Case Report

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Comparison of Dentoskeletal Changes in Skeletal Class II Malocclusion Using Two Different Fixed Functional Appliances: A 2 Case Report

Abstract:

Introduction: Class II malocclusion refers to an anteroposterior discrepancy that could be characterized by a dentoalveolar and/or skeletal involvement. When skeletal involvement is present, mandibular retrusion is the primary etiological factor.Several methods have been proposed for treatment of this malocclusion and their choice would depend on the degree of dentoalveolar or skeletal involvement, patient growth pattern, age, cooperation and main complaint. Fixed functional appliances are an excellent option in patients with growth potential. These appliances have the advantage of not depending on patient compliance, which may be related to more predictability.

Aim: This article presents 2 case reports thatcompare the dentoskeletal changes of patients diagnosed with skeletal class II treated with Forsus fatigue resistant device (FFRD) and Powerscope class II corrector (PS).

Conclusion: PowerScope Class II corrector and Forsus fatigue resistant device (FFRD) are promising appliances that is relatively simple to install and easy to maintain by patients this directly helps the orthodontist in maintaining patient compliance to achieve the predicted treatment outcome.

Key-words: Functional Appliances, Class II Corrector, Skeletal Class II Malocclusion

Introduction:

Fixed functional appliances are reported to correct Class II skeletal problems by encouraging mandibular growth and by eliciting dentoalveolar effects. Different compliance-free appliances include: the Herbst, Mandibular Anterior Repositioning Appliance (MARA), Mandibular Protraction Appliance, Jasper Jumper, Bio bite corrector, Twin force bite corrector, FFRD, and PS[2]. These appliances have the ability to be used in conjunction with comprehensive fixed therapy[9]. However, some side effects from these fixed interarch appliances may be lower incisor proclination and upper molar tipping.

The FFRD is a fixed Class II appliance that was developed by ***Vogt(2021)[4].*** The FFRD (3M Unitek corps, Monrovia, CA) is a three-piece, semirigid telescoping system incorporating a super elastic nickel–titanium coil spring that can be assembled chair-side in a relatively short amount of time[3]. The distal end of the maxillary molar tube to the distal side of the mandibular canine with the patient in centric occlusion is measured by using the measuring guide. An L-pin serves to attach it to the maxillary headgear tube[6]. A circular loop is placed in the mandibular arch distal to the canine bracket for attachment of the push rod. It is compatible with complete fixed orthodontic appliances and can be incorporated into pre-existing appliances[8]. The push rod, which is the mesial end of the appliance, is attached to the mandibular arch wire distal to the canine or first premolar bracket. The telescoping cylinder is inserted into the maxillary molar headgear tube. There are numerous studies that have evaluated the effects of the Forsus and compared it with intermaxillary elastics and untreated controls[6].

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[1]SAHIRA DADHWAL, [2]ISHA AGGARWAL , [3]SANJAY MITTAL, [4]MERRY, [5]ABIDA PARVEEN

[1-5]Department of Orthodontics and Dentofacial Orthopedics Bhojia Dental College and Hospital, Budh, Baddi

Address for Correspondence: Dr. Sahira Dadhwal
Bhojia Dental College and Hospital, Budh,
Baddi (HP) 173205
Email: 10sahiradadhwal@gmail.com

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Powerscope has a ready-to-use concept, and unlike other Class II correctors, there is no need for assembly, measuring, or appliance manipulation. The appliance is placed mesial to the first molar in the maxillary arch and distal to the canine of the mandibular arch. There are case reports showcasing the treatment effects of the PS. Thus, the aim of the present study was to compare the dentoskeletal changes in cases diagnosed with skeletal Class II by using the FFRD and PS.

Case Report 1

A female patient of age 17 years visited the department of Orthodontics and dentofacial orthopaedics at Bhojiadental College, Budh Baddi with the chief complaint of irregularly placed upper front teeth since childhood. Extra oral examination (Figure 1) revealed that she had a mesoprosopic facial form with good facial symmetry, convex profile with posterior divergence, reduced lower facial height, competent lips, obtuse nasolabial angle, normal mentolabial sulcus, normal mandibular plane angle, and a non-consonant smile arc. No signs/ symptoms of temporomandibular joint dysfunction. Intraoral examination (Figure 2) revealed as Class II molar relation bilaterally. The vertical relation showed closed bite (8mm,100%),overjet of 3mm, mandibular midline was coincident. Orthopantomogram (Figure 3)showed full complements of teeth irrespective of third molars. No pathology present. Lateral cephalograms (Figure 3)showed she had orthognathic maxilla (80) and retrognathic mandible (76) with ANB (4), Wits (4mm),betaangle 24 depicting a skeletal Class II jaw bases. Patient had a hypodivergent growth pattern on account of Sn-Go-Gn (24),FMA (18) and Jaraback ratio of 71.7%, IMPA 99° (Table 1).

Figure 1:pretreatmentextratraoral photographs

Figure 2:Pretreatment Intraoral photographs

Figure 3: Pretreatment Radiographs

Table 1:Pre-treatment Cephalometric Values

MEASUREMENTS	PRE TREATMENT
SNA	80°
SNB	76°
ANB	4°
Beta Angle	24°
SN-GoGn	24°
FMA	18°
Jarabak ratio	71.7%
1 to NA	4.5mm
1 to SN	98°
IMPA	99°
Nasolabial Angle	128°
Upper lip to ELine	2mm
Lower lip to ELine	-1mm

Treatment Objectives :

1. To correct the crowding of anterior teeth.
2. To obtain optimum overjet and overbite.
3. To establish Class I molar and canine relation.
4. To obtain skeletal balance by promoting dentoalveolar growth.
5. To improve the facial features by obtaining a straight profile with straight divergence, a pleasing smile arc and soft tissue esthetics.

Treatment:

After analysing all diagnostic records, a non-extraction approach was planned. As patient was in the pre-pubertal growth period, decompensation of the dental arches with leveling and alignment using the straight wire appliance (SWA) MBT 0.022" slot was done simultaneously. The

maxillary and mandibular teeth were bonded and banded with pre-adjusted 0.022" slot MBT prescription brackets. Initial levelling and alignment of maxillary and mandibular arch was done and the arches were aligned using the following sequence of archwires; 0.016 Niti, 17 × 25 Niti, and 19 × 25 Nickel Titanium arch wires. Later 19 × 25 stainless steel archwire (Figure 5) with exaggerated reverse curve of spee in the lower arch were placed to level and improve the torque of the incisors. This plan was completed in 10 months. The visual treatment objective (VTO) was positive showing improvement in facial esthetics when Power Scope was placed. This phase continued for 5 months. This resulted in correction of Class IImalocclusion ad attainment of normaloverjet and overbite. Torque control, Finishing and detailing were carried out and the appliance was debonded. The total treatment time was 15 months.

Figure 5a:Mid Treatment Photographs(Leveling and Alignment)

Figure 5b:Mid Treatment Photographs (Arches with Powerscope)

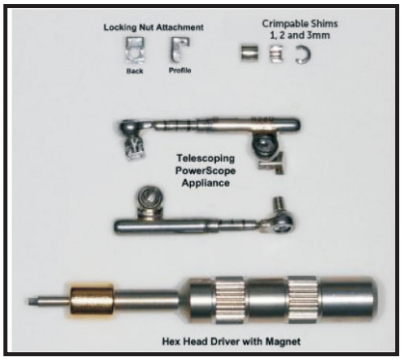

Figure 6: Power Scope Appliance

Treatment Results:

There was remarkable improvement in the patient's profile and facial esthetics as seen in the post-treatment facial photographs. Facial balance, smile esthetics, and lip positions were improved (Figure 7).Class I molar and canine relationships were established. Overjet and overbite were improved to 2 and 2mm respectively (Figure 8).Cephalometrically the upper incisors were proclined from 18° to 22° in relation to NA perpendicular to point A line and lower incisors were proclined from 99 to 102 (IMPA) (Table 2). Superimposition demonstrated the treatment changes (Figure 9). In the maxillary arch there was extrusion of molar but no significant distalization and the incisors were proclined. There was a counter clockwise rotation of mandible, maxillary growth restriction, and overall improvement of soft tissue profile.

Figure 7:Posttreatmentextraoral photographs

Figure 8: Posttreatment intraoral photographs

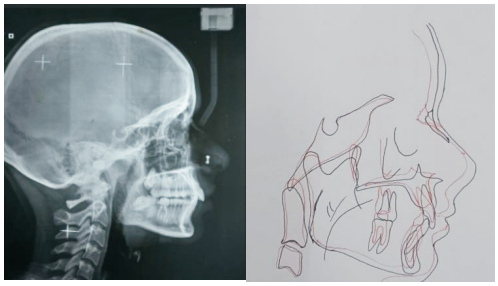

Figure 9: Posttreatment radiographs

Table 2: Post-treatment Cephalometrical Value

MEASUREMENTS	PRE TREATMENT	MID TREATMENT	POST TREATMENT
SNA	80 °	80 °	80 °
SNB	76 °	76 °	76 °
ANB	4 °	4 °	4 °
Beta Angle	24°	25°	25°
SN-GoGn	24 °	29 °	25 °
FMA	18 °	20 °	20 °
Jarabak ratio	71.7%	71%	71.9%
1 to NA	4.5mm	5.5mm	4mm
1 to SN	98°	105°	105°
IMPA	99 °	99 °	102 °
Nasolabial Angle	128 °	105 °	105 °
Upper lip to E-Line	2mm	-1mm	-3mm
Lower lip to E-Line	0mm	1mm	0mm

Case Report 2

A female patient of age 17 years visited the department of Orthodontics and dentofacial orthopaedics at Bhojiadental College, BudhBaddi with the chief complaint of irregularly placed upper front teeth. Extra oral examination (Figure 10) showed that she had a mesoprosopic facial form with good facial symmetry, convex profile with posterior divergence, potentially incompetent lips, obtuse nasolabial angle, normal mentolabial sulcus, reduced mandibular plane angle, and a non-consonant smile arc. No signs/ symptoms of temporomandibular joint dysfunction. Intraoral examination (Figure 11) revealed as Class II half cusp molar relation bilaterally. The vertical relation showed closed bite (4.5 mm),overjet of 8 mm, mandibular dental midline was deviated towards right side by 2mm. Orthopantomogram (Figure 12)showed full complements of teeth irrespective of third molars. No pathology present.Lateral cephalograms (Figure 3) showed she had orthognathic maxilla (84) and retrognathic mandible (77) with ANB (7), Wits (7mm),beta angle 24 depicting a skeletal Class II jaw bases. Patient had a hypodivergent growth pattern on account of Sn-Go-Gn (25), FMA (21) and Jaraback ratio of 74.4%, IMPA 104° (Table 3).s

Figure 10:Pretreatmentextratraoral photographs

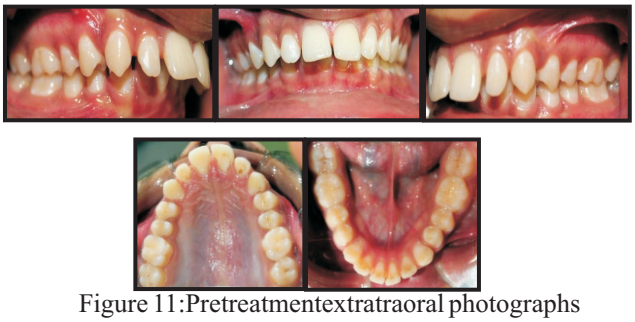

Figure 11:Pretreatmentextratraoral photographs

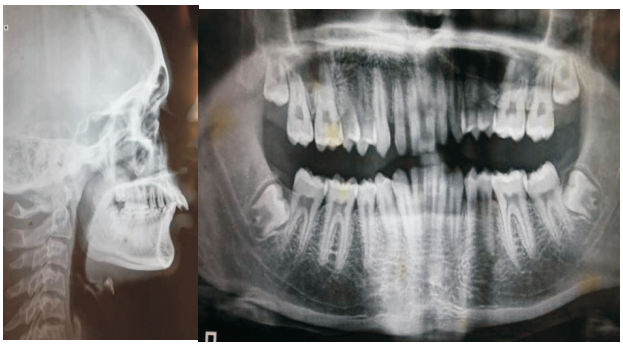

Figure 12: Pretreatment Radiographs

MEASUREMENTS	PRE TREATMENT
SNA	84°
SNB	77°
ANB	7°
Beta Angle	24°
SN-GoGn	25°
FMA	21°
Jarabak ratio	74.4%
1 to NA	5mm
1 to SN	112°
IMPA	104°
Nasolabial Angle	113°
Upper lip to E -Line	2mm
Lower lip to E-Line	-1mm

Table 3: Pre-treatment Cephalometrical Values

Treatment Objectives:

1. To obtain optimum overjet and overbite.
2. To establish Class I molar and canine relation.
3. To obtain skeletal balance.
4. To improve the facial features by obtaining a straight profile with straight divergence, a pleasing smile arc and soft tissue esthetics.

Treatment:

After analysing all diagnostic records, the patient was treated without extractions. As he was in the pre-pubertal growth period, decompensation of the dental arches with leveling and alignment using the straight wire appliance (SWA) 0.022" MBT was done simultaneously. The maxillary and mandibular teeth were bonded and banded with pre-adjusted 0.022" slot MBT prescription brackets. Initial levelling and alignment of maxillary and mandibular arch was done and the arches were aligned using the following sequence of archwires; 0.016 Niti, 17 × 25 Niti, and 19 × 25 Nickel Titanium arch wires. Later 19 × 25 stainless steel archwire (Figure 13) in the lower arch were placed to level and improve the torque of the incisors. Class II elastics were given. After 9 months of treatment, both the arches were leveled and aligned and Forsus appliance was placed. The visual treatment objective (VTO) was positive showing improvement in facial esthetics when Forsus appliance was placed. This phase continued for 10 months. After that short Class II elastics were given. This resulted in correction of Class II malocclusion ad attainment of normaloverjet and overbite. Torque control, Finishing and detailing were carried out and the appliance was debonded. The total treatment time was 21 months.

Figure 13:Mid Treatment Photographs

Figure 14:Forsus fatigue resistant device (FFRD)

Treatment Results:

There was remarkable improvement in the patient's profile and facial esthetics as seen in the post-treatment facial photographs. Facial balance, smile esthetics, and lip positions were improved. Class I molar and canine relationships were established. Overjet and overbite were improved to 2 and 2mm respectively (Figure 15). Cephalometrically the upper incisors were retroclined from 6mm to 4mmin relation to NA perpendicular to point A line and lower incisors were retroclined from to 104º to 102º(IMPA) (Table 4). In the maxillary arch there was extrusion of molar but no significant distalization and the incisors were proclined. There was a counter clockwise rotation of mandible, maxillary growth restriction, and overall improvement of soft tissue profile.

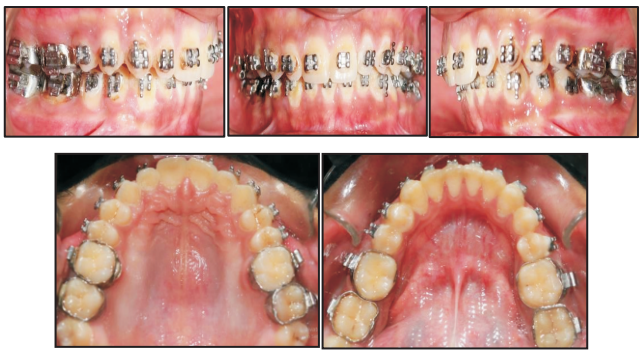

Figure 15:Posttreatment intraoral photographs

Figure 16:Posttreatmentextraoral photographs

Figure 17: Posttreatment radiograph

Table 4: Post-treatment Cephalometrical Values

MEASUREMENTS	PRE TREATMENT	MID TREATMENT	POST TREATMENT
SNA	84 °	84 °	84 °
ANB	7 °	7 °	7 °
Beta Angle	24º	24º	24º
SN-GoGn	25 °	24	24
FMA	21 °	20	21
Jarabak ratio	74.4%	72	73
1 to NA	6mm	5mm	4mm
1 to SN	121º	112	111
IMPA	104 °	102	102
Nasolabial Angle	113 °	112	112
Upper lip to E-Line	2mm	2mm	2mm
Lower lip to E-Line	-1mm	0mm	omm

Comparison of treatment effects of Power Scope and FORSUS appliance was done (Table 5)

Table 5: Comparison of post treatment cephalometric values of Power Scope and Forsus appliance

MEASUREMENTS	POSTTREATMENT(POWER SCOPE)	POSTTREATMENT(FORSUS)
SNA	80 °	84 °
SNB	76 °	77 °
ANB	4 °	7 °
Beta Angle	25º	24º
SN-GoGn	25 °	24
FMA	20 °	20
Jarabak ratio	71.9%	72
1 to NA	4mm	5mm
1 to SN	105º	112
IMPA	102 °	102
Nasolabial Angle	105 °	112
Upper lip to E-Line	-3mm	2mm
Lower lip to E-Line	0mm	0mm

Discussion:

A wide range of orthopedic appliances is available for the correction of class II skeletal and occlusal disharmonies. The main objective is to induce supplementary lengthening of the mandible by stimulating an increase in growth at the condylar cartilage***(Sood et al 2021).*** The functional appliance affects remodeling of the mandibular condyle and glenoid fossa, repositioning of the mandibular condyle, and autorotation of the mandibular bone[1]. Both fixed functional appliances were able to induce significant skeletal and dentoalveolar changes in subjects with Class II malocclusion during the period of active treatment***(Upadhyay M et al 2012).*** The discussion is categorized into five sections: maxillary skeletal, mandibular skeletal, maxillary dental, mandibular dental, and overall effects. The overall treatment effects demonstrated that the Forsus and Powerscope had some amount of restraint of the maxilla[4]. This finding is supported by ***Franchi et al(2023)***who observed that the Forsus had significant restriction on the maxilla[3]. In the overall treatment effects, the Powerscope appliance portrayed a statistically significant increase in mandibular protraction in comparison to the Forsus. This was similar to a study conducted by ***Khumanthem S, Kumar M, Ansari A, Jain A (2021).***There was no significant difference found in Skeletal pattern by both the appliances. The results of our study were in agreement with the results of the study by ***Servello et al.(2021)***[3]Vertical changes, as seen by assessing SN-GoGn, were found to be increased in both groups, respectively. The overall movement of the maxillary dentition was significant in the Forsus and Powerscopepatients. This distal displacement of the upper molar could be due to the greater force placed on the upper molar by the spring of the Powerscope appliance[11]. In both groups, the upper molar crowns moved distally. The upper incisors in both groups were slightly distalized and more upright. Between the Forsus and the Powerscope, the overall mandibular dental treatment effects were statistically significant which is similar to ***Goel et al.(2012)***[5]***. Arora et al. (2023)*** compared the outcomes of the PowerScope and Forsus in the treatment of Class II Div 1 adolescents with late skeletal maturity. They found that the Powerscope group achieved greater forward mandibular molar and incisor movements and more marked dentoalveolar changes than the Forsus group[11]. During the appliance treatment phase, the Powerscope patient had a greater amount of lower incisor proclination in comparison to the Forsus patient. Extrusion of lower incisors and molars was found in the Forsus patient, whereas significant extrusion was found in both incisors and molars in the Powerscope patient which is not in concordance to *Antony* et al.(2023)[13]. When compared within the groups, the results were found to be significant; however, between the groups, the results were not significant. The overall treatment effects show that most of the molar correction in both the Forsus and Powerscope came from skeletal and dental effects. The largest contribution to the skeletal changes came from the mandible in both groups. Vertical changes were seen in both groups, as assessed by SN-GoGn. The results were found to be more in the Powerscope group as compared with the Forsus group. This may be due to increased extrusion of upper and lower molars seen with Powerscope than the Forsus(Singaraju et al. 2022)[12]. Another significant difference was seen in Incisor Mandibular Plane Angle (IMPA) between the two groups. Mandible sagittal advancement (SNB) was not seen but dental protraction was observed which is in favour of Khumanthem et al.(2022)[14]. The maxilla-mandibular skeletal relation (ANB) remained same. Pronounced correction of the overjet was seen which improved the profile and facial aesthetics which is in concordant to Remmiya Mary Varghese(2023)[15]

Conclusion:

Significant amounts of dentoskeletal changes were achieved during the fixed functional appliance treatment. The biggest advantage of this appliance is that being a noncompliance appliance it facilitates fulltime wear by the patient. To conclude, both appliances proved to be good cost-effective appliances in treating Class II skeletal malocclusion. The Power scope has a greater restraint on the maxilla, produces greater forward displacement of the mandible, and may produce greater lower incisor proclination when compared with the Forsus appliance[16].

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