi, and finally, 0.019” × 0.025” stainless steel archwires with anterior lingual crown torque was given. The use of MBT brackets (−6° torque in the lower incisor), molar to molar consolidation in both arches, cinching off the lower archwire, and use of pretorqued wire before insertion of the PowerScope has helped us to counteract the protrusive effect on mandibular incisors.

After initial leveling and aligning procedure, delivery of powerScope appliance according to manufacturer’s instructions, appliance was maintained until an unstrained Class I canine and Class I molar relation was obtained. Followed by the removal of the FFA, post functional lateral cephalogram were taken.

Total treatment time was calculated from the start of treatment to the removal of the brackets, dentoalveolar, soft-tissue changes and location of condyle in glenoid fossa (Figure 2) were calculated by pre- and post-treatment lateral cephalogram

images,.

Table 1. Comparing pre and post treatment variables with powerScope appliance maxillomandibular skeletal parameters

Parameters	Frequency	Pre-Mean±sd	Post Mean±sd	t-value	p-value
SNA	20	81.20±6.05	81.50±4.97	-.053	0.958 (N.S)
A to VRP	20	3.150±2.76	3.40±2.77	-.339	0.735(N.S)
SNB	20	75.90±5.61	77.50±4.45	-2.890	0.00*(SIG)
ANB	20	5.30±1.66	3.80±2.33	-2.492	0.00*(SIG)
MAXILLARY LENGTH	20	91.60±6.44	91.50±5.24	-.110	0.913(N.S)
MANDIBULAR LENGTH	20	114.00±6.77	117.20±7.9445	-3.036	0.00*(SIG)

Wilcoxon signed-ranks test, *P<0.05 (significant). VRP: Vertical reference plane, SD: Standard deviation

The data collected were assessed using IBM SPSS 16.0 (Statistical Package for Social Sciences) computer program. Descriptive statistical analysis was performed using Wilcoxon signed ranks test to compare before and after treatment results. It was also divided into 2groups, non-extraction (14samples) and extraction group (6samples). Independent't' test was done and comparison was done between nonextraction and extraction group. The level of significance was established as P ≤ 0.05 for all statistical tests.

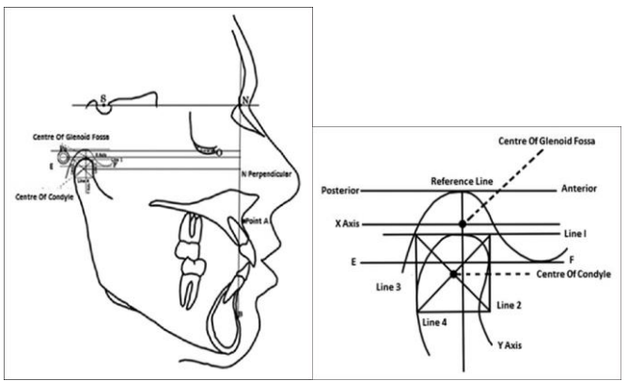

Figure 2: Diagrammatic representation of Center of Condyle (COC) and Center of Glenoid Fossa (COGF) in Lateral Cephalogram

•Line 1: A line is drawn parallel to the reference line and tangent to the highest point of the condyle

•Line 2: A line is drawn perpendicular to Line 1 and tangent to the most anterior aspect of the condyle

•Line 3: A line is drawn parallel to Line 2 and tangent to the most posterior aspect of the condyle

•Line 4: A line is drawn parallel to Line 1, which is at a distance to Line 1 equal to that between Line 2 and Line 3.

RESULTS

Calculated values were subjected to statistical analysis and the results obtained were Tabulated as Tables 1-5.

The NPar Test- Wilcoxon Signed Ranks Test was used in this study to compare pretreatment and post treatment results. The comparison of pre and post treatment variables with powerScope appliance of showed a p= 0.00 for SNB, Mandibular length, WITS, AFH, PFH, L6-MP, L6-VRP, Overjet, Overbite, ULE, LLE, MFL,MZA and p=0.01 for ANB, Y-axis COC-COFG which was highly significant and other parameters showed nonsignificant.

Independent't' test was done and comparison was done between nonextraction and extraction group. Results showed significant difference in SNA angle (p= 0.015), AFH (p= 0.047), L1-MP (p=0.029),LLE (p=0.017) and X-AXIS (p=0.00) parameters only between nonextraction and extraction group.

DISCUSSION

Class II malocclusion is most frequently encountered malocclusion in our day-to-day clinical practice. Treatment options for class II malocclusion depends upon various factors such as the severity of the malocclusion and the age at which the patient reports for the treatment.[7] Various orthodontic techniques and appliances have been introduced to treat Class II malocclusions, including intraarch and interarch appliances, extra-oral appliances, and surgical repositioning of the jaws. Intermaxillary elastics are a typical interarch method used for Class II correction. However, intermaxillary elastics rely heavily on patient compliance for their effectiveness, and compliance in orthodontics is variable and difficult to predict. Poor cooperation can lead to poor treatment results and increased treatment time. A number of compliance-free

interarch appliances have been developed. Fixed interarch appliances typically demonstrate the mesial movement of the mandibular molars, tipping of the mandibular incisors, and variable effects associated with mandibular growth. Efficiency of treatment mechanics of FFAs in noncompliance patients has been a major focus throughout the history of these appliances in orthodontics. [2]

PowerScope appliance is a hybrid and rigid appliance designed to correct Class II malocclusion in growing patients. PowerScope has the ability to treat the following types of cases: [2]

• Class II correction with dentoalveolar compensation of occlusion (Class II elastics effect)

• Class II division 1 malocclusions

• Class II division 2 malocclusions

• Unilateral correction of Class II

• Asymmetric cases - midline correction.

Limited studies have evaluated skeletal, dentoalveolar, soft tissue changes before and after treatment with PowerScope appliance in treating Class II malocclusion.

The literature provides only limited data about the location of the condyle in the glenoid fossa (Nishanth, *et al.* 2017) [2]. Also no study has done which compared between nonextraction and extraction group.

In this study, the pretreatment SNA, A-VRP and Maxillary length values are 81.20±6.05, 3.150±2.76 and 75.90±5.60; post treatment values are 81.50±4.96, 3.40±2.77 and 77.50±4.45 respectively. All this values subjected to wilcoxon signed-rank test showed a *p*= 0.098, 0.73 and 0.913, which indicate that they were not significant **(Table 1).** Hence there is no change in maxillary base with powerScope appliance. This is in accordance to the study conducted by Nishanth, *et al.* 2017) [2] showed that there is no change in maxillary base with powerScope appliance. As a cephalometric study of Pancherz H *et al.* [8] in Class II division 1 with FFA also showed no change in maxillary base, this study results correlate with the present study. An intergroup comparison between nonextraction and extraction group was done which showed only significant difference SNA (*p*=0.015) with mean difference greater in

Table 2. Comparing pre and post treatment with powerScope appliance maxilla-mandibular vertical skeletal relationship.

PARAMETERS	Frequency	Pre-Mean±sd	Post Mean±sd	t-value	p-value
WITS	20	3.70±3.30	-.150±2.67	-3.368	0.00*(SIG)
BETA	20	25.60±5.62	28.10±4.56	-1.914	0.056(N.S)
AFH	20	119.00±5.91	123.10±8.15	-3.442	0.00*(SIG)
PFH	20	80.70±4.52	84.00±3.97	-3.328	0.00*(SIG)
SFCVX	20	8.10±5.65	7.80±4.12	-.723	0.470(N.S)

Wilcoxon signed ranks test, *P<0.05 (significant), SFCVX: Skeletal facial convexity i.e., (Na A Pog), SD: Standard deviation, AFH: Anterior facial height, PFH: Posterior facial height

Table 3. Comparing pre and post treatment with powerScope appliance mandibular dental parameters and interdental relationship

Parameters	Frequency	Pre-Mean±sd	Post Mean±sd	t-value	p-value
L1-NB	20	6.75±3.50	7.700±2.41	-1.201	0.230(N.S)
L1-MP	20	103.80±12.88	105.40±6.63	000	1.000(N.S)
L6-MP	20	31.40±2.52	35.20±2.54	-3.985	0.00*(SIG)
L6-VRP	20	23.70±3.58	20.10±3.98	3.745	0.00*(SIG)
OVERJET	20	7.30±1.59	3.15±.85	-3.940	0.00*(SIG)
OVERBITE	20	5.50±2.27	1.95±.93	-3.940	0.00*(SIG)

Wilcoxon signed ranks test, *P<0.05 (significant), VRP: Vertical reference plane, SD: Standard deviation

nonextraction group.

Table 4. Comparing pre and post treatment with powerScope appliance interincisal and soft tissue relationship

Parameters	Frequency	Pre-Mean±sd	PostMean±sd	t-value	p-value
INTINCSA	20	116.60±16.95	118.80±9.07	-.187	0.852(N.S)
ULE	20	-1.00±2.24	-2.80±2.50	3.550	0.000*(SIG)
LLE	20	.50±3.38	1.35±2.90	-2.241	0.02*(SIG)
NLA	20	103.10±11.75	107.30±7.81	-1.801	0.072(N.S)
MLF	20	114.50±18.74	125.50±14.83	-3.592	0.00*(SIG)
MZA	20	63.70±7.74	61.90±7.58	-2.475	0.00*(SIG)

Wilcoxon signed ranks test, *P<0.05 (significant), INTINCSA: Interincisal angle, ULE: Upper lip to E plane, LLE: Lower lip to E plane, NLA: Naso labial angle, MLF: Mento labial fold, MZA: Merrifield Z angle, SD: Standard deviation

In this study, the pretreatment SNB, Mandibular length, and skeletal facial convexity (SFCVX) value are 75.90±5.60, 114.00±6.77 and 8.10±5.64 and after PowerScope use, posttreatment SNB, Mand L, and SFCVX are 77.50±4.45, 117.20±7.94, and 7.80±4.12. All these values subjected to Wilcoxon signed-rank test showed a *P* = 0.00, 0.00, and 0.470, which indicate that they were significant, except SFCVX which is nonsignificant **(Table 1, 2).** Hence there is change in mandibular base length with powerScope, but skeletal facial convexity shows non-significant change. In contrast to our study, (Nishanth, *et al.* 2017) [2] showed there is no change in mandibular base with powerScope appliance and there is change in mandibular length which was not significant. Studies [9, 10] with other FFA showed that there is no change in mandibular base and is change in mandibular length which was not significant; these study results does not show correlation with the present study.

Relationship of maxilla to mandible was investigated by evaluating ANB, wits, and beta angle. In this study, the pretreatment ANB, wits, and beta value are 5.30±1.65, 3.70±3.30, and 25.60±5.62, respectively, and after PowerScope use, posttreatment ANB, wits, and beta are 3.80±2.33, -.150±2.67, and 28.10±4.55, respectively. All these values subjected to Wilcoxon signed-rank test showed a P = 0.01, 0.00, and 0.056, respectively, which indicate that they were significant, except beta angle which is nonsignificant. **(Table 1, 2)** Hence, there is significant change in maxillo-mandibular relationship with PowerScope appliance. A mandibular advancement was clearly evident as SNB angle increased and reduction in ANB angle and advancement of BO in Wit's appraisal was observed. This is in accordance to the study conducted by Nishanth, *et al.* (2017)[2] showed significant change in maxillomandibular relationship. A study conducted by Jones G et al. 2008 [11] showed a significant change in maxillo-mandibular relationship with other FFA; hence, these study results correlate with the present study.

In this study, the pretreatment L1-to-NB and L1-to-MP are 6.75±3.50 and 103.80±12.88, respectively, and L6-to-MP and L6-to-VRP are 31.400±2.52 and 23.70±3.58, respectively; after PowerScope use, posttreatment L1-to-NB and L1-to-MP are 7.700±2.42 and 105.40±6.64, respectively, and L6-to-MP and L6-to-VRP are 35.20±2.55 and 20.10±3.99, respectively. Both these values subjected to Wilcoxon signed-rank test showed a *p*= 0.230 and 1.000, respectively which is non significant, and 0.00 and 0.00, respectively, which indicate significant **(Table 3).** Hence, Mandibular incisors proclination was not significant after PowerScope appliance correction, different result from previous studies which showed increase in incisor proclination , also L6-to-MP showed clockwise rotation of mandible.

In this study, the pretreatment anterior facial height (AFH) and posterior facial height (PFH) are 119.00±5.91 and 80.70±4.52, respectively, and after PowerScope use, posttreatment AFH and PFH are 123.100±8.15 and 84.00±3.97, respectively. Both these values subjected to Wilcoxon signed-rank test showed *p*= 0.00, which indicate significant AFH and PFH **(Table 2).** Hence, there is a significant change in vertical relationship with PowerScope appliance. In a cephalometric study Ruf S *et al.* 2002 [10] for the Class II correction by FFA, significant change in vertical relationship that is PFH was reported. Hence, these results correlate with the present study.

In this study, the pretreatment overjet and overbite and INTINCSA are 7.30±1.59, 5.50±2.27 and 116.60±16.95, respectively, and after PowerScope use, posttreatment overjet and overbite and INTINCSA are 3.15±.86, 1.95±.93, and

118.80±9.07, respectively. Both these values subjected to

Table 5. Comparing of pre and post treatment with power Scope appliance location of condyle in relation to glenoid fossa.					
Parameters	Frequency	Pre-Mean±sd	Post Mean±sd	t-value	p-value
X-axis COC & COGF	20	1.05±2.13	1.85±1.30	-.187	0.155(N.S)
Y-axis COC & COGF	20	5.10±1.52	6.15±0.82	3.550	0.001(SIG)
Wilcoxon signed ranks test, *P<0.05 (significant), COC: Center of Condyle, COGF: Center of Glenoid Fossa.					

Wilcoxon signed-rank test showed *p*= 0.000, 0.000, and 0.852, respectively, which indicate significant Overjet and Overbite, not significant interincisal angle **(Table 3, 4).** Hence, there is a significant change in interdental relationship with PowerScope appliance. Previous studies [12, 13, 14] showed that overjet and overbite had significant change in interdental relationship in Class II noncompliance patients. A near to normal interincisal angle was established. A substantial improvement in soft tissue was appreciated with a tendency toward an orthognathic profile.

In this study, the pretreatment upper lip to E-plane and lower lip to E-plane value are -1.00±2.25, .50±3.39 respectively after PowerScope use, posttreatment values are 2.800±2.50 and 1.35±2.90 respectively. Both these values subjected to Wilcoxon signed-rank test showed a *p* = 0.000 which indicate that they were statistically significant **(Table 4).** Hence, the lower lip relation to E line improved greatly Upper lip to E line also showed substantial improvement. Similar results were reported in a study of Stromeyer EL et al. 2002 [15] that soft-tissue profile following FFA therapy, resulted significant improvement in facial profile; hence, these results correlated with the present study.

In this study, the pretreatment X-axis COC-COGF and Y-axis COC-COGF are 1.05±2.13 and 5.10±1.52 respectively, after powerScope use; posttreatment values are 1.85±1.30 and 6.15±0.83 respectively. Both these values subjected to Wilcoxon signed-rank test showed *p*= 0.155 and 0.000 respectively, which indicate significant Y-axis COC-COGF and non significant X-axis COC-COGF **(Table 5).** The study result shows center of condyle moved more downward showing significant change, also center of condyle moved slightly anteriorly. In a CT imaging study conducted by Nishanth *et.al.* 2017[2] observed no significant change in CON and GF changes; hence, this study does not correlate with the present study.

CONCLUSION

1. There is slight increase in length of mandible and decrease in ANB angle as point B moved forward with PowerScope appliance
2. Molar relation has been changed from Class II to Class I with PowerScope appliance
3. Overjet and overbite restored to normal with PowerScope appliance
4. The location of condyle moved slightly forward and significantly downward in relation to glenoid fossa.
5. There is no significant difference between extraction and non extraction group.
6. The treatment could thus accomplish a well-balanced face with a pleasant smile which could be well ascertained from the superimposition of soft tissue and hard tissue

Hence, PowerScope, an innovative Class II corrector device brings about the correction of Class II malocclusion for noncopliant patients partly by skeletal movement and mostly by dentoalveolar movement with a significant improvement in facial profile.

Further high-quality randomized controlled trials with CT imaging for Class II malocclusions are needed to fully elucidate the efficiency of PowerScope for late adolescent and young adults.

REFERENCES

1. There is slight increase in length of mandible and decrease in ANB angle as point B moved forward with PowerScope appliance
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5. There is no significant difference between extraction and non extraction group.
6. The treatment could thus accomplish a well-balanced face with a pleasant smile which could be well ascertained from the superimposition of soft tissue and hard tissue
7. Hence, PowerScope, an innovative Class II corrector device brings about the correction of Class II malocclusion for noncopliant patients partly by skeletal movement and mostly by dentoalveolar movement with a significant improvement in facial profile.
8. Further high quality randomized controlled trials with CT imaging for Class II malocclusions are needed to fully elucidate the efficiency of PowerScope for late adolescent and young adults.