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Evaluation of Electromyographic Activity Concomitant to Class II Correction Using Carrier Distalizer Appliance

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ABSTRACT

Purpose: To assess the electromyographic activity of oral muscles concomitant to Class II malocclusion correction using Carrier Distalizer appliance. **Materials and Methods:** 10 female patients with age ranged between (18-21) years old were selected for this study. All patients were examined to fulfill the inclusion criteria. All patients in this study underwent radiographic evaluation (panoramic and lateral cephalometric) and electromyographic evaluation before and after Class II correction using Carrier Distalizer appliance. Study duration for patients was six months. **Results:** The result of this study showed that no significant changes occurred in skeletal measurements except increase angle of convexity. Regarding electromyographic measurements there is statistically significant increase in masseter muscle activity at rest and at occlusion after treatment. And about the dentoalveolar changes including slight maxillary molar distalization, in addition to mesialization of the lower molars and proclination of the lower incisors. **Conclusion:** It was concluded that Carrière Distalizer appliance was able to correct Class II molar relation into Class I relation in adult patients with masseter and temporalis muscles activity were improved after treatment.

KEYWORDS

Carrière Distalizer appliance, Electromyographic activity, Distalization.

INTRODUCTION

Class II malocclusion is one of the most frequent treatment problems facing orthodontists, representing nearly one third of all malocclusion [(1)]. Functional or orthopedic appliance has been used to treat the malocclusions caused by skeletal factor. However, if the problem is dento-alveolar, several treatment options have been attempted such as extraction, at least, in one of the dental arches, dental arch Expansion, use of intramaxillary elastics or distalizing the first maxillary molar without extraction [(1)].

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Distalization is indicated then there is moderate dental or skeletal protrusion of the upper arch, mild to moderate crowding and or when the extraction decision would highly jeopardize the facial esthetics [1]. Distalization can be accomplished through the use of either extra oral (mainly headgear) or intraoral appliances. The major disadvantage of extra oral appliances is either unpleasant look or dependence on patient compliance making them a less favorable choice for the clinician as well as for the patient [2].

There are a variety of intraoral appliances available, such as the Pendulum[3], Distal Jet[4], Jones Jig[5], First Class[6] and Keles Slider [7] used for distalization and not depending on the patient's compliance. However, with most of these appliances, there is always loss of lower anterior anchorage as reported in a systematic review [8]. Mesial movement and lower incisors tipping along with mesial movement to the premolars have been reported. Temporary anchorage devices (TAD) have been used to limit this mesial movement and thus reinforcing the anchorage [9].

Carrier distalizer appliance was first introduced in 2004, to change Class II canine-molar relation into a Class I canine-molar relation by uprighting and rotating first maxillary molar and performing distalization to the whole posterior segment from the maxillary canine to the first maxillary molar before brackets or any other appliances are placed[10].

A reported case where an eleven years old male with a Class II subdivision malocclusion. A nonextraction treatment plan was designed where the Carrière Distalizer appliance was used. After 11 months of the first stage of treatment, a Class I canine-molar relationship had been performed and adequate space has been created for the impacted canine [11].

Another reported case where a twenty-seven years old male was presented with a class II subdivision malocclusion. A two-phase treatment plan was also designed in which a unilateral Carrière Distalizer appliance would be used on the left side initially to correct the class II canine-molar relationship but in second phase consisted of Invisalign therapy. After six months of first stage, a class I canine-molar relationship had been performed [12].

Case reported where a male with fourteen years old presented with a class II on the right, midline deviation with crowding in the upper and lower anterior regions. A two-phase treatment plan was designed in which Carrière Distalizer appliance was used in both sides as a first phase treatment and the second phase consisted of Invisalign therapy. After four months, full class I relationship have been achieved [13].

Another study presented a reported case of an old man with twenty-three years old with a brachyfacial pattern and bimaxillary retrusive profile which is a characteristic feature of Class II, division 2 malocclusion. Carrière Distalizer appliance used as a first phase treatment then Class I canine-molar relationship was performed in five months [14].

A conducted retrospective study was to compare the patients experience with the Carrière Distalizer appliance with patient experience with the Forsus Fatigue Resistance Device. Results showed that the overall experience with Carrière Distalizer appliance group was much better than that with Forsus Fatigue Resistance Device group [15].

Another retrospective study, to compare treatment effects of Carrière Distalizer appliance with another two different types of mandibular anchorage, was conducted. Full fixed orthodontic appliance was compared versus lingual arch. The results showed that successful correction of Class II malocclusion was achieved with the Carrière Distalizer appliance in both groups, with minimal molar tipping. However, adverse effects common with Class II elastics accompanied the correction at variable rates in the groups [16].

Electromyographic activity of the masseter and temporalis muscles, before and after functional

orthopedics was studied. The results showed increased EMG activity of the masseter and temporalis muscles in postural conditions of mandible and molar bite force after 12 months of treatment. In addition, the patient had lack of pain symptoms as well as an improvement in the balance of the mastication muscles, as demonstrated by EMG activity and maximum molar bite force [17].

SUBJECTS AND METHODS

The present study was conducted on 10 female patients' ages 18-21 years old. These patients selected from those attending the outpatient clinic, Department of Orthodontics, Faculty of Dental Medicine for Girls, Al-Azhar University. All procedures were explained for all patients, informed written consents were signed by them before commencing the study work.

Criteria of selection of the participants was fulfilled

Patient Preparation

All subjects included in this study were subjected to the following records before and after treatment:

Extra-oral photograph, Intra-oral photograph, Impression of upper and lower arches to prepare orthodontic study, panoramic radiograph, Lateral cephalometric radiograph and electromyographic records for masster and temporalis muscles.

Inclusion criteria: age range was 18-21 years old, females, had angle class II malocclusion, Overjet was > 5mm, The posterior maxillary segment from the canine to maxillary second molar should be well aligned or at least on the same plane, the patient must have good oral hygiene and should comply with instructional motivation to provide a reasonable prognosis.

Exclusion criteria: Patients with a history of orthodontic treatment or any systemic diseases that affect craniofacial growth.

Operative procedures:

Maxillary arch preparation: patients were referred to the surgery department, Faculty of Dental Medicine for Girls, Al-Azhar University, for extraction of maxillary wisdom teeth to facilitate distalization.

Carrière Distalizer appliance placement: For selecting the correct length, the supplied ruler was used. A measurement was taken from the midpoint of buccal surface of maxillary first molar to the midpoint of labial surface of the maxillary canine. The labial surface of the maxillary canines and buccal surface of maxillary first molars were first polished using a low speed polishing brush. They were then deproteinized with 5.25% sodium hypochlorite (NaOCl) for 1 minute followed by rinsing and then drying. This was done in order to increasing the bond strength [18]. The enamel surfaces were subsequently etched by using 37% phosphoric acid for 30 seconds, rinsed and dried. The bonding agent was then applied. The carrier distalizer appliance was first adjusted and seated on the buccal surface of maxillary first molars followed by adjustment and seating on the labial surface of the maxillary canine. It was then bonded using light cure composite.

Mandibular arch preparation:

During the first visit after bonding of the carrier Distalizer appliance, elastic separators were placed between first and second mandibular molars bilaterally and placing another elastic separator between second and third mandibular molar if found as a preparation before selection of suitable bands for fabrication of passive lingual arch.

Passive lingual arch:

Separators were removed a week later, to place the lower second molar bands. The size of the bands was carefully chosen. An alginate impression was then taken for the lower arch with lower bands in place. Then bands were removed from the teeth

and placed in their imprint in the impression and secured in their place by sticky wax. Passive lingual arch was fabricated on the poured model using 1mm of a round stainless steel wire and soldered on lingual surface of the two bands. After complete isolation and dryness, passive lingual arch was cemented on mandibular second permanent molars using glass ionomer cement to avoid labial flaring lower incisors. A cast was then poured into hard stone. The base was trimmed in order to have a very thin model and any anomalies were removed. The appliance was then checked for retention inside the patient's mouth.

Postoperative:

Class II elastics were attached to the hook presented in the Carrière Distalizer appliance bonded to maxillary canine to hook mandibular second molar band of passive lingual arch bilaterally. During the first month 1/4 heavy elastics were used. The following months 3/16 heavy elastics were used[10]. The patients were instructed to wear the elastics twenty-four hours daily except during mealtime and to change them daily.

Follow up period:

All the patients were asked to attend to their follow up session every 4 weeks in order to check for the following: Compliance of the patient, Integrity of the Carriere Distalizer appliance and the passive lingual arch and amount of correction achieved. If failure of bonding to either Carriere distalizer appliance or passive lingual arch took place, they were bonded immediately. The number of failure was noted down. In order to ensure patients' compliance, a similar technique was used previously to encourage their compliance [19]. The participants were instructed to wear the intermaxillary Class II elastics, and warned that otherwise extraction of the first premolars would take place. In order to assess the degree of compliance, each participant was given an empty plastic bag and instructed to insert all used elastics in the bag. Each participant was instructed to bring bag with her to the recall visit and the number of the used elastics was counted and compared with the number of days between the appointments.

Appliance removal:

The appliance was removed after either reaching a class I canine-molar or a super class I canine-molar relationships.

Figure (1) Preoperative intraoral view

Figure (2) Postdistalization intraoral view

Figure (3) Postoperative intraoral view

RESULTS

All the results indicated that the error of method of angular measurements were varied between 0.12 and 0.39 and for the linear measurements were between 0.16 and 0.57 [16]. By using of the Carrière Distalizer appliance, Class I canine-molar relationships were performed in all of the patients in a mean of 6 months. Tables (1&2) show the treatment changes that achieved skeletally as a result of distalization stage, where no significant changes occur. Table (3) shows dentoalveolar changes including slight maxillary molar distalization, in addition to mesialization were occurred to the lower molars and proclination of the lower incisors which results in correction of Class II malocclusion.

Table (1): *Skeletal angular measurements pre and post value, Mean and standard deviation of difference and significance of paired t test.*

		Mean	Std. Dev.	Std. Error Mean	Mean difference	Std. Dev. Of Difference	T test	P Test
1) SNA	Pre	78.89	2.42	.81	.222	1.481	.450	.665 NS
	Post	78.67	2.69	.90				
2) SNB	Pre	74.67	1.80	.60	-.444	2.242	-.595	.569 NS
	Post	75.11	2.37	.79				
3) ANB	Pre	4.22	2.05	.68	.222	1.394	.478	.645 NS
	Post	4.00	1.80	.60				
4) Articular angle	Pre	145.44	6.86	2.29	.667	3.391	.590	.572 NS
	Post	144.78	5.49	1.83				
5) Facial angle	Pre	83.56	3.17	1.06	-1.333	3.742	-1.07	.316 NS
	Post	84.89	1.83	.61				

Table (2): *Skeletal linear measurements pre and post value, Mean and standard deviation of difference and significance of paired t test.*

		Mean	Std. Dev.	Std. Error Mean	Mean difference	Std. Dev. of Difference	t test	p test
1) UAFH	Pre	49.11	3.82	1.27	2.44	4.22	1.74	.12 NS
	Post	46.67	5.10	1.70				
2) LAFH	Pre	64.78	7.40	2.47	1.33	3.12	1.28	.24 NS
	Post	63.44	6.71	2.24				
3) TAFH	Pre	113.78	9.36	3.12	5.67	7.58	2.24	.06 NS
	Post	108.11	10.55	3.52				
4) PFH	Pre	70.00	6.02	2.01	2.22	4.89	1.36	.21 NS
	Post	67.78	5.63	1.88				
5) Corpus length	Pre	53.78	5.91	1.97	-.44	4.75	-.28	.79 NS
	Post	54.22	4.47	1.49				
6) Ramus height	Pre	67.78	2.59	.86	.56	3.64	.46	.66 NS
	Post	67.22	4.24	1.41				
7) Total mandibular length	Pre	106.44	6.04	2.01	2.00	6.87	.87	.41 NS
	Post	104.44	6.29	2.10				

*Significance level p<0.05, *significant, NS=non-significant. N=9.*

Table (3): *Dental measurements pre and post value, Mean and standard deviation of difference and significance of paired t test*

		Mean	Std. Dev.	Std. Error Mean	Mean difference	Std. Dev. of Difference	T Test	p test
1) U1 - SN angle	Pre	105.89	6.01	2.00	27.22	7.22	11.30	.00*
	Post	78.67	2.69	.90				
2) U1 – NA angle	Pre	28.33	8.82	2.94	4.33	5.45	2.38	.04*
	Post	24.00	9.64	3.21				
3) U1 – NA mm	Pre	7.67	2.45	.82	1.11	1.96	1.70	.13 NS
	Post	6.56	2.65	.88				
4) L1-SN angle	Pre	42.22	8.09	2.70	4.56	6.09	2.25	.05 NS
	Post	37.67	10.70	3.57				
5) L1-NB angle	Pre	32.78	6.96	2.32	-4.33	3.67	-3.54	.01*
	Post	37.11	8.59	2.86				
6) L1-NB mm	Pre	7.11	2.42	.81	-1.33	1.32	-3.02	.02*
	Post	8.44	3.00	1.00				
7) U6-NA mm	Pre	18.33	2.60	.87	-3.44	2.19	2.61	.018*
	Post	21.78	3.27	1.09				
8) L6-NB mm	Pre	16.67	1.97	1.32	2.78	1.77	3.28	.004*
	Post	13.89	1.82	1.27				
9) U1-L1 Angle	Pre	117.22	11.04	3.68	2.44	7.07	1.04	.33 NS
	Post	114.78	11.88	3.96				
10) Overjet mm	Pre	5.50	.71	.24	2.50	2.00	3.75	.01*
	Post	3.00	1.28	.53				
11) Overbite Mm	Pre	4.22	2.28	.76	1.11	2.03	1.64	.14 NS
	Post	3.11	1.82	.84				

Significance level p<0.05, significant, NS=non-significant. N=9.*

Table (4&5) show electromyographic records changes occurred after using Carrière Distalizer appliance, where significant change for masseter muscle (figure 4); at rest and at occlusion, a higher mean value was recorded post-treatment in comparison to pre-treatment and for temporalis muscle (figure 5); at rest, a higher mean value was recorded post-treatment in comparison to pre-treatment, but this difference was not statistically significant (p=0.87) and at occlusion, a higher mean value was recorded pre-treatment in comparison to post-treatment, but this difference was not statistically significant.

Table (4): *Electromyographic records of masseter muscle pre and post value, Mean and standard deviation of difference and significance of paired t test.*

Masseter		Mean	Std. Dev.	Std. Error Mean	Mean difference	Std. Dev. Of Difference	t test	P Test
1) At rest	Pre	35.77	17.56	9.19	-56.19	108.01	-1.56	.016*
	Post	91.96	31.5	43.82				
2) At occlusion	Pre	390.42	110.7	56.87	-27.96	314.12	-.27	.047*
	Post	418.38	125.1	88.35				

Significance level p<0.05, significant. N=9.*

Table (5) *Electromyographic records of temporalis muscle pre and post value, Mean and standard deviation of difference and significance of paired t test.*

Temporalis		Mean	Std. Dev.	Std. Error Mean	Mean difference	Std. Dev. of Difference	t test	p test
1) At rest	Pre	33.38	19.21	6.40	-1.56	26.87	-.17	.87 NS
	Post	34.94	12.29	7.43				
2) At occlusion	Pre	215.70	85.65	28.55	23.41	69.03	1.02	.34 NS
	Post	192.29	85.53	28.51				

Significance level p<0.05, NS=non- significant. N=9

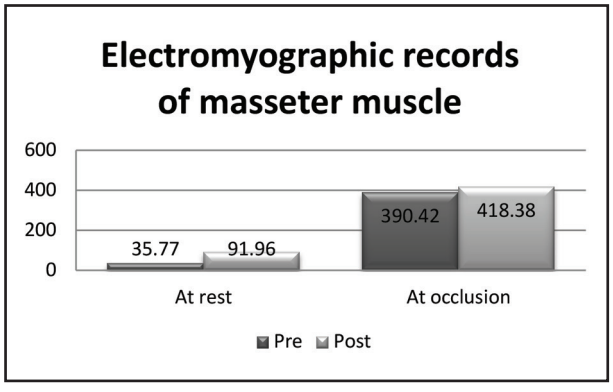

Figure (4) Bar chart showing mean values of Electromyographic records of masseter muscle

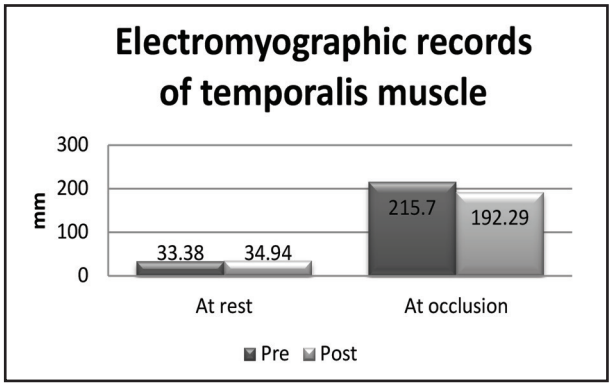

Figure (5) Bar chart showing mean values of Electromyographic records of temporalis muscle

DISCUSSION

Regarding electromyographic activity changes, the anterior temporalis and masseter muscles activity were chosen to be recorded before and after correction of Class II malocclusion to Class I molar relation by using Carriére Distalizer appliance. According to the masseter muscle at rest, a higher mean value was recorded post-treatment (91.96±31.5), in comparison to pre-treatment (35.77±17.56). Independent t test showed that this difference was statistically significant (p=0.016). At occlusion, a higher mean value was recorded post-treatment (418.38±125.1), in comparison to pre-treatment (390.42±110.7). Independent t test showed that this difference was statistically significant (p=0.047). In this study, masseter muscle activity from postural rest position and maximum clenching showed an increased after Carrière Distalizer appliance therapy, but it was statistically significant. These findings are similar the previous findings of another studies [20-22] but against findings of another study [23] which reported a significant decrease in masseter muscle activity during maximum occlusion after 3 months of treatment and was associated with occlusal instability and lack of occlusal contacts of teeth in the posterior segments, which occur usually while bite jumping with using Herbst appliance and activator. The occlusal instability caused by tooth position changes and intermaxillary relations that achieved by treatment reflected in a reduced EMG activity of masseter muscle during maximum occlusion [24].

Regarding electromyographic records of temporalis muscle at rest, a higher mean value was recorded post-treatment (34.94±12.29), in comparison to pre-treatment (33.38±19.21). Independent t test showed that this difference was not statistically significant (p=0.87). At occlusion, a higher mean value was recorded pre-treatment (215.70±85.65), in comparison to post-treatment (192.29±85.53). Independent t test showed that this difference was not statistically significant (p=0.34). In the present study, the anterior temporalis activity increased during postural rest position and maximum clenching after Carriére Distalizer appliance therapy but statistically not significant. A little increase which was not statistically significant can be associated to the slowly adapting receptors in the tendon organs that are not stimulated enough to cause inhibition to the generation of more tension during maximum occlusion. These results were similar to the results of another study. [23]

The results were not affected by the absence of patients' blinding who in the first place would not favor one intervention over the other. On the other hand, usually the absence of the operator's blinding could lead to performance bias by favoring intervention over the other. In addition, an external assessor blindly assessed the outcomes to avoid any detection bias [25]. Another limitation of the study is that included females only and was restricted to one gender group and also restricted to age between (18-21) post-pubertal group only for accuracy of evaluation of muscle activity as it affected by sex and age.

CONCLUSIONS

1- Carrière Distalizer appliance caused electromyographic records changes with masseter and temporalis muscles activity were improved after treatment.

2- Carrière Distalizer appliance able to correct Class II canine-molar relationship into Class I canine-molar relationship in adult patients.

3- Carrière Distalizer appliance caused dentoalveolar changes including slight maxillary molar distalization, in addition to mesialization that occurred to the lower molars and proclination of the lower incisors which results in correction of Class II malocclusion.

4- No skeletal changes occurred.

REFERENCES

1. Moyers RE, Riolo ML, Gurie KE, Wainright RL, Bookstein FL. Differential diagnosis of class II malocclusions. Am J Orthod. 1980; 78:477-94.
2. Cureton SL, Regennttier FJ, Yancey JM. Clinical versus quantitative assessment of headgear compliance. Am J Orthod Dentofcial Orthop. 1993; 104:277-84.
3. Ghosh J, Nanda RS. Evaluation of an intraoral maxillary molar distalization technique. Am J Orthod Dentofacial Orthop. 1996; 110:639-46.
4. Carano A, Testa M. The distal jet for upper molar distalization. J Clin Orthod. 1996; 30:374-80.
5. Jones R, White J. Rapid Class II molar correction with an open coil jig. J Clin Orthod. JCO 1992; 26:661-4.
6. Fortini A, Lupoli M, Parri M. The First-Class Appliance for rapid molar distalization. J Clin Orthod. JCO 1999; 33:322-8.
7. Keles A, Sayinsu K. A new approach in maxillary molar distalization: intraoral bodily molar distalizer. Am J Orthod Dentofacial Orthop. 2000; 117:39-48.
8. Antonarakis GS, Kiliaridis S. Maxillary molar distalization with noncompliance intramaxillary appliances in class II malocclusion: A systematic review. Angle Orthod. 2008; 1133-40.
9. Fudalej P, Antoszewska J. Are orthodontic distalizers reinforced with the temporary skeletal anchorage devices effective? Am J Orthod Dentofacial Orthop.2011; 139:722-9.
10. Carriere L.A. new Class II distalizer. J Clin Orthod. 2004; 38:224.
11. Rodriguez H. Unilateral application of the Carriere Distalizer. J Clin Orthod. 2011; 45:177-80.
12. Rodriguez H. Nonextraction treatment of class II open bite in adult patient. J Clinical Orthod. 2012; 46:367-71.
13. Schuupp W, Haubrich J, Neumann I. Class II correction with the Invisalign system. J Clin Orthod. 2010; 44:28-35.
14. Pardo LB, de Carlos VF, Cobo PJ. Distalizer treatment of an adult class II, division 2 malocclusion. J Clin Orthod. 2006; 40:561.
15. Hamilton C, Saltaji H, Preston C, Flores-Mir C, Tabbaa S. Adolescent patients' experience with the Carriere Distalizer appliance. Eur J Paediatr Dent. 2013; 14:219-24.
16. Sandifer CL, English JD, Colville CD, Gallerano RL, Akyalcin S. Treatment effects of the Carriere Distalizer using lingual arch and full fixed appliances. J of the World Federation of Orthodontists 2014; 3:49-54.
17. Rancan SV, Palinkas M, Bataglion C, De Vasconcelos PB, Siéssere S, Rancan FL et al. Electromyographic analysis of the masseter and temporalis muscles and bite force in a patient treated by functional maxillary orthopedics. Indian J case reports 2016; 2:93-7.
18. Attia KH, Enein KA. Achieving Early Bond Strength: A Solution. Ortho Update 2012; 5:122-4.
19. Veeroo HJ, Cunningham SJ, Newton JT, Travess HC. Motivation and compliance with intraoral elastics. Am J Orthod Dentofacial Orthop. 2014; 146:33-9.
20. Castroflorio T, Icardi K, Torsello F. Reproducibility of surface EMG in the human masseter and anterior temporalis muscle areas. Cranio. 2005; 23:130-7.
21. Glaros AG, Waghela R. Psychophysiological definitions of clenching. Cranio. 2006; 24:252-7.
22. De Felicio CM, Sidequersky FV, Tartaglia GM, Sfoza C. Electromyographic standardized indices in healthy Brazilian young adults and data reproducibility. J Oral Rehabil. 2009; 36:577–83.
23. Kumar S, Tripathi T, Sidhu M, Yadav P, Dabas A. Skeletal Class II correction and neuromuscular adaptation with twin-block: A cephalometric and electromyography study in adults. J Ind Orthod Soci. 2016; 46: 50:94.
24. Ferrario VF, Sforza C, Miani A. Electromyographic activity of human masticatory muscles in normal young people. Statistical evaluation of reference values for clinical applications. J Oral Rehabil. 1993; 20:271–80.
25. Scalf M. Muscles of Mastication. Am Med J.2008; 2: 22-4.