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Original Article

Association of the Vertical and Sagittal Growth Patterns of Jaws with the Type of Third Molar Impactions: A Radiological Analysis

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ABSTRACT

Objective: To evaluate if the jaw growth patterns are associated with third molar impactions.
Design: Cross-sectional study.
Study setting: Orthodontics Department, Islamic International Dental College & Hospital Islamabad, Jan to Jun 2018.
Methods: We analysed the records of 300 mandibular and maxillary third molars with specific criteria. Orthopantomogram X-rays were used to identify impactions and were classified by Pell and Gregory (P&G) and Winter lines. In addition, lateral cephalograms were assessed for sagittal classes and vertical growth patterns.
Results: Angles of impaction (Winter lines) of mandibular M3s were significantly associated with sagittal growth patterns (p=0.021), with most mesioangular impactions found in Classes I and II. High-angle subjects resulted in the highest impactions in the vertical growth patterns. High angle was followed by low angle and normal angle in mandibular M3s and normal angle and low angle in maxillary M3s. Levels of maxillary M3s (P&G) and vertical patterns showed a significant association (p=0.016), with the highest M3s at level C. The maximum number of impacted M3 coexisted with P&G Class- II and level B for both jaws.
Conclusion: Significant associations were found between mandibular M3 angles, sagittal patterns, and levels of maxillary M3s and vertical patterns. Results conclude that facial growth patterns and M3 impactions are not completely independent and may help predict impaction status in adolescence and aid in orthodontic treatment.

Keywords: Third molar impactions, Sagittal class, Vertical growth pattern, Facial growth pattern.

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INTRODUCTION

Impaction is when a tooth fails to erupt into the dental arch within the specified time. Third molar (M3) impactions are commonly observed.[1] Etiological factors include genetics, space deficiency in the maxillary retromolar region and anterior border of the ramus of mandible, mandibular growth, facial growth patterns, remodelling of the ramus, direction of dentition, abnormal size, position or maturation of teeth, etc.[2] Knowledge of aetiology, eruption pattern, prognosis, and possible harmful effects of M3 impactions on the dentition is essential in successful orthodontic treatment planning, especially where first or second molar distalization may be required. [3] Impacted M3s may influence orthodontic treatment parameters such as distalization of molars, lower anterior teeth crowding, post-treatment relapse in crowding, molar uprighting, pericoronitis, and caries. Timely prediction and treatment may prevent these complications.[2,4]

Lack of retromolar space is an essential etiological factor that may be attributed to decreased mandibular growth or growth rotation pattern.[5,6] The normal growing mandible is directed forward and downwards with a normal vertical angle in the "mesofacial" or balanced facial pattern. The downward and backward growth of the mandible with a high vertical angle tendency leads to a "dolichofacial" or long and narrow face.[7] A forward and upward-growing mandible with a low vertical angle leads to a "brachyfacial" or short and wide face.[8,9]

The morphological characteristics in adolescence may help predict impactions and improve orthodontic prognosis. Thus, assessing the association between impactions and facial growth patterns is imperative. This study identified whether an association exists between M3 impactions and sagittal and vertical skeletal patterns in Pakistani subjects.

METHODOLOGY

The cross-sectional study was conducted at Orthodontics Department, Islamic International Dental College & Hospital Islamabad, from January to April, 2018. The Ethical Review Board approved the study (Number IIDC/IRC/2022/003/002).The sample size

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was estimated using the WHO sample size calculator taking the reported prevalence of third molar impactions of 24%.[10]

Inclusion Criteria: Subjects with impacted M3s, aged above 19 years, who have not undergone any extraction or orthodontic treatment, with high-quality orthopantomograms (OPGs) and lateral cephalograms were included in the study. The OPGs exhibiting at least two-thirds of the completed roots were included (Nolla stage above seven).

Exclusion Criteria: The OPGs showing congenitally missing M3s or those associated with any pathological lesion were excluded from the study.

A sample size of 300 M3s was chosen by non-probable convenient sampling method, from among the Orthodontics Department patient records. The classification of M3s is shown in the Figure. Three Winter lines classification is based on the inclination of the longitudinal axis of M3 relative to M2, as vertical (10 to -10°), mesioangular (10 to 80°), horizontal (80 to 100°), and distoangular (-10 to -80°). According to Pell and Gregory's (P&G) classification, the position of M3 relative to the occlusal plane of M2 was categorized into three levels. Level A is categorized when the highest point of M3 is at the same level or below the occlusal plane of the adjacent M2. Level B is denoted when the highest point of M2 is below the occlusal plane but above the cervical line of the adjacent M2. Level C is denoted when M3 is within the bone, its highest point is below the cervical line of M2.[11]

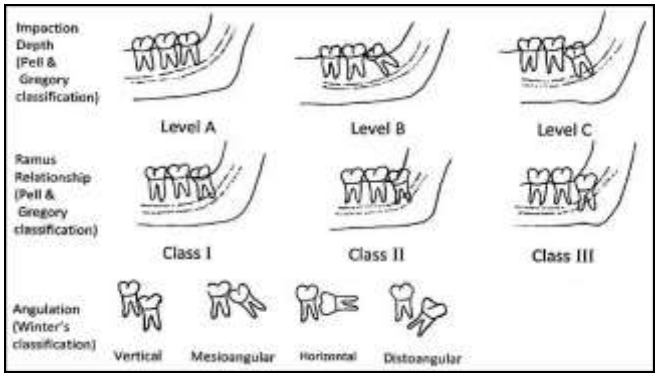

Figure: Types of third Molar Impactions According to Pell and Gregory and Winter lines Classification Systems

Secondly, the relationship of M3 to the ramus of the mandible was classified into three classes. Class- 1 is denoted when the space between the anterior border of the ramus and the distal surface of M2 is sufficient to accommodate the mesiodistal width of M3. Class- 2 is categorized when the space between the anterior border of the ramus and the distal surface of M2 is insufficient to accommodate the mesiodistal width of M2. Finally, Class- 3 is denoted when M3 is embedded in the bone because of the complete lack of space adjacent to M2.[12]

Skeletal growth was classified into vertical and sagittal patterns. The vertical growth was categorized into high, low and normal angles based on cephalometric indices such as the Jaraback index and angles such as MMA, SNMP and SNPP. The sagittal growth was categorized into sagittal Class- I, II, and III based on indices like ANB, SNA, and SNB angles (McNamara corrected values) and wits value.[13]

Statistical Package for the Social Sciences (SPSS) version 23 was used for data analysis. The chi-square test and Fisher's exact test was used to assess if an association existed between the groups. In addition, Cramer's V analysis was performed to test the strength of the association. The *p*-value of ≤0.05 was considered statistically significant.

RESULTS

A total of 300 impacted M3s were assessed radiographically, with 191 mandibular (63.7%) and 109 maxillary (36.3%) M3s. Table-I shows the distribution of mandibular M3 impactions according to Winter lines in sagittal and vertical growth patterns. Among the mandibular impacted M3s, 95(49.7%) belong to sagittal Class-I, 72(37.7%) to Class-II and 24(12.6%) to Class-III. The results showed a significant association between the angular positions of impaction (Winter lines) and the pattern of sagittal growth (p=0.021, Cramer's V value of 0.189). Class-l subjects showed the highest number of impactions of 95(49.7%), followed by Class- II with 72(37.7%) and Class-III with 12(12.6%) impactions. The mesioangular position was the most common, with 95 M3s of the total(49.7%).

High vertical angle subjects showed the highest number of impactions with 72 M3s (37.7%), followed by the normal angle with 63 M3s (33%) and low angle subjects with 56 M3s (29.3%). Among the maxillary impacted M3s, 54(49.5%), 44(40.4%), and 11 (10.1%) M3s belonged to sagittal Class-I, II and III, respectively (Table-II). Table-III shows that vertical growth angles and levels of impactions (P&G) were significantly associated (p=0.016, Cramer's V value of .242), with maximum M3s at P&G level C (40, 45.9%). Table-IV shows that the overall maximum of 100 and 90 M3s coexisted with P&G level B (52.4%) and P&G Class-2 (47.1%), respectively.

Table-I: Distribution of Mandibular Third Molars' Impaction Positions Based on Winter lines among Sagittal and Vertical Growth Patterns (n=300)

Growth Pattern	Impaction Positions Based on Winter lines				*p*-value
	Mesioangular	Distoangular	Vertical	Horizontal	
Sagittal-I	48(25.1%)	2(1.0%)	20(10.5%)	25(13.1%)	0.021
Sagittal Class- II	36(18.8%)	7(3.7%)	4(2.1%)	25(13.1%)	
Sagittal Class-III	11(5.8%)	1(0.5%)	6(3.1%)	6(3.1%)	
Vertical Normal Angle	29(15.2%)	4(2.1%)	8(4.2%)	22(11.5%)	0.069
Vertical Low Angle	37(19.4%)	3(1.6%)	6(3.1%)	10(5.2%)	
Vertical High Angle	29(15.2%)	3(1.6%)	16(8.4%)	24(12.6%)	

Table-II: Distribution of Maxillary Impacted Third Molars in Sagittal Growth Patterns (n=300)

Sagittal Growth Pattern		Impaction Positions Based on Winter Lines				*p*-value
		Mesioangular	Distoangular	Vertical	Horizontal	
	Class- 1	17(15.6%)	14(12.8%)	21(19.3%)	2(1.8%)	0.137
	Class- 2	15(13.8%)	7(6.4%)	22(20.2%)	0(0.0%)	
	Class- 3	1(0.9%)	6(5.5%)	4(3.7%)	0(0.0%)	

Table-III: Distribution of Pell & Gregory levels of Maxillary Impacted Third Molars in Vertical Growth Patterns (n=300)

Vertical Growth Pattern	Impactions Levels Based on P&G			*p*-value
	A	B	C	
Normal Angle	8(7.3%)	16(14.7%)	10(9.2%)	0.016
Low Angle	2(1.8%)	11(10.1%)	24(22.0%)	
High Angle	3(2.8%)	19(17.4%)	16(14.7%)	

Table-IV: Distribution of Mandibular and Maxillary Third Molars among the Pell and Gregory Impaction Levels and Classes (n=300)

M3s	P&G Impactions Levels			P&G Impactions Classes		
	Level A	Level B	Level C	Class-1	Class-2	Class-3
Mandibular (Total 191)	47 (24.6%)	100 (52.4%)	44 (23.0%)	66 (34.6%)	90 (47.1%)	35 (18.3%)
Maxillary (Total 109)	13 (11.9%)	46 (42.2%)	50 (45.9%)	40 (36.7%)	46 (42.2%)	23 (21.1%)

DISCUSSION

The association between patterns of M3 impactions and jaw growth has been analyzed in this study. The impaction status of 300 M3s was radiographically evaluated within the jaw growth patterns. A significant, albeit weak, association was observed between the angular positions of impaction (Winter lines) and the sagittal growth patterns (p=0.021, Cramer's V value of 0.189). Most impactions belonged to sagittal Class- I (49.7%), followed by (37.7%) of Class- II, and the least (12.6%) to Class- III. These findings suggest that the angles of impaction and sagittal growth patterns are not independent. Class- II pattern was predominant after Class- I, and a high percentage of mesioangular M3s (36 M3s, 18.8%) coexisted with Class-II. Moreover, fewer impactions coexisted with Class-III. Richardson *et al*. also reported a higher incidence of M3 impaction in Class-II with a retrognathic mandible.[12] Similarly, Ifesanya and Aladelusi reported a significant association between the angles of impaction and the sagittal skeletal patterns.[13] The results suggest that a deficient mandible such as in Class-II may be associated with a higher mesioangular impaction pattern, since the space may be reduced for the M3s to direct vertical to the mandibular plane. [14] Grover *et al*. has also reported increased M3 impaction with decreased growth of the mandible.[15] Likewise, Bjork *et al*. reported that 90% of subjects with mandibular M3 impaction had reduced retromolar space.[16] Since the mandible is more prognathic in Class-III, impactions were more likely to predominate in Class-I or II.[17]

For maxillary impactions, vertical skeletal pattern and the levels of M3s (P&G) showed a significant association (p=0.016). The highest number of maxillary M3s were present at level C, impacted within the bone (40 cases, 45.9%). Whereas some studies reported that maximum M3s were observed at level B.18,19 The high vertical angle cases had the highest impactions of 19 M3s at level B (17.4%) and 16 M3s at level C (14.7%), and low angle cases at level C, 20 M3s (22%). Maxillary restriction may be a possible reason for increased impacted M3s within the bone. The vertical growth pattern and impactions according to Winter lines and P&G classes showed no significant associations. Moreover, the vertical position was the most common angular position among the maxillary impactions.

This study has added to the literature by presenting data from the Pakistani population. Significant associations have been found between angles of mandibular impactions and sagittal growth patterns and between maxillary impactions levels (P&G) and vertical angles. These findings may be clinically

essential as they assist orthodontists in predicting and treating the angulation and levels of impacted M3s of patients with certain sagittal and vertical skeletal discrepancies. Further longitudinal study designs are recommended for future research.

CONCLUSIONS

Higher impactions were observed in subjects with Class-II compared to Class-III, decreasing with increased sagittal growth of the mandible and, possibly, retromolar space. The angles of mandibular impactions and sagittal growth patterns showed a weakly significant association. The Class-II subjects had the highest mesioangular M3s, which may indicate the inability to upright M3s. M3 impaction incidence was highest in the increased vertical growth pattern. Levels of maxillary impactions (P&G) and vertical angles were significantly associated, with the highest M3s coexisting with level C. Facial growth patterns and M3 impactions are not completely independent and may help predict impaction status and aid in orthodontic treatment.

Conflict of Interest: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

AS: Conception, interpretation of data, drafting the manuscript, approval of the final version to be published.

SK: Study design, data analysis, drafting the manuscript, critical review, approval of the final version to be published.

AS: Critical review, approval of the final version to be published.

MB: Data acquisition, interpretation of data, approval of the final version to be published.

OKD: Study design, Drafting the manuscript, interpretation of data, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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