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ORIGINAL RESEARCH

MAXIMUM INTERINCISAL CLEARANCE AND FIXED ORTHODONTICS

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ABSTRACT

Background: While fixed orthodontic therapy is undertaken, mouth opening is one of the key clinical parameters supposed to be affected, which is essential for normal function and various dental as well as orthodontic procedures.

Aim: To evaluate effects of fixed orthodontic appliance on mouth opening by measuring it's maximum millimeter distance for three different groups.

Materials and Methods: A total of **(337)** subject, with mean age of patients was (23.11± 6.10) years are randomly requited to participate in the study. Almost all sample are students from faculties of medical group of Babylon University. They are categorized as (total, male, female) groups, which are further subdivided into three groups (control, treatment, post-treatment). The participant are requested to open as much as possible so the maximum mouth opening was recorded using digital caliper.

Results: The mouth opening mean values are (42.84 ± 8.01; 46.07 ± 8.26; 39.54 ± 6.24) for total, males, and females of control group; respectively. However, these values seems to be increased significantly during active treatment with fixed orthodontic appliance for all groups. Unfortunately, the post-treatment (retention) group showing a reduction in maximum mouth opening reaching closer of what was measured initially for the control subjects whether total or gender groups are dealing with.

Conclusion: Although it is not a follow up study, the temporal positive change in maximum mouth opening for a limited time resulting from addressing some teeth irregularities during fixed orthodontic appliance treatment could predict weak or even no association between orthodontic therapy and mouth opening.

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

INTRODUCTION

Fixed orthodontic appliances have so many beneficial effects on patients' occlusion, function, aesthetics, and thereby psychosocial well beings. However, a growing concern about their possible impact on the temporomandibular joint (TMJ) has been determined.[1] 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.[2] 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.[3-5] 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.[1]

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.[6] 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.[7-9]

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.[10]

Maximum Mouth opening has been described as the maximum interincisal distance, or corrected interincisal distance where vertical overlap between the incisors is added to it.[11] 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.[12]

On the availability of little data about the impact of fixed orthodontic appliances on maximum mouth opening, the present study is conducted to evaluate the millimeter distance of maximum mouth opening of three different groups (control group, treatment group, post-treatment group) for Iraqi adult sample in Babylon Province.

2. MATERIALS AND METHODS

2.1 MATERIAL

A certain patients' criteria are followed to randomly select a total of **(337)** subject, their age between 18-35 years, with mean age is (23.11± 6.10) years. Each subject was instructed about the aims of the study and have to opt whether or not to be a participant in the study. Most sample are requited from students of Babylon University (college of medicine, college of dentistry, college of pharmacy, and college of nursing), and some are patients seeking orthodontic treatment selected from a specialized orthodontic clinic as well as the orthodontic clinic of teaching hospital of college of dentistry. The study sample are collected during the period of November /2024 to February/ 2025. Maximum mouth opening was took from each participant by direct measurement of millimeter distance between the upper and lower incisors.

The study sample is categorized as (total, male, female) groups, which are further subdivided into three groups:

Control Group: Are subjects who did not wear fixed orthodontic appliance.

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

Post treatment Group: Are patients who removed orthodontic appliance which are within the retention phase for at least 6 months. **(Table: 1, 2, 3)**

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 history of bruxism, clenching.
- 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.
- Patients with neuromuscular and craniofacial deformities.

2.1.3 Instruments:

The following instruments were used:

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

2.2 METHOD

2.2.1 Maximum Mouth Opening (MMO):

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 as wide as possible to degree of maximum comfortable position till pain is initially felt, [13] and as follows:

- Using digital vernia , the maximum distance from the incisal edge of the maxillary central incisor to incisal edge of mandibular central incisor at the midline was measured.
- The recorded value of MMO should repeated subsequently at the same patient until the average value is assured (the more reproducible the patient can open, the more is recorded correct value of MMO can be achieved.
- The average value of MMO is summated with the original over bite of the patient. These values are entered in computer along with demographic features of all sample to be ready for data analyses[11]

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 test was used to compare means among the three groups. Pearson Chi-Square test was used to find the association between categorical variables. P value ≤ 0.05 was considered as significant.

3. RESULTS

Table 1: The comparison among three study groups including (Control group, Treatment group and Post- treatment group) according to maximum mouth opening (mm). There a significant difference is found in maximum mouth opening among three study groups. Multiple comparison reveals that the treatment group is higher statistically in mouth opening values than the control as well as the post-treatment groups.

Table 1. Analysis of variance and Multiple comparison among three study groups including in total sample (Control group, Treatment group and Post- treatment group) according to maximum mouth opening (mm).

Study variable	Study group/total	N	Mean ± SD	P-value	LSD	
					Groups	P-value
Maximum mouth opening (mm)	Control	164	42.84 ± 8.01	**<0.001***	Control	**<0.001***
					Treatment	
	Treatment	92	49.33 ± 8.45		Control	0.084
					Post-treatment	
	Post-treatment	81	45.74 ± 8.36		Treatment	**0.047***
					Post-treatment	
	Total	337	45.00 ± 8.64			

Table 2. The comparison of mouth opening among three study groups dealing with male patients. The mean values are different significantly as they change from the control group to treatment group and post-treatment group as well. A significant mean elevation in maximum mouth opening of males in treatment and post-treatment groups compared to control group.

Table 2. Reveals the mean values of maximum mouth opening in each study subgroup, and a statistical comparison among them regarding male subjects

Study variable	Study group/male	N	Mean ± SD	P-value	LSD	
					Groups	p-value
Maximum mouth opening (mm)	Control	83	46.07 ± 8.26	**0.001***	Control	**<0.001***
					Treatment	
	Treatment	42	52.29 ± 8.09		Control	**0.036***
					Post-treatment	
	Post-treatment	37	51.43 ± 7.80		treatment	0.765
					Post-treatment	
	Total	162	47.97 ± 8.58			

Table 3. dissimilar to male subjects, the females have a reduced maximum mouth opening among all groups. However, their maximum mouth opening mean values are differ significantly among the three study groups. There was a significant increase in maximum mouth opening in treatment group in comparison to other groups regarding female patients.

Table 3. Reveals the mean values of maximum mouth opening in each study subgroup, and a statistical comparison among them regarding female subjects.

Study variable	Study group/female	N	Mean ± SD	P-value	LSD	
					groups	p-value
Maximum mouth opening (mm)	Control	81	39.54 ± 6.24	**<0.001***	control treatment	**<0.001***
	Treatment	50	47.74 ± 8.28		control Post-treatment	0.315
	Post-treatment	44	41.47 ± 5.99		treatment Post-treatment	**0.002***
	Total	175	42.54 ± 7.90			

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.[13] 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.[14,15]

Various methods were depicted to measure the maximum interincisal clearance, of which the direct method is more reliable measurement than others as conducted by Wood and Branco.[16]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 removal of fixed orthodontic appliance. This study is conducted to predict the maximum mouth openings' mean values during and after fixed orthodontic treatment for an Iraqi adult sample by cross sectional study. The sociodemographic characteristics among the three study groups are not significant regarding both, the age and sex of sample. Dealing with maximum mouth opening for total sample, the mean values for control group is (42.84 mm) which is consistent with Faleh et.al.[17], who document that the MMO is (42.9 mm) but inconsistent with Ahmed Al-Noaman [18] and Graber et.al. [13], whom revealed higher MMO values in their studies which may be attributed to facial type, sample size, and sample age. By considering the probable effect of fixed orthodontic appliances on MMO, there is a significant increase in their mean values from the control group to treatment group (49.33 mm) during which some occlusal changes are encountered. However, the maximum interincisal distance is found to reduced significantly from the fixed appliances' treatment group to post-treatment (retentive phase) group, (Table 1). Such significant high values of the treatment group compared with other groups ($P< 0.05$), could reflect the natural limitations associated with untreated malocclusion, imbalanced masticatory muscle function, or potential joint restrictions.

These results suggest that the treatment was effective in enhancing mouth opening during the active phase of treatment. During treatment with fixed 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.[19]

Moreover, the gender mean values of MMO among the groups is also evaluated. The study shows that male subjects tend to have more mouth opening values than females among all groups; whether in controls, and during active treatment with fixed appliances, or even during the passive phase of treatment. Similar to total sample, the MMO of treatment group is more obvious whether in males or females than control or post-treatment groups. Adding to that the mouth opening mean values of both genders are higher significantly dealing with treatment group compared with control group, ($P<0.001$). These findings are come in accordance with multiple previous isolated studies that show that females having a reduced mean values of MMO than their counterpart.[17,18,20] The physical and physiological characteristics of males are well known to be different in almost all features, so there is no doubt the interincisal distance of males is greater than females. The statistical elevation of MMO from the control to active phase of treatment with fixed orthodontic appliance of both genders may imply the therapeutic effects of orthodontics on the condyle within the temporal fossa due mostly to improving tooth interferences as well as muscle balance. However, a period after the removal of the orthodontic appliance from the teeth during the retention phase, the MMO seems to be reduced to a degree comparable of what was measured initially for control group. In other words, such improvement in MMO is no longer permanent for treatment group 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

Although it is not a follow up study, the temporal positive change in maximum mouth opening for a limited time resulting from addressing some teeth irregularities during fixed orthodontic appliance treatment could predict weak or even no association between orthodontic therapy and mouth opening. 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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