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ORIGINAL RESEARCH

THE EFFECT OF FACIAL PROFILE ON MOUTH OPENING DURING ORTHODONTIC THERAPY

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ABSTRACT

Background: Understanding the impact of fixed orthodontic appliances on mouth opening is crucial for orthodontists to minimize complications and ensure a comfortable and functional treatment outcome.

Aim: To evaluate the effects of facial type for subjects undergoing fixed orthodontic appliance on greatest mouth opening, by estimating the vertical distance between the upper and lower incisors using the digital vernia.

Materials and Methods:A total of randomly selected **(320)** university student, their age between 18-23 years, are requited for the study. The sample are selected from students of three colleges of medical group. Maximum mouth opening was took from each participant by measuring the distance between two reference points (the upper and lower incisors' edge) while the participant open maximally. According to facial type, the study sample is categorized as an average (175) and convex (145) facial profile; each study group is further subdivided into three groups thereafter (non-treated, treated, post-treated).

Results: The recorded mean values of mouth opening are (42.49 ± 8.10; 49.68 ± 9.14; 46.10 ± 8.33) and (44.11 ± 7.66; 49.05 ± 7.93; 45.47 ± 8.65) for study (non-treated, treated, post-treated) groups of average and convex facial profile; respectively. The transient significant increase in MMO during orthodontic treatment and the likely similar manner of mouth opening among all groups of both facial types indicating that there is no direct relationship among all these parameters.

Conclusion: Neither fixed orthodontic therapy nor the facial type of individuals are considered during clinical evaluation of maximum mouth opening.

***Keywords*:** maximum mouth opening, fixed orthodontic appliance, facial profile.

INTRODUCTION

The true relationship between the orthodontic therapy and the initiation of problems involving temporomandibular joint is yet uncertain. Nevertheless, a thorough examination of the stomatognathic system is necessary in order to disclose probable joint signs and symptoms before the orthodontic tratment.[1] A growing concern, however, about fixed orthodontic appliances on the temporomandibular joint has been determined.[2] It was found that certain individuals may be at increased risk to TMJ problems although there is no definitive evidence linking fixed orthodontics to its' problems in all cases, due to force application and occlusal changes during treatment.[3] In the late 20th century, well conducted studies have demonstrated that some skeletal/occlusal factors, such as unilateral posterior crossbite, anterior open bite, overjet greater than 6-7 mm, absence of more than five posterior teeth, and centric relation to maximum intercuspation discrepancy greater than 2 mm are some occlusal factors that could predispose for temporomandibular dysfunction.[4-6] nevertheless, most of individuals displaying these occlusal features have ever demonstrate whichever symptoms of temporomandibular dysfunction. An appropriate adaptability is probably able to recover prospective small functional alterations, initiated by the presence of malocclusion.[2]

Findings of such studies are mostly come from cross-sectional studies and likely reflect a possible association between these parameters, which although valid, it does not allow a temporal description of the variables.[7] However, most of recently conducted studies have shown no difference among individuals with malocclusion and those with normal occlusal relation as well as between orthodontically treated and non-treated individuals in relation to signs and symptoms of temporomandibular dysfunction.[8-10]

Maximum mouth opening (MMO) is one of the key clinical variables supposed to be affected during orthodontic therapy, which is essential for normal

function and various dental or orthodontic procedures**.**

Changes in mouth opening during appliance therapy may be the result of inflammation, muscular discomfort, or stress on the TMJ, especially during the initial treatment phases. Although these effects are usually mild and reversible, it is important to monitor mouth opening to ensure that jaw function is not compromised. Accordingly, understanding the impact of fixed orthodontic appliances on MMO is crucial for orthodontists to minimize complications and ensure a comfortable and functional treatment outcome.[11]

MMO has been described as the maximum interincisal distance, or corrected interincisal distance where vertical overlap between the incisors is added to it**.**[12] However, an active mouth opening achieved by the patient without assistance can be considered as clinically relevant. Wood & Branco in 1979 have reported various methods of measuring interincisal distance and concluded that direct measurement was the most accurate**.**[13]

Among Iraqi population, there is a limited availability of mouth opening data regarding their mean values as well as few researches presenting the influence of fixed orthodontic devices on mouth opening measurement. It is attempted by the present study to predict the mean of MMO values of normal and convex facial profile in Babylon province categorized according to clinical examination, and to evaluate the possible effect of fixed orthodontics on such values for both groups.

2. MATERIALS AND METHODS

2.1 MATERIAL

A total of randomly selected **(320)** university student, their age between 18-23 years, are chosen for the study. Each subject was instructed about the aims of the study and have to opt whether to be a participant in the study. The sample are requited from students of Babylon University (college of medicine, college of dentistry, college of pharmacy, and college of nursing). The study sample are collected during the period of November /2024 to February/ 2025. Maximum mouth opening was took from each participant by measuring the distance between the upper and lower incisors. according to facial type, the study sample is categorized as an average (175) and convex (145) facial profile; each study group is further subdivided into three groups thereafter:

Control Group: Are subjects who did not receive orthodontic therapy.

Treatment Group: Are patients who underwent fixed orthodontic treatment during the active stage of treatment for at least 6 months of treatment.

Post treatment Group: Are patients who complete orthodontic therapy and within the retention phase for at least 6 months. **(Table. 1, 2**)

2.1.1. Inclusion Criteria

The following criteria were included in the study:

- Patients with no history of jaw, head, or facial trauma.
- Patients with no facial, dental abnormalities or jaw asymmetry.
- Patients with no history of TMJ sounds.
- Average facial profile and proportional face.
- Patients with no dental prosthesis on anterior teeth.

2.1.2 Exclusion Criteria:

The following criteria were excluded from the study:

- Patients with missing or severe attrition of incisors.
- Patients with broken maxillary or mandibular incisors due to any reason.
- Patients with severe orthodontic / skeletal problems.
- History of bruxism, clenching.
- Previous orthodontic treatment.
- Patients with neuromuscular and craniofacial deformities.

2.1.3 Instruments and devices:

1- Digital vernier caliper 2- Dental mirrors. 3- Dental chair. 4- Kidney dishes.

2.2 METHOD

2.2.1 Maximum Mouth Opening:

After thorough clinical examination, the students or patients are requested to sit in upright comfortable position on the dental chair. The maximum mouth opening then measured using digital caliper. To measure MMO, each subject was asked to open his/her mouth actively as wide as possible to degree of maximum comfortable position till pain is initially felt, [14] and as follows:

- Using two reference points (the incisal edge of maxillary and mandibular central incisors) and measure the vertical linear distance them while the patient open maximally.
- The recorded value of MMO should be repeated subsequently for the same patient until the average value is assured (the more reproducible the patient can open, the more is the recorded correct value of MMO can be achieved).
- The average value of MMO is added to the original over bite of the patient.[11] the recorded measurements are entered in computer along with demographic features of all sample to be ready for data analyses**.**

2.2.2 Data Analysis

Statistical analysis was carried out using SPSS version 27. Categorical variables were presented as frequencies and percentages. Continuous variables were presented as (Means ± SD). ANOVA and LSD test was used to compare means among the three groups.

3. RESULTS

Table 1 shows the extent of mouth opening (mm) for three study groups (Control group, Treatment group and Post- treatment group) among subjects with average facial type. The mean values of mouth opening are higher for treatment group than other groups and there is a significant difference among groups, (P<**0.001).**

Treatment group and Post- Multiple comparison clarify that the treatment group is significantly higher MMO mean values than the control individuals.

Table 1. A comparison among three study groups (Control group, Treatment group and Post- treatment group) regarding the maximum mouth opening in average facial profile.

Study variable	Study group	N	Mean ± SD	P-value	LSD	
					groups	p-value
Maximum mouth opening (mm)	Control	60	44.11 ± 7.66	**0.023***	control treatment	**0.008***
	Treatment	46	49.05 ± 7.93		control Post-treatment	0.571
	Post-treatment	39	45.47 ± 8.65		treatment Post-treatment	0.129
	Total	145	46.55 ± 8.20			

(Table 2): Display how subjects with facial type of convex profile are open their mouth maximally among all groups. The mean values of MMO in convex facial type are approximately similar in all study groups to those of average facial type, and a significant difference was found among three groups. A significant increase in mean values of maximum mouth opening for treatment group subjects compared with non-treated control subjects.

Table 2. A comparison among three study groups versus maximum mouth opening in convex facial profile.

Study variable	Study group	N	Mean ± SD	P-value	LSD	
					groups	p-value
Maximum mouth opening (mm)	Control	60	44.11 ± 7.66	**0.023***	control treatment	**0.008***
	Treatment	46	49.05 ± 7.93		control Post-treatment	0.571
	Post-treatment	39	45.47 ± 8.65		treatment Post-treatment	0.129
	Total	145	46.55 ± 8.20			

4. DISCUSSION

Evaluation of individual's range of lower jaw movement is one of important screening examination that should be included during orthodontic assessment and continue throughout treatment or even thereafter.[14]

Maximum opening is an important preliminary diagnostic procedure carried out during routine dental visit. Restricted mouth opening result in discomfort to patients undergoing treatment and so difficulty in carrying out many medical, dental, and orthodontic procedures, as the latter need some prolonged period of mouth opening. The earliest sign of issues associated with the masticatory system is the reduction of mouth opening.[15,16]

Various methods were depicted to measure the maximum degree of mouth opening,[17-19] of which the direct method is more reliable, consistent, and reproducible measurement than others as conducted by Wood and Branco.[20]

Although few studies are present to evaluate the maximum mouth opening in either growing or adult population, they cannot evaluate mouth opening during fixed appliance treatment or even during retentive phase; after completion of orthodontic treatment. The study is conducted to predict the potential effect of fixed orthodontics on the range of mouth opening for subjects with normal and convex facial profile.

Dealing with mean values of control group of both facial skeleton (average and convex profile), the recorded maximum mouth opening are seem identical for either facial type, which is around (43 mm). Moreover, the measured mean values of opening for subjects underwent orthodontic treatment in both facial profile were found to increased significantly compared with control patients, (Table 1).

Such study results were come in accordance with Faleh et.al.[21] who document that the MMO is (42.9 mm) but inaccordance with Ahmed Al-Noaman [22] and Graber et.al. [14], whom shown higher MMO values in their studies using adult non treated sample, which could be attributed to their methodology, sample size, and geographical variation. Although there is a positive effect of fixed orthodontic therapy on the extent of mouth opening as mentioned earlier in treatment group, during which some occlusal changes might be encountered; most of recently conducted studies have shown no difference among individuals who orthodontically treated and non-treated in relation to signs and symptoms of temporomandibular dysfunction which is the site at which lower jaw is hinged during mouth opening.[8-10]

The similar pattern between the average and convex facial profile regarding the MMO as it increased from the non-treated to treated patients, it is clear that mean values of maximum interincisal distance is found to be reduced during the retention phase of post-treatment group, (Table 2). These results suggest that the treatment was effective in enhancing mouth opening during the active phase of fixed orthodontic therapy. During treatment with an orthodontic appliances, the jaws and teeth are repositioned by appliances' forces, inducing a favorable muscular balance and coordination between the masticatory system. Also these forces can promote adaptive changes in the skeletal tissues and their surrounding structures, result in enhanced flexibility and range of mandibular motion, so increasing MMO thereafter.[23]

However, a period after debonding of orthodontic appliance from the teeth during the passive phase following treatment, the MMO seems to be reduced to a degree comparable of what was measured initially for non-treated group. In other words, such improvement in MMO is no longer permanent for treated subjects as it seems approximately similar to measurement of control group when the patient recall while they are in the retention period. Other factors should be considered rather than fixed orthodontic appliance itself during assessment of maximum mouth opening for extended time span using a longitudinal study.

5. CONCLUSION

The limited positive change in mouth opening during orthodontic treatment could reflect weak or even no association between orthodontic therapy and mouth opening in different facial prfile. Moreover, other factors should be considered rather than fixed orthodontic appliance itself during assessment of maximum mouth opening.

DECLARATIONS

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Competing Interests

The authors have no competing interests to declare.

Ethical Approval

The study was approved by the appropriate ethics committee and conducted according to relevant guidelines and regulations.

Informed Consent

Not applicable.

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