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ASSOCIATION OF MOLAR ANGULATION WITH ANTERIOR CROWDING AND DENTAL INCLINATIONS

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ABSTRACT

Objective: *To determine the association between molars angulation, anterior crowding and dental inclinations*

Methods: *This descriptive cross sectional study was conducted from June 2020 to August 2020. Pre treatment records (lateral cephalograms and dental casts) of 82 individuals were selected from the database of the Orthodontics Department. Angulation of molars and incisors inclination was evaluated from the lateral cephalograms. Anterior dental crowding in upper and lower arches was measured with the help of digital calipers using Little,s irregularity index. Correlation among molars angulation, anterior dental crowding and incisor inclination was measured with the help of Pearson,s product moment correlation.*

Results: *Out of 82 patients 39 were males and 42 were females. Mean age of the patients was 17 ± 3 years. Results showed that a positive but insignificant correlation was found between angulation of upper and lower molar and anterior dental crowding. A positive and significant correlation was found between angulation upper 1st molar and upper incisors inclination. Similar relationship was also determined between lower 1st molars and lower incisor inclinations.*

Conclusions: *It was concluded that there was no association between the angulation of posterior teeth and anterior crowding in both arches. Also the angulation of incisors changed according to the angulation of molars in both arches.*

INTRODUCTION

Human occlusion is a dynamic entity. The various aspects of dental occlusion change with respect to time. Lower incisor crowding is one of the associated features of this dynamic phenomenon. Etiology of lower crowding has been extensively studied. It is stated to be a multi factorial phenomenon [1, 2]. The role of third molar in the development of lower anterior crowding is a subject of much debate for past many years. Data from the literature shows that the association between third molar eruption and anterior dental crowding is variable and inconsistent [3]. It is stated that the erupting 3rd molars exerts a force on adjacent teeth and the alignment of anterior teeth worsens with the eruption of 3rd molars [4]. Richardson [5] conducted a systematic review and found that the existing evidence implicated the pressure from the back of arch and the role of third molars in development of anterior crowding.

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According to some studies the role of 3rd molar in late lower crowding is insignificant [6, 7]. The views of American and Swedish orthodontists regarding the role of third molars in dental crowding suggest that these teeth rarely or never cause crowding [8]. The lack of space in the dental arch for complete 3rd molar eruption results in increased molar heights accompanied by increased anterior pressure on the 2nd molar that may lead to crowding. This concept is termed as posterior dentoalveolar discrepancy [9-11]. The upper and lower molars tend to incline mesially if there is insufficient space for the lower third molar [12], but the effect of molars angulation (upper and lower 1st and 2nd molars) on anterior dental crowding (both upper and lower aches) is not clear.

The angulation of molars also changes with respect to different growth stages. Mandibular molars tend to be more stable with respect to developmental stages, while maxillary molars tend to tip more mesially with advancing age [13]. Most of the studies in the literature have been carried out to study the influence of third molars on angulation of posterior teeth, anterior crowding and overbite [4].

The change in the inclination of both upper and lower incisors is a multifactorial phenomenon. Changes in the growth rotation of the maxilla and mandible tend to alter the inclination of anterior teeth. In patients with hyperdivergant profile and open bite tendency the upper and lower incisors migrate in a more upward and forward direction thus increasing their prominence [14].

The role of angulation of upper and lower molars (1st and 2nd molars) in the development of anterior crowding and changes in different occlusal parameters (incisors inclination) haven't been studied extensively. We suggest that the change in angulation of posterior teeth (upper and lower 1st and 2nd molars) might also be associated with such changes.

The purpose of this study was to determine the correlation between upper and lower molars angulation, anterior dental crowding and incisor inclinations.

MATERIALS AND METHODS

This descriptive cross-sectional study was carried out at Orthodontics Department Sardar Begum Dental College. Pretreatment records of 82 individuals were selected by using consecutive sampling. The records were obtained from the database of the department and included lateral cephalograms and dental casts. The inclusion criteria were presence of all permanent teeth, no anomalies of crown morphology, complete set of records (lateral cephalogram and dental casts) and no history of previous orthodontic treatment. The lateral cephalograms were taken with teeth in maximum intercuspation and lips at rest. Imaging was performed with digital cephalometric panoramic equipment (CRANEX™3D, SOREDEX, Finland). The lateral cephalograms were traced on acetate sheets and measured by a single investigator. If the left and right projections were not matched in the cephalogram the midpoint of two sides was located. The definitions of cephalometric points, linear and angular measurements used

in this study are shown in **(Table 1)**.

The mandibular plane and palatal planes were drawn according to the definitions given by Down,s [15]. Anterior dental crowding in upper and lower arches was measured with the help of digital calipers using incisors irregularity index described by Robert M. Little [16]. Upper and lower incisors inclinations were evaluated through UI-PP (upper incisor palatal plane angle) and IMPA (incisor mandibular plane angle) respectively (table 1). The angulation of upper and lower molars were measured by the angles formed by the molars long axis (intercuspid groove-bifurcation) and the palatal plane and mandibular plane respectively [17]. **(Figures 1, 2).** The data obtained were recorded on a data collection form designed for this study.

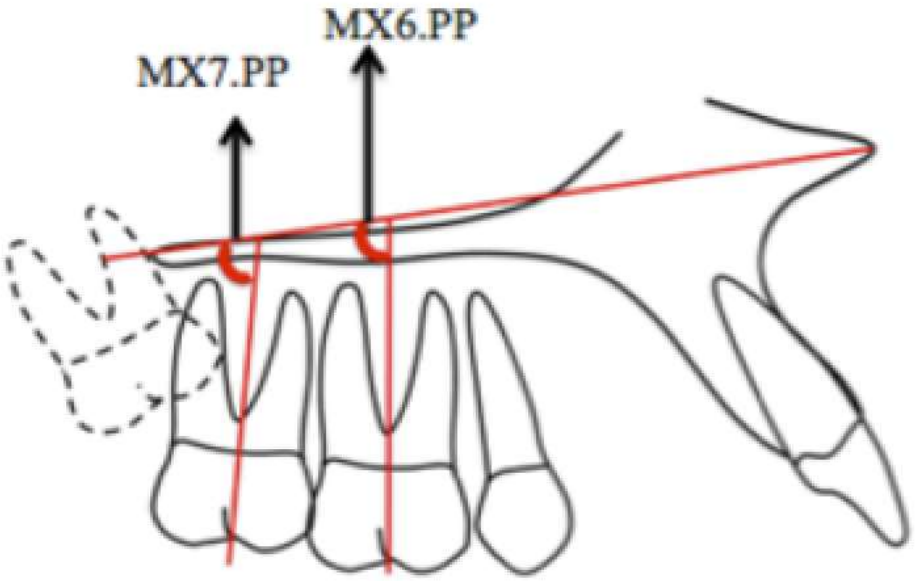

Fig. 1 Evaluation of maxillary molars angulations

Table 1. Definitions of cephalometric points and angles used in this study

Angular measurements	Definition
Maxillary molars	The distal angle formed by the maxillary first molar axis (intercuspid angulation groove, bifurcation) and the palatal plane (ANS-PNS) represented by a horizontal line[12].
Mandibular molars	The distal angle formed by the mandibular first molar axis (intercuspid angulation groove, bifurcation) and the palatal plane (ANS-PNS) represented by a horizontal line[12]
UI-PP	The angle between the maxillary incisor inclination and the palatal plane[11].
UI-SN	The angle between the maxillary incisor inclination and the SN plane.
IMPA	The angle formed by the intersection of the mandibular plane with a line Passing through the incisal edge and the apex of root of mandibular central incisor [15].

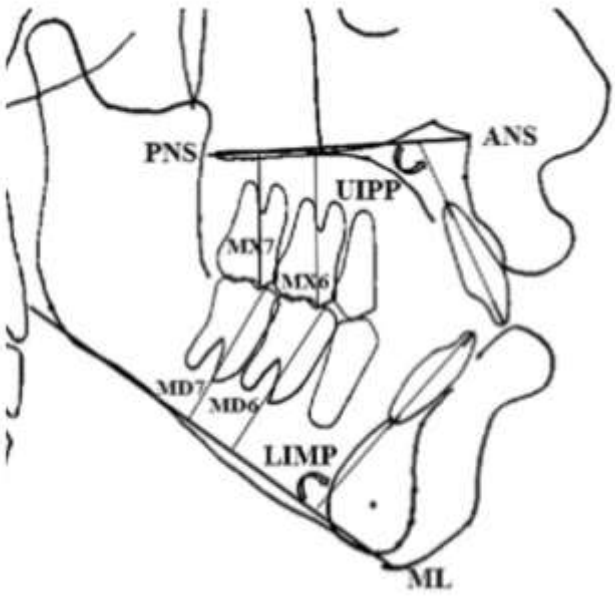

Fig. 2 Mandibular molars sagittal angulations and incisor inclination

Statistical analysis

All the statistical analysis was done using SPSS version 21 software. Descriptives tatistics including means, standard deviation and ranges were calculated for all the linear and angular variables used in the study. Correlation among molars angulation and other variables (overbite, incisal angulation, anterior crowding) were measured with the help of **Pearson,s product moment correlation.** Statistical significance was pre-determined at $p< 0.05$.

RESULTS

Descriptive statistics of the linear and angular measurements used are given in **Table 2.** Out of 82 subjects 39 were males and 42 were females. Mean age of the subjects in the entire sample was 17.72 $\pm$ 3.805 years.

A positive but insignificant correlation was found between upper molars angulation and anterior crowding. In the lower arch the correlation between molars angulation and lower anterior crowding was also positive but insignificant **(Table 3)**.

Table 4 shows a positive and significant correlation between upper 1st molar angulation and upper incisors inclination. In lower arch a similar pattern was observed among the angulation of lower 1st molar and lower incisors inclination**.** The subjects with more more mesial angulation of upper and lower 1st molars had increased labial inclination of upper and lower incisors respectively.

Table 2. Descriptive statistics of variables

Variables	N	Minimum	Maximum	Mean	Standard deviation
MX7.PP	82	63	101	79.77	7.324
MX6.PP	82	72	99	82.38	5.967
MD7.MP	82	71	104	86.94	6.837
MD6.MP	82	65	100	82.38	6.638
UI-SN	82	65	132	107.48	9.514
UI-PP	82	70	138	117.16	8.888
IMPA	82	70	117	99.24	8.646

MX7.PP= upper 2nd molar angulation, MX6PP= upper 1st molar angulation, MD7.MP= lower 2nd molar angulation, MD6.MP= lower 1st molar angulation, UI-SN= upper incisor to SN plane angle, UI-PP= upper incisor to palatal plane angle, IMPA= lower incisor mandibular plane angle.

Table 3. Correlation between molars angulation and anterior dental crowding

Upper molars angulation	Upper anterior crowding	
	r	*p*- value
MX7.PP	0.25	0.914
MX6.PP	0.12	0.879
Lower molars angulation	Lower anterior crowding	
MD7.MP	0.12	0.912
MD6.MP	0.35	0.825

Test of significance: Pearson's correlation
Level of significance: $p \leq 0.05$

Table 4. Correlation between molar angulation and incisors inclination

Upper molars angulation	Upper incisors angulation	
	r	*p*- value
MX7.PP	0.175	0.166
MX6.PP	0.223	0.044*
Lower molars angulation	Lower incisors angulation	
MD7.MP	0.57	0.612
MD6.MP	0.272	0.014*

Test of significance: Pearson's correlation (r)
Level of significance: $p \leq 0.05$
*$p \leq 0.05$

DISCUSSION

Andrews [18] included crown angulations in his six keys to normal occlusion and suggested that crown angulation is an important factor in obtaining a proper occlusal relationship. Angulation of upper and lower molars varies considerably among individuals and is considered to be a multifactorial phenomenon. The angulation of upper and lower molars changes in order to compensate for variation in the growth of apical bases in both sagittal and vertical directions.

The purpose of the current study was to determine the effect of molar angulation on anterior dental crowding and incisors inclination. In our study a positive correlation

was found between molars angulation and incisors inclination. The molars inclined more mesially in cases with proclined upper incisors. The results of our study are in agreement to the study carried out by Ali Aga et al [9]. They conducted a study to determine the effect of posterior space discrepancy and 3rd molar angulation on overbite and dental angulations. Their results showed that there was a positive correlation between molars angulation and incisors inclination in cases where there was sufficient space available for 3rd molar eruption, which is in agreement to our study although we did not include 3rd molars in our study.

Sangcharearn et al [19] conducted a study to determine the effect of incisors inclination on molar relationship. They find out that there was a very strong negative relationship between the angulation of upper incisors and molar relationships. The change in molar relationship was observed due to the change in the angulation of upper molars. In cases with proclined upper incisors, the molars tend to incline distally. The molars were more mesially inclined in cases with upright incisors. For every 5 degrees of change in incisors angulation the molar relationship changed by 0.46mm per side and vice versa. The difference in both studies can be due to the study design. The study carried out by Sangcharearn et al [19] was an in vitro study, carried out on experimental models, while our study was an observational study based on the pretreatment records of the actual patients. The in vivo conditions (like oro facial musculature) have a great influence on the tooth angulation. Such changes cannot be predicted in in vitro studies.

Regarding the relationship between angulation of lower molars and anterior crowding, we observed that there was a positive correlation between angulation of lower posterior teeth and anterior dental crowding. An observational study was carried out by Cherian and Ravi [20], which showed that the lower 1st and 2nd molars and the premolars were inclined mesially in cases with crowded lower incisors. These results are similar to our study. They also demonstrated that the presence of insufficient space for the lower 3rd molars was responsible for the mesial angulation of the posterior teeth, which is in accordance to the concept of posterior dentoalveolar discrepancy. The results of our study are in contradiction to the study carried out by Hasegawa et al [4]. They found that there was a lack of significant correlations between the tooth axis of most teeth in the lateral segment and Little's index of irregularity. Anterior dental crowding is a multi-factorial process and the etiological factors may differ between individuals (Including their ethnicity and genetics), which might be a possible cause for difference between both the studies. The study population of both the studies belonged to different ethnic groups.

Zacharsson et al [21] stated that mesially directed force is an important cause in lower anterior dental crowding. A possible explanation for this phenomenon is that the mesial movement in the buccal segment (mesial tipping of posterior teeth) results in rotation and mesial drift of the canine position at the point of greatest curvature of the dental arch [22]. These findings are similar to our

study and help to explain the effect the angulation of posterior teeth on anterior crowding.

Our study has certain limitations. First, we had a smaller sample size. Second, the correlations between all the variables were weak to moderate; therefore, a clearer outcome cannot be stated.

We recommend that the study should be carried out again in the future with a larger sample size. It will help to yield more predictable results that can have some useful clinical applications.

CONCLUSIONS

1. There was a positive correlation between molars angulation and inclination of incisors. The inclination of incisors changed according to the angulation of molars in both arches.
2. There was a positive but non-significant correlation between the angulation of posterior teeth and anterior crowding in both arches.

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