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Early correction of class II division 1 by the modified fixed lingual mandibular growth modificator

Ahmed Saeed Baattiah[1,*], Ahmad Mohammad Hafez[2], Maher Abd El-Salam Fouda[3]

[1]UG Student, [2]Lecturer, [3]Professor, Dept. of Orthodontics, Faculty of Dentistry, Mansoura University

***Corresponding Author:**
Email: homesick_saudi@hotmail.com

Abstract

Objective: The aim of this study was to assess the skeletal and dental changes of Class II division 1 malocclusion corrected by Modified Fixed Lingual Mandibular Growth Modificator (MFLMGM).

Materials and Method: This study was conducted on a sample of 15 patients, which they presented with CL II division 1 malocclusion. Overjet was ≥ 8mm. Age ranges from 9-12 year. The maxilla was protruded and the mandible was retruded.

Results: The results showed that the maxillary growth was not significantly affected by MFLMGM treatment while the mandible was advanced. The overjet reduction was 7mm, and overbite reduction was 2.2mm. A reduction of 2.9º in ANB was largely due to an increase of 2.3º in SNB, slight non-significant increase in posterior facial height (S-GO) was 1.4mm. The changes in the other vertical skeletal relationships were negligible.

Conclusion: Modified Fixed Lingual Mandibular Growth Modificator (MFLMGM) was successful in treatment cases of severe overjet skeletal Class II division 1 malocclusions. MFLMGM can control degree of severe overjet in treatment of skeletal Class II division 1 malocclusion by Gurin lock. Distal movement of upper molars were an important required in correction of molar relationship.

Keywords: Fixed functional appliances, Class II correction, Mandibular advancement.

Introduction

Most of class II malocclusion accompanied by skeletal discrepancies. The causes of Skeletal class II; could be because of: (1) Maxillary jaw protrusion. (2) Mandibular jaw retrusion. (3) Combination of both. Appliances that are used to modified jaw growth can be broadly divided into headgear and functional appliances.[(1)]

Fixed Lingual Mandibular Growth Modificator (FLMGM) was first introduced by Osama Alali.[(2)] He verified the effectiveness of this appliance in correcting of skeletal Class II division 1 malocclusion in a number of studies.[(3-5)]

The authors of the present study modified the original appliance to treat class II division 1 with combined maxillary protrusion and mandibular retrusion. The sample of Osama Alali was class II division 1 with normal maxilla and retruded mandible.

Wieslander (1984) adding high-pull headgear to the Herbst appliance in the early treatment of severe Class II division 1 malocclusions showed marked maxillary and mandibular changes.[(6)] A functional appliance during the active growth period may solve a mandibular deficiency. Fixed functional appliances with extraoral force can affect both jaws.[(7,8)] Fixed functional appliances are reported to treat Class II skeletal problems by encouraging mandibular growth and by eliciting dentoalveolar effects.[(9-11)]

The aim of this work was to determine the dentoskeletal effect in skeletal patients Class II division 1 malocclusion treated with Modified Fixed Lingual Mandibular Growth Modificator (MFLMGM).

Materials and Method

This study was conducted on a sample of 15 patients seeking orthodontic treatment at the outpatient clinic of the Orthodontic Department, Faculty of Dentistry, Mansoura University.

Criteria of patient's selection

- CL II/1 malocclusion with maxillary protrusion and mandibular retrusion with overjet ≥ 8mm.
- Age ranges from 9-12 year.
- Patients with previous orthodontic treatment were excluded.
- Patients with a good oral hygiene with free of medical history were chosen.

Appliance Design

Maxillary part had the following components:

Fig. 1: **(a) Upper part of modified fixed lingual mandibular growth modificator**
(b) components of upper part: acrylic button (1), headgear tube (2), retention wires (3), advancement loops (4), lab Gurin lock (5), rubber bumper sleeve (6)

1. **Acrylic button:** round shape of acrylic like Nance button, fitted on the anterior part of the palate, away from the gingival margin by 1-2mm. This part of the acrylic allowed the wire elements to connect each other.[8]
2. **Headgear tubes:** solder to the palatal surfaces of the upper molars bands on each side. The retention wires extend posteriorly and pass through the palatal headgear tubes.
3. **Two retention wires:** one in each side. This wire allowed simple sliding which was the extensions of the modified palatal arch lied distal to the helixs. Retention wire were made by 1 mm round stainless steel orthodontic wire. The retention wires extend posteriorly away from the palatal mucosa, and formed on a "U" shaped loop with the coil of the helix at the level of second upper premolar on each side. This gave more flexibility to the appliance. Distal to coils, the wires ran posteriorly and fitted inside the headgear tubes which were soldered to the bands.
4. **Two advancement loops:** embedded in the acrylic button anteriorly and consist of two long "U" shaped loops with small protection coils. These two loops extend vertically toward the mandible. The inclination degree of this loops was 90 ◦ to the modified palatal arch.
5. **Arch wire stop (Gurin lock):** for prevention of wire movement and to select the amount of activation.
6. **Rubber sleeve:** Inserted in the ends of the retention wires to protect the tissue from the irritation.
7. **High pull headgear:** was fitted to every patient with safety modules to transmit distal and vertical force to the appliance.

Fig. 2: (c) High pull headgear (d) components of high pull headgear: facebow(1), High pull headgear strap(2), Safety modules(3)

Mandibular part:

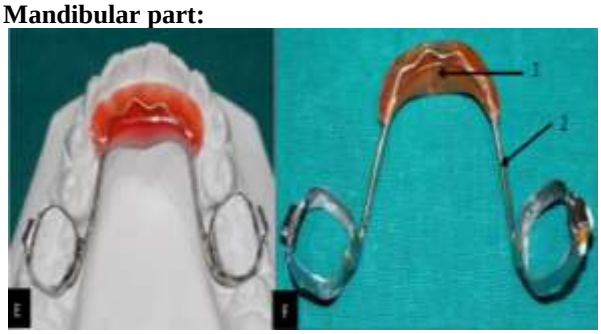

Fig. 3: (e) lower part of modified fixed lingual mandibular growth modificator.
(f) component of mandibular part: Inclined guiding plane(1),lingual arch(2).

The mandibular appliance was a made of lingual arch wire 1.0mm hard stainless steel wire soldered to the lingual surfaces of the first molar bands. It included an inclined guiding plane, which made by acrylic. The inclination of finished surface of the acrylic was not too steep to avoid disengagement of the "U" shaped loops of the modified palatal arch.

Treatment method: Bands were selected and placed in position on the upper and lower first molars. Upper and lower good silicon rubber base impressions were taken with the bands on the molars. Fig. 4.

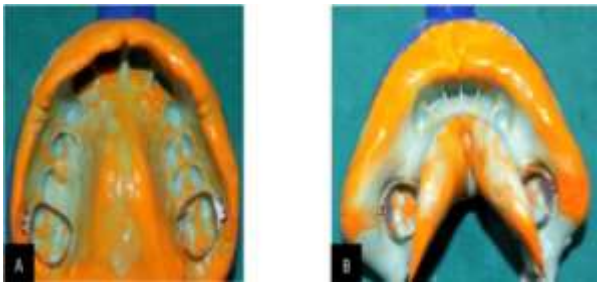

Fig. 4: Upper and lower silicon rubber base impression with selected band placed in position (a and b)

Band were removed from the mouth and seated accurately in the impression. Construction bite was unnecessary as the bite was taken in centric position to articulate the working casts. The casts were used to fabricate the appliance on them. The appliance was constructed in such a way that the "U" shaped loops (Advancement loops) touch the lower anterior acrylic (Fig. 5).

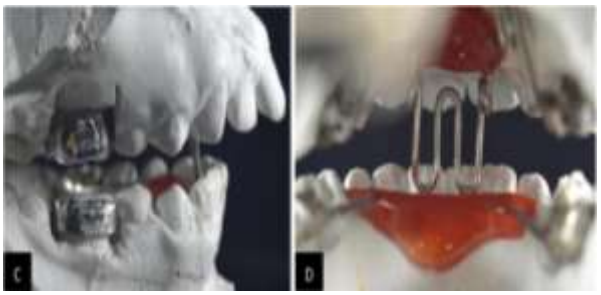

Fig. 5: Advancement loops contacts the anterior part of lower inclined plane (c) lateral view (d) lingual view

When the appliance was fitted and the patient in the rest position, there was dropping of the mandible of the patient. For the patient to get bite of comfort, he had to protrude the mandible.

Subsequently, the appliance placed in situ and cemented (Fig 6).

Fig. 6: Modified Fixed Lingual Mandibular Growth Modificator, upper part (e), lower part (f)

This is the first step of activation, when the patient needed to close his mouth he advanced his lower jaw until the advancement loops placed positioned distal to the lower inclined guiding plane. The Width of lower inclined plane was approximately 5mm. if the patient overjet was 12mm, by the first step of activation it will was reduced to 5mm Fig. 7.

Fig. 7: First step of activation (g) Lateral View (h) Lingual View

The duration of the first step was 4-5 months, but follow up was taken place to check the appliance every 3 weeks. The wearing of the high pull headgear started after the first month by a force of 350gm, then increased gradually until 500mg (Fig. 8).

Fig. 8: Headgear force (i) force 350gm (j) force 500gm

The Second step of the activation was done with gurin lock by moving the modified palatal arch 2mm anteriorly, and close the gurin lock. The distal part of the modified palatal arch was covered by cover by rubber sleeve to protect soft tissue (Fig. 6 E). Subsequently the appliance was activated 2mm every 6 weeks until the overjet was corrected (Fig. 9).

Fig. 9: Overjet corrected (k) right view (l) left view (m) frontal view

The appliance left in passively 6 months place for retention after the overjet corrected. After 6 months removable retention was used at night only (Fig. 10).

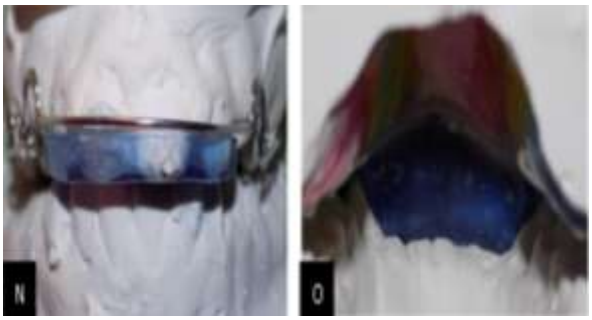

Fig. 10: Retainer; frontal view(n); lingual view(o)

Fig. 11: Pretreatment facial and intraoral photographs

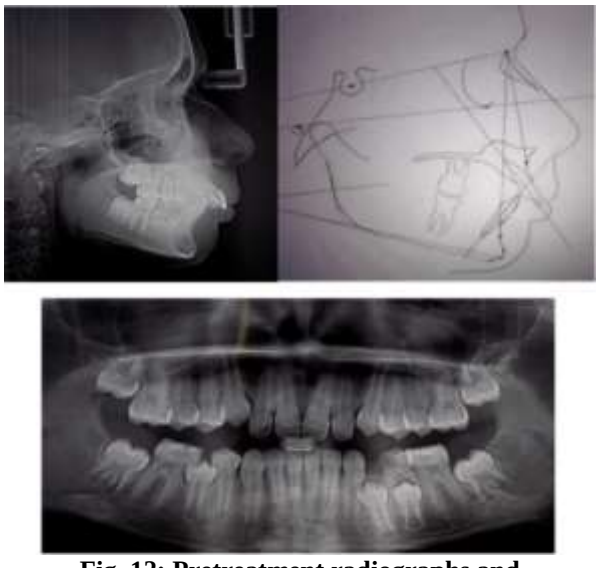

Fig. 12: Pretreatment radiographs and cephalometric

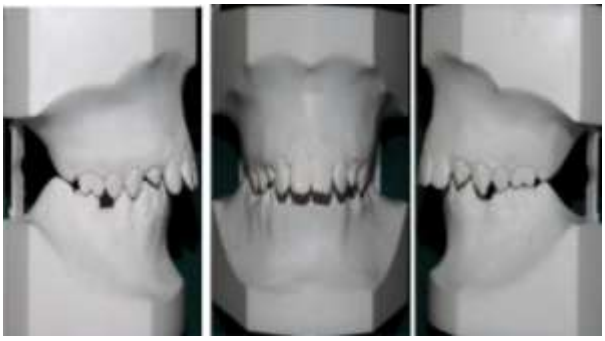

Fig. 13: Pretreatment study cast

Fig. 14: Post treatment facial and intraoral photos

Fig. 15: Post treatment study cast

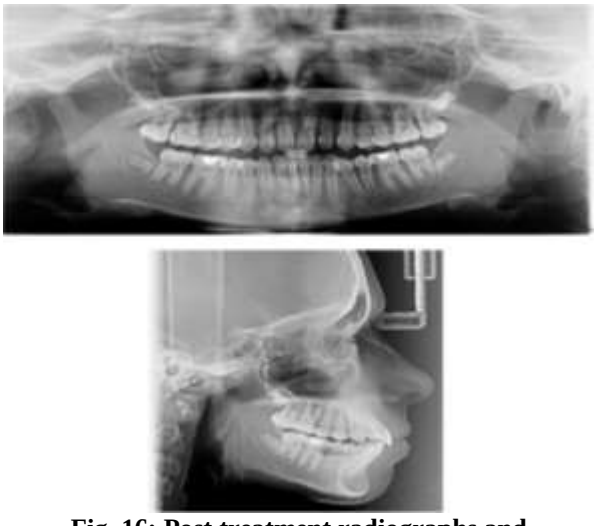

Fig. 16: Post treatment radiographs and cephalometric

Results

Table 1: Skeletal anteroposterior

Parameters	N=15	
Age (Years) Mean±SD	10.27±0.79	
Sex	**N**	**%**
Male	9	60.0
Female	6	40.0

Measurement	Pre-treatment	Post-treatment	Test of significance	P value
SNA (Degree)	84.25±3.7	83.72±3.5	T= 1.14	0.27
SNB (Degree)	75.96±3.3	78.37±3.11	T= 4.65	<0.001**
ANB (Degree)	8.35 (3.44, 12.81)	5.26 (0.83, 8.47)	Z= 3.35	<0.001*

p: p value for paired t-test **p value high statistically significant
* p value significant if <0.05 t: Paired t test z:Wilcoxon Signed rank

Table 1 showed SNA was reduced according to P= 0.27, SNB was increased (p=0.001) and ANB decreased (p=0.001). The increased of SNB and the decreased of ANB were significant.

Table 2: Skeletal vertical

Measurement	Pre treatment	Post treatment	test of significance	P value
FMA (degree)	27.95±5.01	28.54±5.3	t=1.46	0.17
SN/PP (degree)	6.36 (0.42,11.17)	5.97 (0.89,10.87)	z=0.37	0.71
SN/MP (degree)	38.27±6.12	38.93±6.2	t=1.27	0.22
PP/MP (degree)	32.72±7.04	32.96±7.4	t=0.46	0.66
N-ME (mm)	107.8±6.6	107.23±5.45	t=0.72	0.48
S-GO (mm)	63.93±6.03	65.23±5.1	t=1.44	0.172
ANS-ME (mm)	63.53±4.6	63.45±3.9	t=0.135	0.89

FMA(Frankfort Mandibular Plane Angle), N-ME(Anterior facial height), S-GO(Posterior facial height), ANS-ME(Lower facial height).

Table 2 showed a non-statistically changes in all skeletal vertical measurements after treatment. FMA, SN/PP, SN/MP, PP/MP and S-GO was increased according to (p=0.17), (p=0.47), (p=0.22), (p=0.66) and (p=0.172) respectively. In contrast; N-ME, ANS-ME was equal according to (p=0.48), (p=0.89) respectively.

Table 3: Dentoalveolar

Measurement	Pre treatment	Post treatment	Test of significance	P value
U1-SN (degree)	109.70 + 7.37	111.80 + 6.27	- 0.990	0.339
L1-MB (degree)	98.10 + 8.84	94.20 + 9.64	2.04	0.060
Interincisal (degree)	111.76 + 8.26	114.90 + 10.87	- 1.130	0.277
U1-PP (mm)	27.53 + 3.50	27.80 + 1.43	- 0.288	0.778
L1-MP (mm)	37.53 + 3.04	37.20 + 2.40	0.455	0.656
U6-PP (mm)	19.66 + 1.48	19.93 +1.44	- 1.169	0.262
L6-MP (mm)	26.50 + 2.70	26.50 + 2.84	0.000	1.000
U6MB 1 VR (mm)	24.56 + 3.54	22.73 + 3.41	3.40	0.004**
L6MB 1 VR (mm)	21.20 + 4.26	23.50 + 5.74	- 3.29	0.005**

*Vertical reference plane (VR): a perpendicular line was drawn to the SN plane from the intersection of the anterior wall of sella turcica and the anterior clinoid processes, structures that do not move with growth changes.
*U6MB 1VR (The perpendicular distance between VR and mesiobuccal cusp of maxillary first molar.

Table 3 showed L1-MB(degree), L1-MP(mm) and U6MB 1 VR was reduced according to (p=0.06), (p=0.656), (p=0.004) respectively. However, U1-SN, Interincisal angle, U1-PP, U6-PP And L6MB1 VR was increased according to (p=0.339), (p=0.277), (p=0.778), (p=0.262) and (p=0.005) respectively. L6-MP was equal result pre

and after treatment (p=1). The decreased of U5MB 1 VR and the increased of L6MB 1 VR were high statistically significant.

Table 4: Cast

Measurement	Pre treatment	Post treatment	test of significance	P value
Overjet (mm)	9.5±1.6	2.42±1.1	t=20.97	<0.001**
Overbite (mm)	3.0 (1.0-7.0)	1.0 (0.0-3.0)	z=2.9	0.004**
U1CW (mm)	31.3±2.76	33.65±2.98	t=4.06	0.001**
L1CW (mm)	26.63±1.98	26.22±1.7	t=1.22	0.25
U1MW (mm)	43.72±2.7	42.6±2.72	t=3.6	0.003**
L1MW (mm)	39.17±2.26	39.35±2.25	t=0.89	0.386

*Canine width (U1CW) the distance between upper canines, (L1CW) the distance between lower canines. *Molar width (U1MW) the distance between upper first molars, (L1MW) the distance between lower first molars.

Table 4 showed overjet, overbite, L1CW and U1MW was reduced according to (p<0.001), (p=0.002), (p=0.25) and (p=0.003) respectively. In contrast; U1CW and L1MW was increased according to (p=0.001) and (p=0.386) respectively. The increased of U1CW and the decreased of overjet, overbite, and U1MW were high statistically significant.

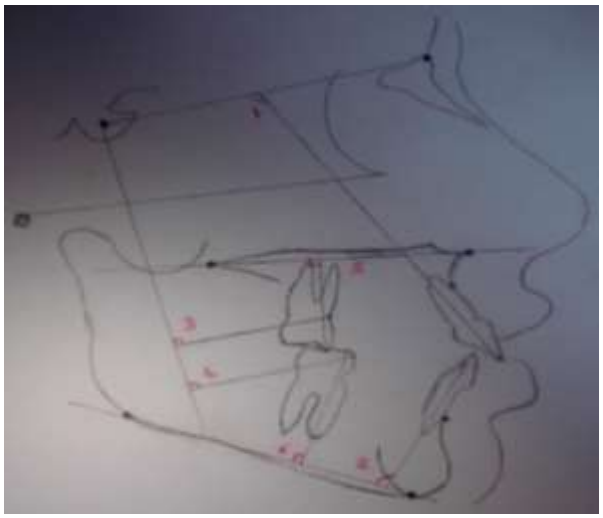

Fig. 17: Cephalometric linear measurements

1. **U1/SN Angle**
2. **L1/MP Angle**
3. **U6MB 1VR(mm)**
4. **L6MB 1VR(mm)**
5. **U6-PP(mm)**
6. **L6-MP(mm)**

Discussion

The Modified Fixed Lingual Mandibular Growth Modificator (MFLMGM) gave successful effect and it was efficient in the treatment of severe cases of skeletal class II division 1 malocclusion.in this study, the appliance attempted to stimulate mandibular growth within 1 year of treatment. At the end of this period, the overjet was completely decreased, the overbite also decreased and the patient accepted the facial profile.

At the first month of treatment by MFLMGM which was the critical time of treatment, because patients feel uncomfortable. They had to change their occlusion to the new forward position and needed time to be accommodate to the advancement loops. Accordingly, patients instructed the to keep their mouths closed as long as possible. When the patients closed their mouths the advancement loops was positioned behind the inclined plane (Fig. 7 H). Patients started wearing the high pull headgear when they feel adapted to the appliance and this took one to two months.

Changes in skeletal anteroposterior measurements: There are some changes in anteroposterior measurements. ANB angle decreased from 8.29° to 5.34°, this leading to skeletal change happened by MFLMGM. SNA angle decreased 0.5 ° by using high pull headgear. SNB angle increased by 2.4°. The increased of SNB and the decreased of ANB were significant.

Changes in skeletal vertical measurements: Regarding to the vertical dimension; this study treated by MFLMGM was resulted increased in most vertical measurements, they could be referred to the increase in ramus height by remodeling of the condylar bone growth and gonial angle may also rotation of mandible in clockwise rotation. Increased in posterior facial height and rotation of the mandibular line has been commonly reported with functional treatment.

Changes in dentoalveolar measurements: Most of cases in this study was severe overjet skeletal class II division 1 malocclusion. The angle between upper incisors and to cranial base was increased due to force generated from the tongue.

The up righting of the lower incisors was favorable and accounted for the increased Interincisal angle. This can be attributed to two causes: (1) there is no mesial force acting on the lower teeth, because the inclined guiding plane does not contact the lower anteriors. (2) There is mechanism of muscular equilibrium breaking between the tongue and lips. Distal movement of upper

first molars was expected the load of the functional appliance mostly transmitted through the upper molars. Also, the force which generating from the headgear effect aids to occurs the distal movement of upper molars. Mesial movement of lower molars due to mandibular advancement.

Changes in cast measurements: The present study showed a highly significant reduction in the overjet and overbite. The overjet was corrected by mandibular advancement (forward growth of the mandible), the overbite was reduced due to combined effect downward and backward rotation of the mandible and increased in mandibular ramus height. The increased in upper canines width and decreased in upper molars width were high statistically significant.

Conclusion

Modified Fixed Lingual Mandibular Growth Modificator (MFLMGM) has some advantages in addition to some benefits of FLMGM which mentioned Osama alali in some studies,[2-5] that are:

1. Treat Maxillary protrusion and Mandibular retrusion.
2. Can be control degree of severe overjet in treatment of skeletal Class II malocclusion by Gurin lock.
3. No need for construction bite. Take patient bite in normal occlusion, because lab technician always put upper advancement loop in the anterior part of lower inclined guiding plane.

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