Clinical Measurement of Maximum Mouth Opening in Children Aged 6-12

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Objective: *To evaluate the clinical maximum mouth opening in children and its correlation with age, and sex.* ***Study Design:*** *Three hundred children of age 6-12 years, from different schools of Moradabad city were included. The participants were divided into three groups based on their age i.e Group 1 (n=100) 6-8 years, Group 2 (n=100) 8-10 years and Group 3 (n=100) 10-12 yrs. Three recordings of maximum mouth opening (MMO) were obtained using digital vernier caliper and the mean of three was considered as the MMO of that child. The data was analyzed using Spearman correlation, ANOVA with post- hoc Bonferroni test. The significance level was predetermined at p≤0.05 .* ***Results:*** *The mean MMO for children of Moradabad of aged 6-8yrs in boys is 39.87 ± 4.91 mm and in girls is 36.85± 4.09 mm. In 8-10 yeas age group, the MMO in boys is 44.5± 5.1 mm and in girls 41.77± 5.24 mm. In 10-12 year age group, the MMO in boys is 49.63± 5.56 mm and in girls is 49.33±5.32 mm respectively. The MMO was found to be higher in boys in all the three age groups.* ***Conclusions:*** *There was a significant difference in values of MMO in all the three age groups with boys having higher MMO values when compared to girls. Varying range of MMO values was observed within three age groups.*

Keywords: *Children, Mouth opening, Vernier caliper*

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INTRODUCTION

Pediatric Dentistry not only concerns about child's teeth and maintenance of adequate oral health but also emphasize on all the factors that play a crucial role in their sustenance, maximum mouth opening (MMO) is one of them. Evaluation of normal range of MMO in children of particular population is a crucial indicator for various complications which can lead to reduce mouth opening pertaining to that locality. It is described as the greatest distance between the upper and lower incisors or the inter-incisal distance when mouth is opened wide painlessly.[1]

Diminution in the movement of mandible is often frequently related to a major sign of mandibular dysfunction. Ineptitude to open the mouth may lead to various other situations such as it may hamper in perpetuate oral hygiene, edge social interactions due to speech defects, and can activate various deficiencies leading to deprivation of nutrients, which can in return retard the growth and development of a child making his/her health compromised. Furthermore reduced mouth opening poses many intricacies for a pediatric dentist to work in a oral field with limited access.[2] Therefore maximum mouth opening is a diagnostic clinical entity which helps the clinician to examine oral cavity expediently and to recognize the early signs of reduce mouth opening in children especially for those with temporomandibular problems[3] such as ankylosis[4], fractures[5], odontogenic infections[6], oral malignancies[7], traumatic injuries of head and neck region, congenital & developmental abnormalities[8] and various other idiopathic conditions. The initial acknowledgment of

pathological and traumatic conditions for reduced mouth opening is obligatory as it can be effective in diagnosing the underlying cause and also in planning the treatment plan prudently.

In a particular population it is a requisite to know a normal mouth opening range in order to make an accurate diagnosis of reduced mouth opening. Various studies in the literature states that MMO values vary significantly with age, sex, and race. Several methods have been advocated for measuring MMO, such as Zawawi *et al* [9] measured MMO from the first three knuckles (index, middle & ring finger) of a non dominant hand by placing it between upper and lower central incisor with mouth fully opened. Whereas Kumar et al[2], measured using a modified vernier caliper which they stated it a pioneer method used for measuring MMO in children. A new instrument was developed by Yoshitake[10] for measuring mandibular movement, including mouth opening, the mouth opening pathway, protrusive and lateral movements of mandible. Mezitis et al[11] measured the normal range of mouth opening by using a pachymeter. Miller et al[3] used modified boley gauge for measuring voluntary mouth opening. Abou Atme et al[12] used a simple gauge for MMO measurements, while some used ruler graded in millimeters for taking measurements.[13,14]

There are studies which have shown that in a child MMO can vary with age, sex & height, weight and different facial types, also MMO steadily ascends after birth until adolescence and then gradually descends as the age progress.[1,15] Gender difference was also found to be associated with MMO with females having less mouth opening when compared to males. Since it is evident in the literature that MMO has clinical importance and in a growing individual, a single cut-off value defines MMO which seems to be less passable. Regardless of clinical significance of MMO, incredibly narrow data is available in pediatric population and the work is attributed to Nevakari[16], Sheppard *et al* [17], Ingervall[18] and Agerberg.[19] There is no data available regarding the MMO values in pediatric population of Moradabad region of Uttar Pradesh, India. Hence this study was undertaken to evaluate MMO in school going children of Moradabad region so that it can serve as a baseline reference data.

MATERIALS AND METHOD

The investigation entente was reviewed and approved by Ethics Committee of Teerthanker Mahaveer Dental College & Research Centre, Moradabad, Uttarpradesh, India (Ref No: TMDCRC/IEC/18-19/PPD4 dated 22/1/2019). Before the initiation of the present study, permission from various schools and legally responsible persons were obtained. Complete particulars regarding the study, instruments being used along with the merits, demerits, limitations and drawbacks of the investigation were informed to the school authorities before allowing the school children to participate in the study. A total of 300 children fulfilling the inclusion criteria with age group ranging between 6-12 years were included in the study from various schools of Moradabad. All the participants were divided into three groups, Group 1= 6-8 years (n=100), Group 2= 8-10 years (n=100), Group 3= 8-12 years (n=100) and the same size was calculated after power analysis which was 95% for this study using stratified sampling technique.[20] Children aged 6-12 yrs (Boys & girls) and who were co-operative were included in the study. Children having significant behavioral problems, orthodontic problems, presence of unerupted or partially erupted central incisors, history and symptoms of trauma in jaw, head, face and neck either at rest or during function, history of severe bruxism, facial dental prosthesis on anterior teeth, facial and dental abnormalities, neurologic disorders & craniofacial deformities, systemic diseases such as juvenile rheumatoid arthritis & neck pain and history of TMJ sounds were excluded.

A single well trained calibrated examiner (S.A) performed dental examination in adequate natural daylight. The amount of the mandibular opening i.e. the distance between the incisal edge of upper and lower anterior teeth was measured using digital vernier calipers, with children resting their head against the firm wall in an upright position. Children were pre-instructed to open their mouth as wide as possible, thrice to relax the oral musculature in order to avoid any bias in the measurement. The examiner then measured the maximum distance from incisal edge of maxillary central incisal to incisal edge of mandibular central incisor in a midline using digital vernier caliper. For each child, the examiner took three recordings of MMO in millimeters and the mean of three recordings was considered as MMO of that child. The data was subjected to statistical analysis using statistical package for social science software (IBM SPASS statistics, IBM Corp., Armonk, NY, U.S.A, 2011) version '20' for windows to evaluate the relationship of MMO with age and sex. Spearman correlation and analysis of variance were also employed to analyze the results. The significance level was predetermined at $p \leq 0.05$.

RESULTS

The mean age and MMO of the participants in various groups are presented in Table-1. It was observed that MMO increased with age and was found to be in higher in males in all the three age groups. Varying range of MMO values were observed in the same age group. Table -2 shows the correlation between age, sex & MMO and Table -3 shows the comparison of MMO among groups using ANOVA with post-hoc Bonferroni. The results showed statistical significant difference among the groups.

DISCUSSION

MMO is an indicator of various pathological and non pathological situations related to maxilla-mandibular apparatus which can lead to restricted mouth opening and in turn can create havoc in one's day to day life. Various methods by using different devices[2,9,10,15] and techniques[9] have been elucidated in literature for measuring MMO values which includes: 1) Measuring the distance between the upper and lower incisor, 2) Measuring the distance of the alveolar crest, 3) Measuring the greatest vertical mandibular opening. In the present study MMO was estimated by measuring the distance between upper and lower central incisors when mouth was opened maximum. This method was found to be uncomplicated[21] and was easy to perform in children. Soft tissue landmarks are mobile and considering them may give inaccurate values while recording MMO. On the other hand, upper and lower incisors are comparatively reasonable, more stable and reliable in determining MMO values. So as an attempt to avoid any bias in the results, first method was employed in this study.

In this study, children were encouraged to open their mouth a number of times before taking the readings. This was done to relax the musculature and to obtain more accurate results. Various studies

Table 1: Mean age (yrs), and MMO (mm) of the participants in various groups

Groups	Gender	N	Mean age	Mean MMO
Group 1 (6-8Yrs)	Males	50	7.220±0.783	39.87±4.91
	Females	50	6.800±0.7559	36.85±4.09
Group 2 (8-10Yrs)	Males	50	9.190±0.6052	44.50±5.10
	Females	50	8.994±0.6988	41.77±5.24
Group 3 (10-12 Yrs)	Males	50	11.540±0.5035	49.63±5.56
	Females	50	11.340±0.5664	49.33±5.32

Table 2: Spearman's correlation between sex, age with MMO in various groups

		Group-1		Group- 2		Group- 3	
		r value	p value	r value	p value	r value	p value
Males	**Age**	0.39	0.005*	0.23	0.10	0.18	0.21
Females	**Age**	0.25	0.07	0.211	0.14	0.22	0.11

***significant**

Table 3: Comparison of MMO among various groups (ANOVA with post hoc Bonferroni)

	F value	P value
MMO	51.84	0.00*

		MMO	
Groups		Mean Difference	p value
Group 1 (Males) (6-8 Yrs)	Group 1 (Females)	3.01	.047*
	Group 2 (Males)	-4.62	.00*
	Group 2 (Females)	-1.90	.90
	Group 3 (Males)	-9.76	.00*
	Group 3 (Females)	-9.45	.00*
Group 1 (Females) (6-8 Yrs)	Group 2 (Males)	-7.64	.00*
	Group 2 (Females)	-4.92	.00*
	Group 3 (Males)	-12.77	.00*
	Group 3 (Females)	-12.47	.00*
Group 2 (Males) (8-10 Yrs)	Group 2 (Females)	2.72	.113
	Group 3 (Males)	-5.13	.00*
	Group 3 (Females)	-4.83	.00*
Group 2 (Females) (10-12 Yrs)	Group 3 (Males)	-7.85	.00*
	Group 3 (Females)	-7.55	.00*
Group 3 (Males) (10-12 Yrs)	Group 3 (Females)	.30	1.0

have been done concerning normal values of MMO in boys and girls of different ages. Gallagher et al[22] in their study evaluated MMO values in an Irish population where MMO values were 43.3mm and 41.1mm in males and females respectively. In Greek adults, Mezitis *et al* [11] performed a study and revealed different MMO values in both males and females. A study on child population of Bengaluru done by Kumari *et al* [23] revealed high MMO values in males. Yao et al[24] reported that age, sex & height has significant influence on MMO values in Chinese adult population. Similar findings were also found by Hirsch et al[25] in 10-17 yr old German children. The results of the present study exposed that the mean MMO was higher in group 3 (males) which tend to be 49.63 ± 5.56 mm followed by Group 3 (females) 49.63 ± 5.56mm.

It was also observed in all the three groups that the MMO values increased with age. Also varying range of MMO values were seen in the children of same age group. This is in contrast with other studies done by Muller *et al*[14] and Vanderas[26]. Many studies illustrate that MMO increases with age i.e MMO values tends to ascend after birth till adolescents [16,18] and then it declines as the age advances.[21,27] The results were in harmony with the results attained from the studies done by Fatima *et al* [1], Hirsch *et al* [25], Sridhar *et al* [28] and Vanderas.[26] In their studies they have stated that MMO was directly influenced with age. One of the reasons of MMO to increase with age can be attributed to growing growth pattern of skeleton which tends to increase with growing age and also the diversity of various growth patterns within the same age. On the contrary, few studies have also reported lower MMO values such as studies done by Cortese *et al* [29] and Muhtarogullary *et al*.[27]

While correlating with gender difference, Group 1 weak, positive and significant correlation was found in males where as in females weak positive non-significant correlation was observed. In Group 2 and 3, males were found to have weak, positive and non significant correlation whereas in females weak positive non-significant correlation was seen. The reason for gender difference could be attributed to the difference in the facial morphology and the orofacial musculature of males and females. This was in contrast to the study done by Fatima et al[1] where gender difference was observed between boys and girls. Our results were also in agreement with the study done by Pullinger *et al* [30] who concluded that males had 2.7% mouth opening more than compared to females. The gender difference was enumerated by findings by Weinstein[31] and Helkimo[32] and Dijkstra *et al* [33] who stated that the anatomical size and length of the mandible is greater in males as the reason for males having high MMO values. On converse Abou- atme *et al* [12] in their study done on children of age 4-15yrs found that no gender difference was correlated to MMO. Similarly studies done by Reicheneder *et al* [34], Rothenberg *et al* [35] and De Vis *et al* [36] did not exposed any association of MMO with gender. Sousa *et al* [37] also found no gender correlation but slight positive relation of MMO and weight was observed. In addition, studies done by Higbie *et al* [38], Kuroda *et al* [39] and Uritani *et al* [40] have also shown that head positions play a significant role as the values of MMO affects with the head motion. In order to avoid any discrepancy in our MMO values, children were asked to rest their head against the firm wall while considering the MMO measurements.

The advantages of this study include, normal MMO values can serve as a baseline data for children for comparison and future references for a pediatric population. Further in children who have been treated for TMJ abnormalities, maxilla mandibular anomalies and maxillofacial trauma usually complains of reduced mouth opening. So in order to deal with such conditions which lead to restricted mouth opening the main goal is to reinstate MMO to its average value. Hence it is of chief importance to know normal values of MMO of any given population. This can also help in identifying any pathologic or non pathologic conditions which usually goes unnoticed in a child with limited mouth opening. Moreover, after ascertaining the MMO values in pediatric population of particular region it will be helpful for pediatric dentist to easily identify the child with retarded mouth opening and the underlying cause for the same.

One of the limitations of this study was relatively smaller sample size and inclusion criterion does not involve any radiological examination for temporomandibular joint evaluation. So, asymptomatic individuals with undetected limited moth opening might have been enrolled in the sample size. An attempt should also be made in future for accurate measurement of MMO using laser technology also. In a growing child a single cut off value defining MMO of a child seems to be less passable. Despite the clinical implications of MMO, very limited data is available pertaining to pediatric population. To conclude, this study is an attempt to evaluate maximum mouth opening in children which will be helpful in serving as baseline data for comparison.

CONCLUSIONS

The conclusions drawn from this study are:

1. The mean MMO for children of Moradabad aged 6-8yrs in boys is 39.87 ± 4.91 mm and girls is 36.85± 4.09 mm. In 8-10 yrs age group, the MMO in boys is 44.5 ± 5.1 mm in girls 41.77 ± 5.24 mm. In 10-12 yrs age group, the MMO in boys is 49.63± 5.56 mm and in girls 49.33 ±5.32 mm respectively.
2. It was observed that MMO increased with age, and was found to be higher in boys in all the three age groups. Varying range of MMO values were observed in the same age group.

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