Original Article

Relation of Facial Growth Pattern with Molar's Axial Inclination

Erum Behroz Khan, Danish Ali Mottani, Sarvaich Kumar, Ayesha Bibi, Hunny Kumari, Sohail Khan

ABSTRACT

OBJECTIVE: To investigate the relationship between mesiodistal angulation of maxillary and mandibular 1st molar to different facial growth patterns.

METHODOLOGY: This cross-sectional study was conducted from January to February 2021 at the Jinnah Sindh Medical University, Karachi, Sindh. According to the non-probability consecutive sampling technique, a lateral cephalogram of 90 individuals (55 female and 35 male) with mean age 19.7±4.38 was analyzed for the vertical growth pattern. Only those patients with age between 14 to 30, teeth in permanent dentition, and presence of teeth posteriorly from 1st premolar to 2nd molar were included. Mesiodistal angle was measured of the maxillary and mandibular molar to the palatal plane (PP), mandibular plane(MP), and occlusal plane(OP). The findings were then related to the facial growth pattern. Data were analyzed utilizing SPSSversion 20.

RESULTS: Molar's angulation was significantly (P<0.001) related to the change in facial growth pattern. The mesiodistal angle of the molar increased with an increase in facial divergence and was relatively upright in patients with low-angle individuals. However, there was a decrease in both maxillary and mandibular molar's inclination on the occlusal plane with an increase in facial divergence.

CONCLUSION: A strong relationship exists between the molar mesiodistal inclination and facial growth pattern. This research presents relative information that can help the clinician in better diagnosis and treatment plan based on the pattern of individual's vertical growth.

KEYWORDS: Facial divergence, growth pattern, mandibular plane, masticatory force, molar inclination, occlusal plane, palatal plane

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INTRODUCTION

The stability of occlusion is of great importance in orthodontics. The masticatory system is considered to be well balanced when a stable occlusion is in synchronization with a stable temporomandibular joint position[1]. In any individual, an astable endoskeletal pattern can only be established when there is an equilibrium between intraoral forces that are exerted by the masticatory muscles, teeth, and bone[2]. Even if any skeletal malocclusion exists, there is significant dentoalveolar compensation that makes the malocclusion stable[3]. The purpose of this compensation is to keep the dentofacial component in proportion and harmony[4, 5]. However, this can cause the mandibular and maxillary molar to tip distal or mesial which in turn can bring changes in the facial pattern.

In literature, researchers have reported changes in the inclination of each tooth according to the facial growth pattern[6]. Adding to this, the mandibular molar inclination is found to be significantly reduced in the brachyfacial pattern[7]. Steiner in 1959 found that the harmony of the craniofacial relationship is reliant on the degree of variation of the measured values[8]. Bjork et al. predicted, that uprighting of mandibular and maxillary molars can be perceived as an essential dentoalveolar change that compensates for the divergent facial pattern that is typically related to open -bite characteristics[9].

Moreover, precise root positioning is as important as a crown. Relapse can be minimized and long-term stability can be achieved if the crowns and roots have accurate angulation[10]. However, there are limited studies done on the relationship between the mesiodistal angulation of molars and facial growth patterns. In regards to this, studies done previously have revolved around the dentoalveolar compensation of open bite, deep bite, and buccolingual inclination and very little attention have been paid to the angulation of posterior teeth mesiodistally[11].

Therefore, this research aimed to establish the relation between mesiodistal angulation of maxillary and mandibular 1st molar with different facial growth patterns. The results of this research will not only help in diagnosis but also will be helpful with a suitable treatment plan and better outcome.

METHODOLOGY

The study was a cross-sectional study and was conducted at the Orthodontics Department of Sindh Institute of Oral Health Sciences (SIOHS), Jinnah Sindh Medical University (JSMU), Karachi, Pakistan from January to February 2021. The research was reviewed and approved by the Institutional Ethical

Review Board (IERB) of JSMU (IR JSMU/IRB/2020/-392). 90pretreatments lateral cephalograms were obtained using a nonprobability consecutive sampling technique from the patients enrolled at the JSMU for their orthodontic treatment. All patients with ages between 14 to 30, teeth in permanent dentition, and the presence of teeth posteriorly from 1st premolar to2nd molar were included in the study. The exclusion criteria comprised of previous orthodontic treatment, periodontal disease, the existence of any metal prostheses or restoration in the maxillary or mandibular posterior teeth, infra-occluded molars/ submerged teeth, pathologic occlusal erosion or crown fractures, and presence of systemic conditions.

According to cephalometric analyses, three groups were formed:

Group, I comprised of 30 patients. In this group, subjects had a vertical growth pattern with the angle between the Frankfort's Horizontal plane (FH) and mandibular plane (MP)was more than 29° and sella-nasion plane(SN) and mandibular plane (MP) was more than 36°.

Group II comprised 30 patients. In this group, subjects had a normal growth pattern with the angle between the FH and MP was between 25°-29° and SN and MP was between 32–36°.

Group III comprised 30 patients. In this group, subjects had a horizontal growth pattern with the angle between the FH and MP was less than 25° and SN and MP were less than 32°.

Themesio-distal inclination of maxillary and mandibular 1st molar was measured with the mandibular plane (MP), palatal plane (PP), and occlusal plane (OP). Figure I

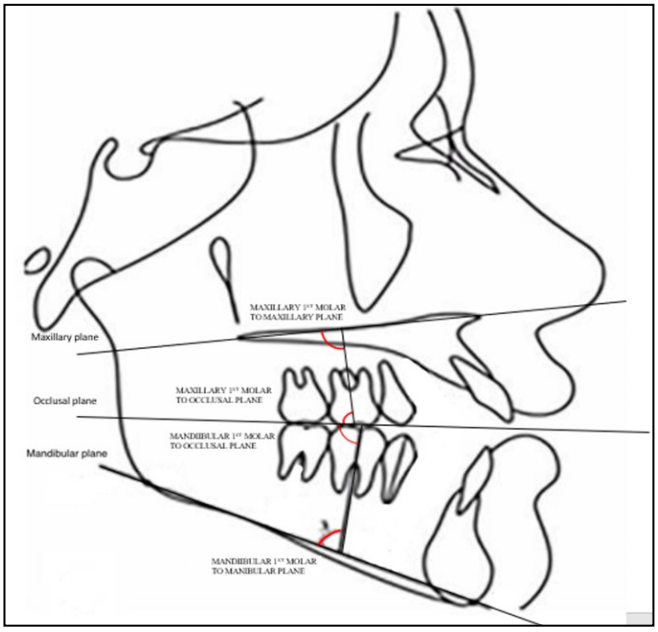
The OP was considered a horizontal line is drawn from the fully erupted mandibular molar extending anteriorly to the occlusal contact of the fully erupted premolars.

Data analysis was done utilizing SPSS for Windows (version 20.0, SPSS Inc. Chicago, USA). The categorical variables such as gender were presented as absolute frequencies and percentages. The numerical variables such as age and angles of facial growth patterns were presented as mean with standard deviation. A one-way ANOVA test was used to compare the angle of a molar with different facial growth patterns: horizontal, normal, and vertical. A p-value of < 0.05 was taken as statistically significant. For pairwise comparison post hoc LSD test was done if statistically significant results were found.

RESULTS

Out of ninety, 55 study patients were female and 35 were male with a mean age of 19.7±4.38. On cephalometric analysis, mean FH-MP increased from horizontal growth pattern21.56±3.47 to vertical growth pattern 32.50±2.17. The mean cephalometric measurements of the groups are shown in **Table I**.

FIGURE I:
CEPHALOMETRIC PLANES AND ANGULATIONS



On the palatal plane, the maxillary molar was found to be more inclined in subjects with vertical growth pattern88.54°±1.40° than in horizontal 79.56°±1.54°or normal growth pattern84.43°±1.35°. A significant difference between normal, horizontal, and vertical growth pattern was observed when one-way ANOVA was applied (P<0.001). The mean angle of the maxillary molar relative to the palatal plane and occlusal plane in 3 groups is shown in **Table II**. The molar's mesiodistal angle also increased with an increase in facial divergence i.e., it had an upward trend. On the contrary, it decreased on the occlusal plane i.e., it had a downward trend.

TABLE I: MEANS OF CEPHALOMETRIC MEASUREMENTS IN THREE GROUPS

	Mean ± SD		
Growth pattern	**Horizontal growth**	**Normal growth**	**Vertical growth**
SN-MP (°)	28.33 ± 2.97	33.53 ± 1.43	40.03 ± 2.50
FH-MP (°)	21.56 ± 3.47	26.63 ± 1.49	32.50 ± 2.17

n = number of cases

On the mandibular plane, the mandibular molar was found the be more inclined in subjects with vertical growth pattern87.84°±1.26° than in horizontal80.01° ±1.03° or normal growth pattern 84.58°±1.32°. A significant difference between normal, horizontal, and vertical growth patterns was observed when one-way ANOVA was applied(P<0.001). The mean angle of the mandibular molar about the mandibular and occlusal plane in 3 groups is shown in Table III. The mandibular molar's mesiodistal angle also increased as there was an increase in facial divergence i.e., it

had an upward trend. On the other hand, the mandibular molar's mesiodistal angle decreased on the occlusal plane i.e., it had a downward trend.

TABLE II: MEAN ANGLE OF MAXILLARY MOLAR TO PALATAL PLANE AND OCCLUSAL PLANE

	Mean ± SD			P-value
Growth pattern	Horizontal growth	Normal growth	Vertical growth	
Mx 6. MxP (°)	79.56±1.54	84.43±1.35	88.54±1.40	<0.001
Mx 6. OP (°)	89.23±1.10	87.78±1.21	80.11±0.93	<0.001

TABLE III – MEAN ANGLE OF MANDIBULAR MOLAR TO MANDIBULAR PLANE AND OCCLUSAL PLANE

	Mean ± SD			P-value
Growth pattern	Horizontal growth	Normal growth	Vertical growth	
Md 6. MdP (°)	80.01±1.03	84.58±1.32	87.84±1.26	<0.001
Md 6. OP (°)	90.40±1.32	87.30±1.37	80.20±1.15	<0.001

DISCUSSION

Incisal inclination has always been of much focus[12-14]. It has been long-established by Solow that there is a statistically significant association between jaw relation and incisal inclination[15]. However, posterior teeth inclination has not been considered to have a role in the development of malocclusion and is usually not considered in the diagnosis of malocclusion. In any malocclusion, the axial inclination of each tooth of the whole dentition is significant[16]. For the development of normal occlusion, dentoalveolar compensation plays a major role[17,18]. This compensation affects the position and inclination of teeth which is governed by multiple factors such as mastication, tongue, and muscles[19]. It is also found that the maxillary molar erupts more than the incisors which in turn reduces the inclination of OP with maxilla[20]. The inclination of posterior teeth takes a huge impact due to the vertical growth of the patient. Therefore, these different angulations found in molar seems to be essential to provide the compensation for the skeletal discrepancy during development.

The study was designed to evaluate the inclination of molar mesiodistally in patients with horizontal, normal, and vertical facial growth patterns. The sample in this study comprised 90 cephalometric radiographs carefully chosen according to the inclusion criteria. The results revealed that the molar inclination relative to the palatal, mandibular, and occlusal plane in different individuals, changes with the facial height i.e., these angles increased with an increase in vertical growth. Furthermore, these angulations had an inverse relationship relative to OP, these angles decreased with an increase in vertical growth. The findings were in good agreement with that of Badiee et al.[2]. Another study also reported that subjects with low mandibular plane angles have vertically positioned molars[21].

It is evident in the literature, that high masticatory forces are associated with a flat mandibular plane, increased posterior facial height, and a small gonial angle[22-26]. There is a significant role of functional demand on craniofacial growth and development[27]. These high forces might be responsible for the relative backward inclination of mandibular molars which are relatively upright in patients with horizontal growth patterns. The bite forces which are produced via the masticatory muscles not just affect the occlusal variation and dental arch form but also the structure of the mandible and its shape[28]. Thus, a significant change can be observed in the pattern of facial growth.

On the other hand, with more vertical growth in subjects, the forward inclination of molars was found. This may be due to the relative difference in the masticatory force. Multiple studies indicate that in subjects with more vertical growth, the maximum bite force generated by the masticatory muscle is lower than the normal[29]. This could be the reason behind the forward inclination of the molars. Although biting force is not dependent on facial height[29], chewing pattern and masticatory movements are closely related to the change in axial inclination of molar[30]. Mandibular molars are said to incline to a more upright posture when grinding strokes are used for chewing[30]. Perhaps most importantly, this study indicated that the facial growth pattern is highly related to the change in angulation of the molar and that the clinician should not overlook the angulation of posterior teeth. In future research, the author recommends studies with long-term follow-up and studies on individual age groups with increased sample sizes for further investigation.

CONCLUSION

A strong correlation exists between molar inclination and vertical facial growth. In subjects with increase vertical growth, molars were more forwardly inclined. On the other hand, molars had a comparatively backward angulation in subjects with more horizontal growth. Thus, identifying this can better help in precise diagnosis and treatment plans based on the pattern of an individual's vertical growth.

Ethical Approval: Jinnah Sindh Medical University Exemption letter for IRB letter No. JSMU/IRB/2020/-392, dated 19-01-2021.

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AUTHOR CONTRIBUTIONS

Khan EB: Conception or design of the work, Critical revision of the article, Final approval of the version to be published
Mottani DA: Conception or design of the work, Data collection, Data analysis and interpretation, Drafting the article, Final approval of the version to be published
Kumar S: Data collection, Final approval of the version to be published
Bibi A: Data analysis and interpretation, final approval of the version to be published
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Khan S: Critical revision of the article, Final approval of the version to be published

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AUTHOR AFFILIATION:

Dr. Erum Behroz Khan *(Corresponding Author)*
Associate Professor, Department of Orthodontics
Sindh Institute of Oral Health Sciences
Jinnah Sindh Medical University, Karachi, Sindh-Pakistan.
Email: erum.behroz@jsmu.edu.pk

Dr. Danish Ali Mottani
Resident, Department of Orthodontics
Sindh Institute of Oral Health Sciences
Jinnah Sindh Medical University, Karachi, Sindh-Pakistan.

Dr. Sarvaich Kumar
Resident, Department of Orthodontics
Sindh Institute of Oral Health Sciences
Jinnah Sindh Medical University, Karachi, Sindh-Pakistan.

Dr. Ayesha Bibi
Resident. Department of Orthodontics
Sindh Institute of Oral Health Sciences
Jinnah Sindh Medical University, Karachi, Sindh-Pakistan.

Dr. Hunny Kumari
Resident, Department of Orthodontics
Sindh Institute of Oral Health Sciences
Jinnah Sindh Medical University, Karachi, Sindh-Pakistan.

Dr. Sohail Khan
Resident, Department of Orthodontics
Sindh Institute of Oral Health Sciences
Jinnah Sindh Medical University, Karachi, Sindh-Pakistan.