

# Maximum bite force in relation to maximum mouth opening among primary school children

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## ABSTRACT

**Background:** The vertical distance between the upper and lower incisal edge of the central incisors when the mouth is opened as wide as possible is called maximum mouth opening (MMO). Any pathological change in the masticatory system had a direct effect on the maximal mouth opening. The aim of this study was to evaluate the relationship between the maximum bite force and the maximum mouth opening among group of children.

**Materials and methods:** Four hundred children of both genders were included in this study, their age ranged from eight to ten years. Anterior and posterior (right, left) bite force were measured using bite force sensor. Maximum mouth opening was evaluated by electronic digital caliper. Data was statistically analyzed by descriptive statistics and by using paired t-test and Chi-square test.

**Results:** The value of Maximum mouth opening was increased with the increasing of age in both genders; however, boys had higher value of Maximum Mouth opening than that of girls. A significant difference was found between genders among 9 years old children concerning the maximum bite force. A weak positive relation was observed between Maximum mouth opening and Maximum Bite Force among the boys in both of the age groups.

**Conclusions:** In this study, a significant positive correlation was found between Maximum bite force and Maximum Mouth opening for boys, as they had higher mean value of maximum mouth opening and maximum bite force than girls. (Received: 15/12/2018; Accepted: 21/1/2019)

## INTRODUCTION

Teeth have an important role in the masticatory system, as they form the occlusal area where the food particles are fragmented, so that the grinding force will depend on the total occlusal area and thus on the number of teeth <sup>(1-3)</sup>. Chewing performance and bite force can influence the development of masticatory function. Chewing is a developmental function and its maturation occurs from learning experiences. If mastication is adequate, it gives stimulus for the proper function to normal development of maxilla and mandible. <sup>(1,4)</sup> Masticatory function can be predicted by a number of parameters, including bite force <sup>(5)</sup> and occlusal contact area, the higher the bite force and the larger the occlusal contact area can aid in the more efficient mastication. On the other hand, reduced masticatory function may be related to the smaller occlusal contact area <sup>(6)</sup>.

Maximum mouth opening which is the greater distance between the incisal edges of the upper and lower central incisors (at the midline when the mouth is open widely) <sup>(7)</sup>. It is a simple but important clinical parameter to conduct a thorough conventional oral examination and for the follow-up assessments of the diverse affections of the stomatognathic system.

Limitation in the mouth opening is one of the early signs of some pathological and/or traumatic conditions that may affect the oral cavity, e.g. temporomandibular disorders (TMD) <sup>(8)</sup>, odontogenic infections <sup>(9)</sup> trauma <sup>(10,11)</sup>, tumors <sup>(12)</sup>, dental infections, craniofacial malignancies, fractures and myopathies (in the head and neck region) <sup>(13)</sup>. All clinicians dealing with the oral cavity facing various problems when there is a limited mouth opening <sup>(14)</sup>. Till now there is no previous Iraqi studies dealing with this subject. The aim of present study to identify the possible relationship between maximum bite force and maximum mouth opening among children for this reason this study conducted.

## MATERIALS AND METHODS

In total, 400 primary school children aged 8-10 years were selected from (1100) students at ten primary schools in AL-Khalis city/ Diyala /Iraq. After getting the approval from the Scientific Committee of the Pedodontics and Preventive Dentistry Department / College of Dentistry/ University of Baghdad, this cross sectional study was carried out during the period from the end of December 2017 until the end of February 2018. To conduct this study without obstacles, official permission was obtained from the General Directorate of Education of Diyala Governorate. Aims of this study were explained to the school authority to obtain cooperation as much as possible and that was done by a formal document. A signed consent was gained from the

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parents of each student participated in this study to get full information about the child (general health and age) and to examine their children as a part of the study sample without obligation. Examination was done at the students' school. The students were examined intra and extra-orally and the exclusion criteria were 1.Children with uncooperative behavior 2.Children with cleft lip and/or palate. 3.

Facial abnormalities.4. Children who their teeth were present with: congenital defects or deformed teeth, missing, unerupted, or fractured permanent centrals, large carious lesions or presence of large restorations.5.Children who had any prosthesis or orthodontic treatment.6.Children with TMJ problems.

In this study, the bite force were measured using bite force sensor (Loadstar sensor, USA).The device capacity was 100 Kg. Children were instructed to bite three times, as hard as possible, on the gauge sensor without moving the head .The measurement was done while the child was sitting on a chair, with straight head and back, when his Frankfort horizontal plane was kept horizontal<sup>(15)</sup>. Biting force of each child was measured alternately three times for the posterior area (right and left) and the anterior area each at 10 seconds intervals and the average of the readings was assumed to be MBF of each child where the teeth at maximum intercuspation according to standard procedure <sup>(15)</sup>. Meanwhile, evaluation of the maximum mouth opening (MMO) was done by asking the child to open the mouth as wide as possible <sup>(16)</sup>, while the child

was seated comfortably in the chair resting their head against hard wall surface in an upright position. The maximum distance from the incisal edges of the maxillary and the mandibular central incisors at the midline <sup>(7)</sup> was measured by using electronic digital caliper (China).

The values of the present study were subjected to statistical analysis by using SPSS version 20 (Statistical Package for Social Sciences) to specify the statistical differences between the two groups. P value of less than or equal the 0.05 level of significance was considered to be statistically significant.

**RESULTS**

Table (1), shows the distribution of the sample according to their age and gender in relation to the maximum mouth opening (MMO). In both of the groups, the girls had the higher maximum value of MMO than that of boys. However, the value of the MMO was increased with increasing of the age in both genders. Table (2), shows that although the maximum bite force (Total) of 8 years boys was larger than that of girls, (106.4 ± 34.6, 104.3±31 respectively) the difference was not statistically significant. However, among the age group of 9 years the difference between genders concerning the maximum bite on the anterior area and maximum bite force (total) were statistically significant (p=0.01).

As shown in Table 3, a significant but weak positive correlation was found between (MMO) and MBF (Total) among boys for both of the age groups.

**Table (1): Distribution of the study sample according to age and gender in relation to the maximum mouth opening**

Variable	Maximum mouth opening			
	8 year		9 year	
	Boy	Girl	Boy	Girl
Number %	80 39%	97 49.7%	125 61%	98 50.3%
Range	25.40	28.40	25.90	25.60
Minimum	22.00	22.00	24.30	25.00
Maximum	47.40	50.40	50.20	50.60
Mean± SD	37.53 ±4.65	37.51±4.93	39.39±4.76	38.83±5.29

Table (2): Maximum bite force by age and gender

Variable	8 year					9 year				
	Boys Mean± SD	Girls Mean± SD	T-test	df	P	Boys Mean± SD	Girls Mean± SD	T-test	df	P
MBF(R)	129± 61.4	114.5±57.1	1.92	87	0.1 <sup>NS</sup>	134.4±70	121.6±62.8	1.436	220.3	0.1 <sup>NS</sup>
MBF(L)	110.9±49.6	121.7±56.8	- 1.35	173.5	0.1 <sup>NS</sup>	120.9±57	115.5±67.2	0.636	169.3	0.4 <sup>NS</sup>
MBF(A)	79.2 ±35.8	76.5 ±28.9	0.544	0.53	0.5 <sup>NS</sup>	96.2±32.6	83.6±29	3.048	220.5	0.01 <sup>S</sup>
MBF(Total)	106.4±34.6	104.3±31	0.421	143.3	0.6 <sup>NS</sup>	117.2± 3	106.8±3	25.694	208	0.003 <sup>HS</sup>

MBF (R) =Maximum bite force in the right side. MBF (L) =Maximum bite force in the left side. MBF (A) =Maximum bite force in the anterior area. MBF (Total) = average maximum bite force. NS =Not significant, S=significant, HS= highly significant, (Significance level=P ≤ 0.05).

Table.3: Pearson correlation coefficient of maximum mouth opening in relation to maximum bite force

Maximum mouth opening	Age groups	Genders	MBF(R)	MBF(L)	MBF(A)	MBF(Total)
	8 Years	Boys	-.067 <sup>NS</sup>	.218 <sup>S</sup>	.029 <sup>NS</sup>	.147 <sup>S</sup>
		Girls	-.008 <sup>NS</sup>	.054 <sup>NS</sup>	.064 <sup>NS</sup>	-.001 <sup>NS</sup>
	9 Years	Boys	.013 <sup>NS</sup>	.028 <sup>NS</sup>	-.004 <sup>NS</sup>	.125 <sup>S</sup>
Girls		.024 <sup>NS</sup>	.151 <sup>S</sup>	.065 <sup>NS</sup>	.096 <sup>NS</sup>	

S=significant, NS=Not significant (Significance level=P ≤ 0.05).

**DISCUSSION**

Maximum mouth opening is an important tools for dental clinicians as a preliminary evaluation .It is a relevant references for assessment of the masticatory functional status (7,17). In this study, the values of maximum mouth opening varied considerably among the children. It ranged from a minimum values (22 mm) among the 8 years old children (both boys and girls), to a maximum value which was (50.60 mm) among the 9 years old girls .The measurement of MMO of the present study come in accordance with that of other studies (18-22). Lower value of MMO (25.40 to 28.40) at the mixed dentition stage was reported by other studies (23, 24). This narrow range value could be due to the small-ranged age groups (8 - 9 years) of the current study. As reported by Hirsh *et al.* (22), Cortese *et al.* (24) and Vanderas (25) MMO was related to age, which was in agreement with the present study, which revealed that the MMO was increased with increasing age. In the present study, the significant difference between genders was present only among the age group of 9 years. Meanwhile, gender differences concerning MMO were observed in a few studies (20, 26, 27), while other studies reported that there was no gender difference in the measurement of MMO among children, which disagreed with the present study (18, 24, 26, 28). The results of the present study showed that a significant difference was not found between genders in regard to the maximum bite force MBF on the posterior area (right and left side) among children in both of the age groups. However,

gender difference concerning MBF (total) was significant only among the older age group. While some investigators did not find a difference in MBF between genders that disagree with present study (29-32) , a significant difference in bite force between boys and girls was reported by several studies (27, 33-35) by which the bite force of boys was considerably stronger than that of girls. Results of the present study revealed that there was no clear relationship between the MMO and the MBF, which could be due to the age of the sample (children) and the sample size. However, Fields *et al.* (36) previously reported an associated between the presence of larger mouth opening and the presence of a stronger maximum bite force. However, this study was done among adults.

**CONCLUSION**

Based on the finding of present study, there was a significant weak positive correlation between maximum mouth opening (MMO) and maximum bite force (MBF Total) among boys in both of the age groups as they had higher mean maximum mouth opening and maximum bite force than girls

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#### الخلاصة:

المقدمة: المسافة العمودية بين الحافة العلوية والسفلية للقواطع الامامية عندما يتم فتح الفم على أوسع نطاق ممكن تُسمى فتحة الفم القصوى (MMO). كان لأي تغيير مرضي في طريقة المضغ تأثير مباشر على فتحة الفم القصوى. هدفت هذه الدراسة إلى تقييم العلاقة بين قوة العضة القصوى والحد الأقصى لفتح الفم بين مجموعة من الأطفال. المواد والطريقة: تم تضمين أربع مائة (400) طفل من كلا الجنسين في هذه الدراسة، تراوحت أعمارهم بين 8 و 10 سنوات. تم قياس قوة العضة الامامية والخلفية (اليمنى واليسرى) باستخدام جهاز استشعار قوة العضة. تم تقييم الحد الأقصى لفتح الفم بواسطة الفرجار الرقمي الإلكتروني. تم تحليل البيانات إحصائياً عن طريق الإحصاء الوصفي وباستخدام اختبار t المزدوج واختبار مربع كاي. النتائج: تم زيادة قيمة الحد الأقصى لفتح الفم مع زيادة العمر في كلا الجنسين. ومع ذلك، كان لدى البنات قيمة أعلى لفتحة الفم القصوى مقارنة بالفتيان. تم العثور على اختلاف كبير بين الجنسين فيما يتعلق بقوة العض القصوى على المنطقة الخلفية وعلى المنطقة الامامية بين كل من الفئات العمرية و لوحظ وجود علاقة ايجابية ضعيفة بين الحد الأقصى لفتح الفم وقوة العض القصوى على الجانب الأيسر بين الأولاد في الفئة العمرية من 8 سنوات. الاستنتاجات: في هذه الدراسة كانت العلاقة بين الحد الأقصى لقوة العض وفتحة الفم القصوى علاقة ضعيفة ايجابية ولكنها ليست كبيرة بين أقصى فتحة للفم (MMO) وقوة العضة القصوى (الجانب الأيسر) MBF (L) عند 8 سنوات للبنين و 9 سنوات من الفتيات بينما يوجد ارتباط ضعيف وإيجابي بين الحد الأقصى لفتح الفم (MMO) وقوة العضة القصوى (MBF) (المجموع) عند الأولاد لكل من الفئات العمرية. الكلمات المفتاحية: قوة العضة، فتحة الفم القصوى، الأطفال.