



Unique Journal of Medical and Dental Sciences

Available online: www.ujconline.net

Case Report

SKELETO-DENTAL EFFECTS PRODUCED BY FUNCTION REGULATOR-2 IN A CIRCUM-PUBERTAL CLASS II PATIENT: A CASE REPORT

Rais Ahmed^{1*}, Satinder Pal Singh², Vinay Kumar³

¹MDS, Orthodontics, Junior Resident, Unit of Orthodontics, Oral Health Sciences Centre, PGIMER, Chandigarh, India

²MDS (Orthodontics), DIBO Additional Professor and Head, Unit of Orthodontics, Oral Health Sciences Centre, PGIMER, Chandigarh, India

³MDS, Orthodontics, Senior Resident, Unit of Orthodontics, Oral Health Sciences Centre, PGIMER, Chandigarh, India

Received: 13-07-2015; Revised: 11-08-2015; Accepted: 09-09-2015

*Corresponding Author: **Rais Ahmed**

MDS, Orthodontics, Junior Resident, Unit of Orthodontics, Oral Health Sciences Centre, PGIMER, Chandigarh, 160012

ABSTRACT

Correction of the developing class II malocclusion with skeletal mandibular retrusion of a 9 year old boy, having abnormal perioral musculature and hyperactive mentallis muscle, requires a myofunctional appliance that bears specific indication for such cases. The appliance found to be most suitable for this case was Frankel's function regulator 2. Patient was compliant enough to use the appliance 12-14 hours daily for 15 months. Immediately after FR-2 discontinuation, an anterior inclined bite plate was fabricated and delivered to the patient. The design of appliance and skeleto-dental changes are demonstrated in this case report. As a result of FR-2 therapy, there was significant improvement in patient's profile with overjet reduction and the molar relation was corrected to super class I from the original class II due to increase in effective mandibular length and mandibular advancement. Lower lip trap and lip trap swallow was eliminated due to FR-2 therapy in the present case. With proper case selection and good patient cooperation a significant skeletal, dental and most importantly soft tissue changes were achieved.

Keywords: Function Regulator 2, Abnormal perioral musculature, Skeletal Class II Division 1 malocclusion, mandibular retrusion.

INTRODUCTION

Class II malocclusion with various combination of dental and skeletal components are most common in our day to day orthodontic practice.^{1,2} Growing Class II patients need treatment for their psychosocial well being in early ages so that their maxillo-mandibular growth can be modulated to achieve the desired profile changes. There are many removable or fixed functional appliance reported in literature to correct Class II skeletal malocclusion due to skeletal mandibular retrusion during active growth period (e.g., Activator, Bionator, Clark's Twin block etc). Function Regulator-2 of Rolf Frankel (1967) is the most common myofunctional appliance used to correct the functionally retruded mandible with hyperactive perioral musculature.^{3,4} FR-2 causes significant mandibular growth but no maxillary growth changes in terms of lower anterior facial height, palatal tipping of maxillary incisors, increased IMPA and extrusion of lower molars.⁵⁻¹² Passive transverse expansion of maxillary and mandibular arch has been found in cases treated with function regulator.¹³ Functional Regulator of Frankel is used worldwide as an aid to maturation, training and reprogramming of the orofacial neuromusculature.

The modus operandi of Frankel's function regulator was based on Roux axiom. Frankel emphasized on the importance of soft tissue environment especially the aberrant postural behavior of the orofacial musculature affecting growth and development of skeletal and dental deformations.¹⁴ Frankel believed that growth regulation ability lies in the soft tissue environment thus he made FR to correct the spatial inadequacy of the circumoral capsule which would otherwise restrict the displacement and development of maxilla and mandible. Major effects of FR therapy was passive expansion of dental arches.¹⁵ The present case report highlights the skeleto-dental changes following treatment with Frankel's FR-2 in circum-pubertal boy with functional skeletal mandibular retrusion.

CASE REPORT

A 9 year old circum-pubertal boy with early mixed dentition stage was reported to the Unit of Orthodontics, Oral Health Sciences Centre, Post Graduate Institute of Medical Education and Research, Chandigarh with the chief complaint of forwardly placed upper front teeth. He had normal milestone of growth and development with a past history of treatment with a removable plate for one year. On clinical examination,

he had a leptoprosopic face, convex profile, incompetent lips, hyperactive orbicularis oris and mentallis muscle with lower lip trap and lip trap swallow. (Figure 1A-D)

He had Class II molar relation bilaterally on skeletal Class II base due to mandibular retrusion, normodivergent growth pattern, increased overjet of 14 mm and overbite of 40%. Maxillary arch was symmetrical, V shaped and constricted, GIC restoration # 53, 54, 63 and 64. Mandibular arch was apparently symmetrical, U-shaped with mild crowding in anterior segment and GIC restoration # 74 and 84. (Figure 1E-I)

He had a favorable clinical VTO (Figure 2A, 2B). Functional examination revealed slight chin deviation to right due to functional shift of mandible. Temporomandibular joint was normal.

Panoramic radiograph revealed no gross pathology, dentition in early mixed period with full complement of teeth present except third molars. Cervical vertebrae examination on lateral cephalogram showed that patient was at CS₃ stage (Figure 3A, 3B). Pre-functional and post functional cephalometric readings are given in Table 1.

OBJECTIVES OF TREATMENT

- Correction of functionally retruded mandible
- Transverse expansion of maxillary arch
- Modulation of circumoral and perioral musculature
- To achieve Class II molar and canine relation
- Leveling and alignment of arches
- Normalization of incisor inclinations
- To achieve normal overjet and overbite

TREATMENT PLAN

It was decided to start phase I of treatment with FR-2 appliance followed by maintenance phase with Anterior Inclined Bite Plate in maxillary arch. A second phase of fixed comprehensive orthodontic therapy would be started, after all the deciduous teeth were replaced by their successors, to normalize upper and lower teeth inclinations.

Bite registration was done by single step sagittal mandibular advancement of 9 mm and vertical opening of 2 mm.

TREATMENT PROGRESS

Since the patient reported at an early age with developing class II malocclusion with lip trap and abnormal perioral musculature, so Frankel's FR-2 was chosen to start the treatment (Figure 4A-F). Patient was advised to wear it for 1-2 hr in the beginning then slowly the period of appliance wear was increased. By the end of first month, he started to wear it for 12-14 hrs a day. At the end of 15 months of continuous appliance wear, all the records were repeated and the appliance was discontinued (Figure 5A-I). Immediately a maintenance plate called Anterior Inclined Bite Plate (AIBP) was fabricated and delivered to the patient. He was advised to wear the plate all the time except during meals. Presently patient is on AIBP.

As the patient was still 10 years old so wait and watch strategy was opted till all the deciduous teeth were replaced by their successors. Post functional cephalometric tracings were compared with pre-functional tracing a significant improvement in skeletal class II bases was seen (Table 1 and Figure 6, Figure 7). Molar relation was over-corrected from

Class II to super Class I. Divergence was reduced by 2° and the ratio of UAFH to LAFH was now more towards normal.

Initial 14 mm of overjet was reduced to 5.5 mm at the end of functional therapy. Pre-functional and post-functional model analysis revealed that there was significant increment in transpalatal width of both arches in molar and premolar segment (as shown in Table 1). Maxillary inter-molar width was increased by 7 mm and mandibular inter-molar width was increased by 2 mm.

Significant improvement in abnormal perioral muscle tone and elimination of lip trap occurred with dramatic improvement in lateral profile due to forward posturing of mandible (Figure 6A-B). Lip trap is successfully eliminated and speech has improved. Improvement in esthetic and function were satisfactory. Now he is being followed up with the maintenance plate continued till the start of phase II treatment with fixed orthodontic therapy.

DISCUSSION

Correct timing and choice of treatment for developing class II malocclusion is still a dilemma even after continued research has made significant progress. Majority of class II patients have poorly developed mandible^{16,17,18} and this makes it a clear indication for functional appliance treatment. Redirection of maxilla is not possible with Frankel's FR.^{8,9,13,19} FR induced increment in mandibular growth was supported by many studies^{5,8,10,11,19} while a few studies said that effective mandibular lengthening (Co-Gn) remained same.^{13,20} The present case report shows an increase of 5 mm in effective mandibular length. There was slight decrease in gonial angle²¹ which is in accordance with this case report. No significant change in ANB is reported in previous reports.^{4,5,22} There is significant reduction in ANB,^{9,11,19} and Wits⁹ with FR treatment. This is in accordance with our case report where ANB reduced from 5° to 2° and Wits normalized to 1 mm from 5.5 mm most probably due to spontaneous class II correction as a result of maxillary arch widening due to FR 2 therapy. The change in proportion between maxillary and mandibular effective length were significant thus indicating that all round treatment effect is more evident as compared to any single variable. Statistically no significant decrease was found in FMA, SN-Go-Gn, SN-PP, SN-OP in previous studies^{4,8,23,9,10}, but here in our case, the patient had an originally normodivergent growth pattern which further moved towards more normal as the correction in skeletal pattern occurred. thus indicating an upward and forward rotation of mandible. Significant palatal tipping and a decrease in protrusion of maxillary incisors occurs⁴.

CONCLUSION

The Frankel's FR-2 appliance has shown clinically significant skeletal effect on skeletal Class II malocclusion during circumpubertal growth phase. An increase of 5 mm of effective mandibular length was observed in this case. Success of FR functional therapy depends much on the patient's compliance and on the clinicians skill and accuracy in the whole process of appliance construction. This appliance has some specific indications as abnormal perioral musculature

and hyperactive mentallis activity. Frankel's FR treatment in the present case produced an increase in mandibular body length, a proportionally greater increase in mandibular growth as compared with maxillary growth, a reduction in the overbite and overjet, an improvement in the molar relationship from Class II to Class I, retrusion and palatal tipping of the maxillary incisors, decrease in interlabial gap, elimination of lip trap swallow and a significant improvement in esthetics and soft tissue profile. Apart from improvements in speech and swallowing patterns, which were in learning stage, early class II correction helped in proper psycho-social development of the patient. Overall quality of life and self esteem of the patient has been improved. This functional phase of treatment also simplifies the comprehensive fixed orthodontics phase which would follow after the maintenance phase.

REFERENCES

1. Freeman DC, McNamara JA, Baccetti T, Franchi L, Fränkel C. Long-term treatment effects of the FR-2 appliance of Fränkel. *Am J Orthod Dentofacial Orthop* 2009; 135(5): 570.e1–6; discussion 570–1.
2. Proffit WR, Jr HWF, Sarver DM. *Contemporary Orthodontics*. 5th ed. Elsevier Health Sciences; 2014.
3. Graber TM. *Dentofacial Orthopedics with Functional Appliances*. Mosby; 1997.
4. Janson GRP, Toruño JLA, Martins DR, Henriques JFC, de Freitas MR. Class II treatment effects of the Fränkel appliance. *Eur J Orthod* 2003; 25(3):301–9.
5. TD Creekmore, Radney LJ. Fränkel appliance therapy: Orthopedic or orthodontic? 1983; 83(2): 89–108.
6. Haynes S. Anterior vertical changes in function regulator therapy. *Eur J Orthod* 1983; 5(3): 219–23.
7. Haynes S. A cephalometric study of mandibular changes in modified function regulator (Fränkel) treatment. *Am J Orthod Dentofacial Orthop* 1986; 90(4): 308–20.
8. Righellis EG. Treatment effects of Fränkel, activator and extraoral traction appliances. *Angle Orthod* 1983; 53(2): 107–21.
9. McNamara JA, Bookstein FL, Shaughnessy TG. Skeletal and dental changes following functional regulator therapy on class II patients. *Am J Orthod* 1985; 88(2): 91–110.
10. McNamara JA, Howe RP, Dischinger TG. A comparison of the Herbst and Fränkel appliances in the treatment of Class II malocclusion. *Am J Orthod Dentofacial Orthop* 1990; 98(2): 134–44.

11. Perillo L, Johnston LE, Ferro A. Permanence of skeletal changes after function regulator (FR-2) treatment of patients with retrusive Class II malocclusions. *Am J Orthod Dentofacial Orthop* 1996; 109(2): 132–9.
12. Toth LR, McNamara JA. Treatment effects produced by the twin-block appliance and the FR-2 appliance of Fränkel compared with an untreated Class II sample. *Am J Orthod Dentofacial Orthop* 1999; 116(6): 597–609.
13. Hamilton SD, Sinclair PM, Hamilton RH. A cephalometric, tomographic, and dental cast evaluation of Fränkel therapy. *Am J Orthod Dentofacial Orthop* 1987; 92(5): 427–36.
14. McNamara JA. In Memoriam Rolf Fränkel, 1908-2001. *American Journal of Orthodontics and Dentofacial Orthopedics* 2002; 121(2): 238–9.
15. Fränkel R, Fränkel C. Clinical implication of Roux's concept in orofacial orthopedics. *J Orofac Orthop* 2001; 62(1): 1–21.
16. McNamara JA. Components of class II malocclusion in children 8-10 years of age. *Angle Orthod* 1981; 51(3): 177–202.
17. Karlsen AT. Craniofacial morphology in children with Angle Class II-1 malocclusion with and without deepbite. *Angle Orthod* 1994;64(6):437–46.
18. Sarhan OA, Hashim HA. Dento-skeletal components of class II malocclusions for children with normal and retruded mandibles. *J Clin Pediatr Dent* 1994; 18(2):99–103.
19. Falck F, Fränkel R. Clinical relevance of step-by-step mandibular advancement in the treatment of mandibular retrusion using the Fränkel appliance. *Am J Orthod Dentofacial Orthop* 1989;96(4):333–41.
20. Nelson C, Harkness M, Herbison P. Mandibular changes during functional appliance treatment. *Am J Orthod Dentofacial Orthop* 1993;104(2):153–61.
21. Petrovic A. Auxologic categorization and chronobiologic specification for the choice of appropriate orthodontic treatment. *Am J Orthod Dentofacial Orthop* 1994; 105(2):192–205.
22. Webster T, Harkness M, Herbison P. Associations between changes in selected facial dimensions and the outcome of orthodontic treatment. *Am J Orthod Dentofacial Orthop* 1996; 110(1):46–53.
23. Gianelly AA, Arena SA, Bernstein L. A comparison of Class II treatment changes noted with the light wire, edgewise, and Fränkel appliances. *Am J Orthod* 1984; 86(4): 269–76.

Table 1: Pre-functional and post-functional Skeleto-dental changes achieved with FR-2 appliance

Skeletal Parameters	Parameters	Pre-functional Jan 2014	Post functional May 2015
	SN length (65mm)	62 mm	63.5 mm
	SNA	77.5°	77°
	SNB	72.5°	75°
	ANB (3.12°±1.8°)	5°	2°
	Wits (-0.01mm)	5.5 mm	1 mm
	Maxillary length (44mm)	41 mm	42mm
	Mandibular length (69mm)	63.5 mm	67 mm

	Effective Maxillary length		84 mm	86 mm
	Effective Mandibular length		112 mm	117 mm
	N to A point (-4mm)		-5.5 mm	-6 mm
	N to B point (-10mm)		-17 mm	-13 mm
	N to Pog (-10mm)		-16.5 mm	-12.5 mm
	SN-MP (32±2°)		30°	28°
	SN-MP (32-35°)		39°	36°
	Y Axis (59.62°±3)		65°	62°
	Bjork's Sum (394°)		400°	396°
	Jaraback Ratio (62-65%)		62.6 %	65.7 %
	Gonial Angle (123±7°)		129°	127°
	Upper anterior facial height (46%)		41.3 %	42.7 %
	Lower anterior facial height (54%)		58.7 %	57.3 %
	Dental Parameters	A-Pog (6.04±1.3 mm)		10 mm
NA (4.42±2.05mm)		8 mm	8 mm	
NA (24.02±5.82°)		40.8°	38°	
Palatal Plane (71°)		57°	60°	
SN(103°)		116°	114.5°	
A-Pog (-2 mm to 2 mm)		-1 mm	2.5 mm	
NB (4.4 ± 1.7mm)		2.5 mm	4 mm	
NB (27 ± 4.3°)		15°	20°	
IMPA (99°)		84°	90°	
Inter-incisor Angle (123°)		120°	121°	
Soft tissue parameters	E-line (mm)	Upper lip (-3.6mm)	-1 mm	-3.5 mm
		Lower lip (-1.8 mm)	-1 mm	-0.5 mm
	Nasolabial angle (90° -110°)		101°	103°
	Inter labial gap		5.5 mm	4 mm
	Lip strain		3.5 mm	3 mm
Model analysis	Transpalatal width at 54-64 (14-24)		25 mm	28 mm
	Transpalatal width at 55-65		27.5 mm	33 mm
	Transpalatal width at 16-26		30 mm	37 mm
	Transpalatal width at 74-84		25 mm	26 mm
	Transpalatal width at 75-85		27.5 mm	30 mm
	Transpalatal width at 36-46		31 mm	33 mm

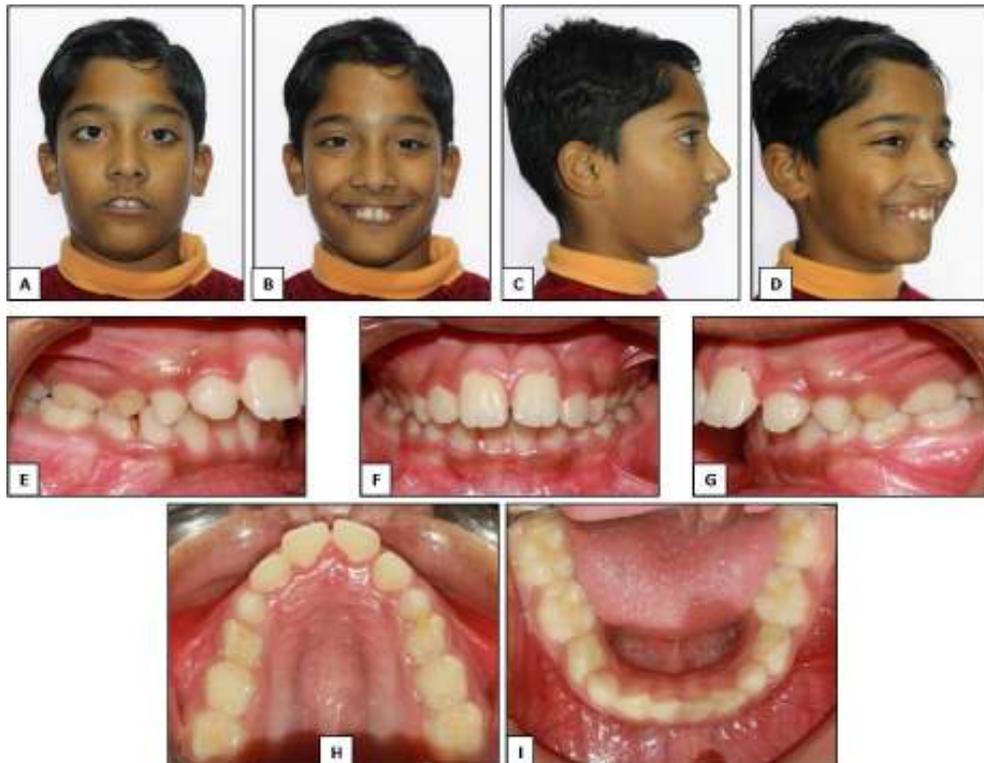


Figure 1: Pre-functional photographs: (A-D) Extra-oral and (E-I) Intra-oral

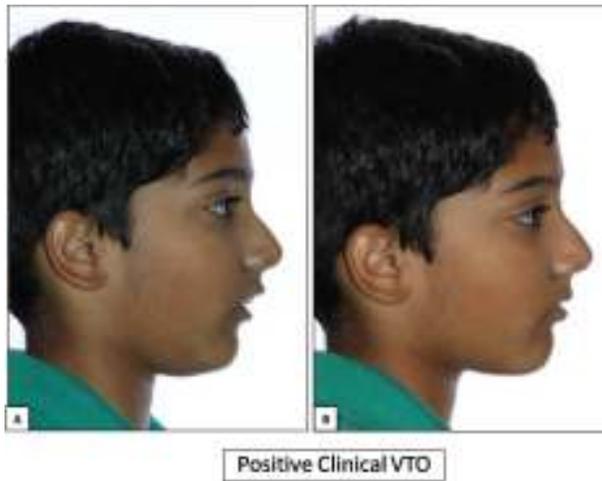


Figure 2: Clinical VTO: (A) At rest; (B) Positive VTO

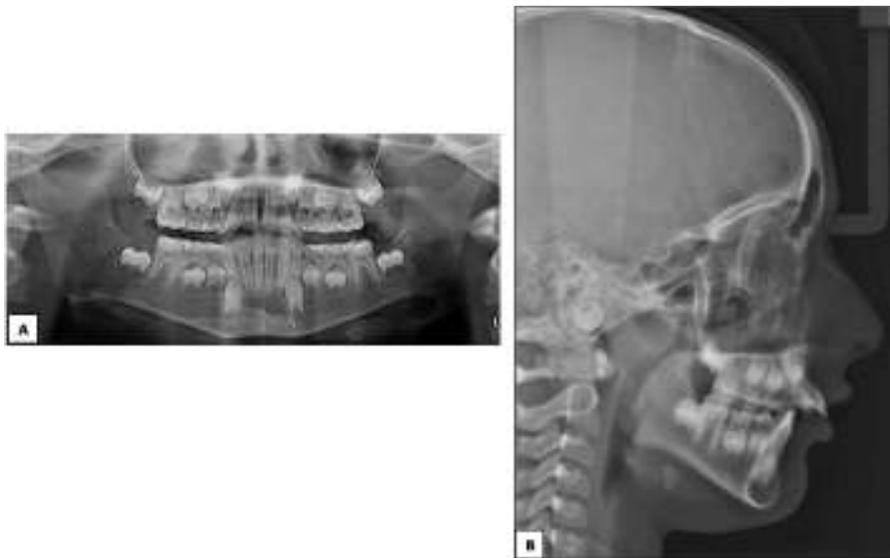


Figure 3: Pre-functional: (A) Panoramic radiograph and (B) Lateral cephalogram

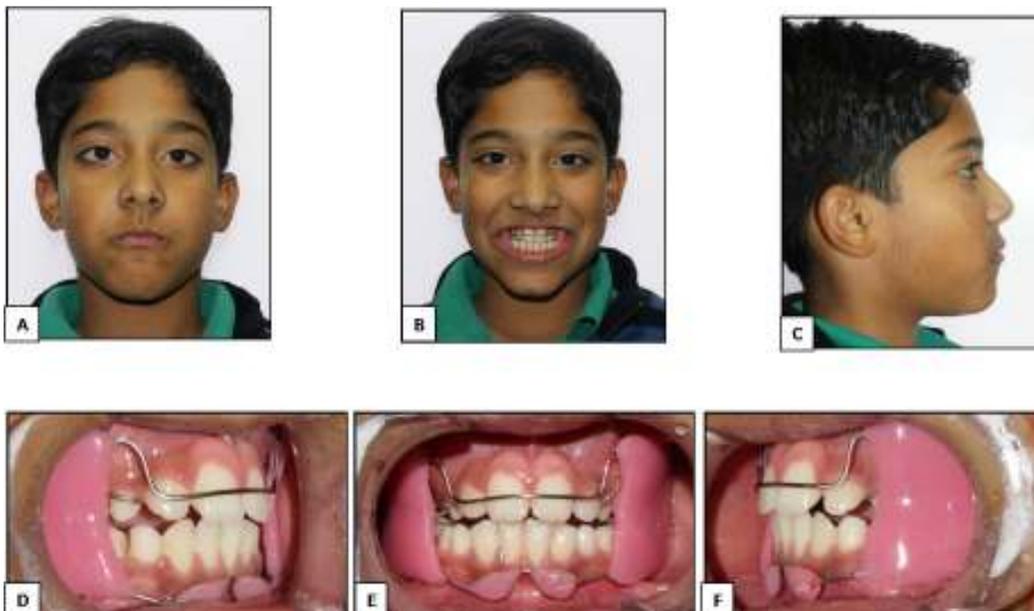


Figure 4: Delivery of FR-2 appliance: (A-C) Extra-oral photographs; (D-F) Intra-oral photographs

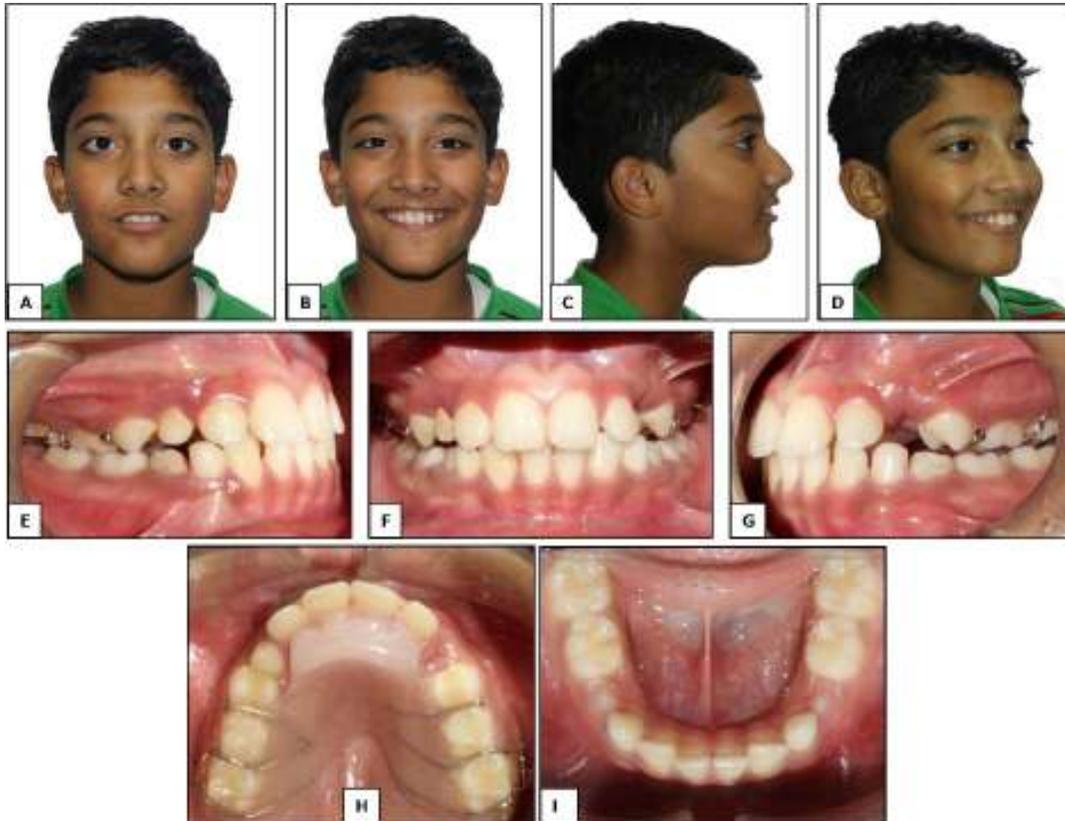


Figure 5: Post-functional photographs: (A-D) Extra-oral and (E-I) Intra-oral with "Anterior inclined bite plate" in maxillary arch during the maintenance phase

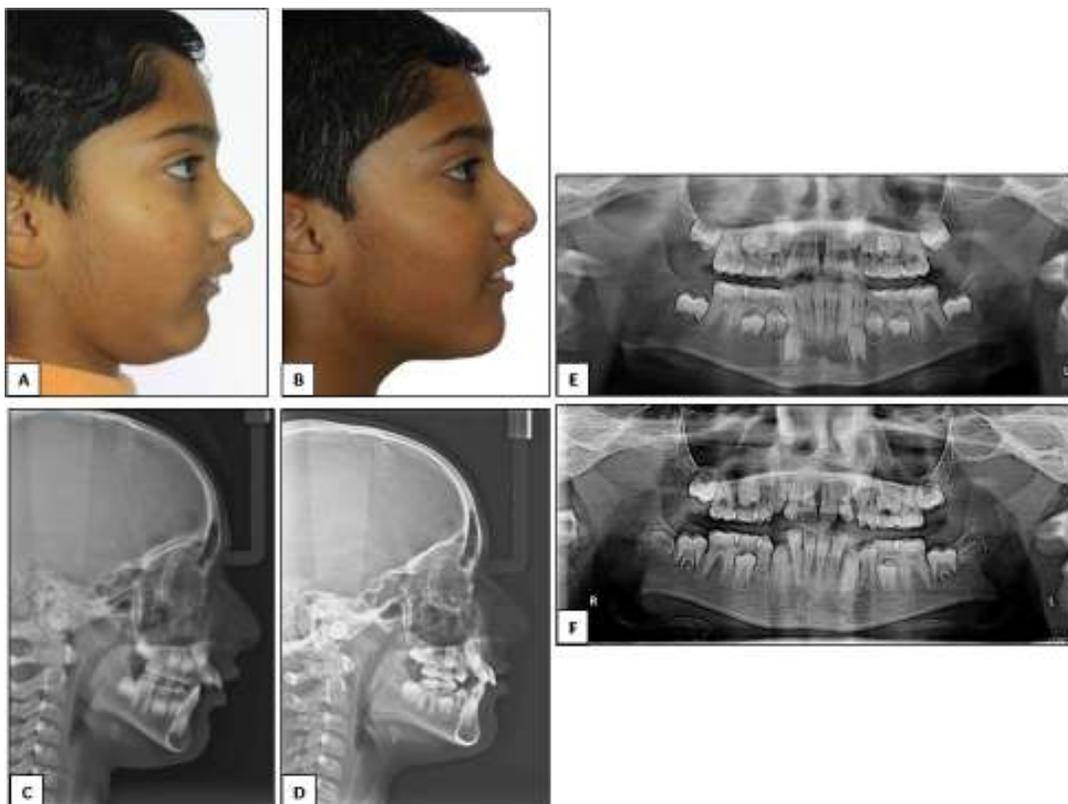


Figure 6: Change in profile, seen photographically and radiographically: (A) Extra-oral pre-functional profile photograph; (B) Extra-oral post-functional profile photograph; (C) Pre-functional lateral cephalogram; (D) Post-functional lateral cephalogram; (E) pre-functional OPG and (F) post-functional OPG

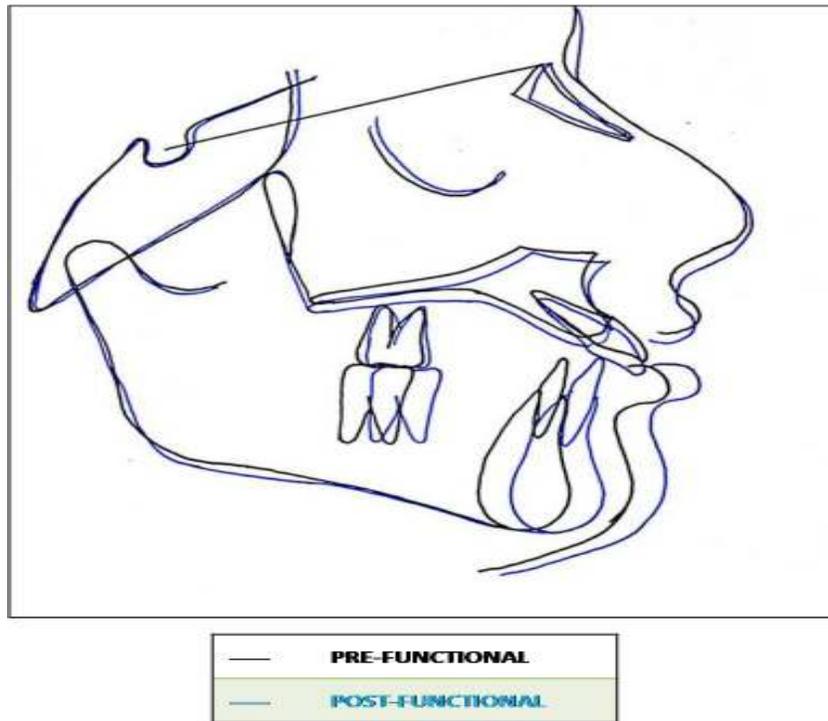


Figure 7: Composite superimposition done on SN plane at Sella (S) showing Pre-functional and post-functional changes

Source of support: Nil, Conflict of interest: None Declared