Scientific Foundation SPIROSKI, Skopje, Republic of Macedonia
Open Access Macedonian Journal of Medical Sciences. 2022 Sep 12; 10(D):389-397.
https://doi.org/10.3889/oamjms.2022.10301
eISSN: 1857-9655
Category: *D - Dental Sciences*
Section: *Orthodontics*

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Evaluation of the Position and Incidence of Impaction of Mandibular Third Molars in Different Anteroposterior and Vertical Skeletal Patterns: A Retrospective Study

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Edited by: Aleksandar Iliev
Citation: Zarzora A, Foda MY, El Dawlatly MM, Dehis HM. Evaluation of the Position and Incidence of Impaction of Mandibular Third Molars in Different Anteroposterior and Vertical Skeletal Patterns: A Retrospective Study. Open-Access Maced J Med Sci. 2022 Sep 12; 10(D):1-9. https://doi.org/10.3889/oamjms.2022.10301
Keywords: Impaction; Mandibular third molar; Anteroposterior and vertical facial skeletal patterns; Orthopantomogram; Lateral cephalometry; β angle
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Received: 02-Jun-2022
Revised: 04-Aug-2022
Accepted: 02-Sep-2022

Funding: This research did not receive any financial support
Competing Interest: The authors have declared that no competing interest exists

Abstract

AIM: This study aims to evaluate the incidence of impacted mandibular third molar in different anteroposterior and vertical facial skeletal patterns and to evaluate the angle of impaction of mandibular third molar.

METHODS: A total of 207 panoramic and lateral cephalometric radiographs for patients above 20 years old with impacted mandibular third molar were recruited from the orthodontic department clinics in multiple universities in Egypt and traced using WebCeph™ software. From the lateral cephalograms, three anteroposterior measurements were taken which were termed as ANB, A-B difference, and Wits appraisal and three vertical angles were measured which were SN/MP, MMPA, and FMPA to determine different skeletal facial types. The angulation of mandibular third molar impaction was determined by β angle according to Winter's classification from the orthopantomogram.

RESULTS: Among all 207 analyzed cases, impacted third molars were detected in 38.6% of cases unilaterally and 61.4% bilaterally. Anteroposteriorly, the higher percentage of total impactions was found in subjects with a Class 2 skeletal pattern (97.2%). Vertically, the higher percentage of total impactions was found in subjects with a mesocephalic facial pattern (45.9%). The most common type of impaction was mesioangular based on Winter's classification.

CONCLUSION: A higher incidence of lower third molar impaction was found in subjects with a Class 2 skeletal pattern. A higher incidence of lower third molar impaction was found in subjects with a mesocephalic facial pattern. In almost all skeletal facial types, the mesioangular position of the impacted mandibular third molar was the most prevalent position.

Introduction

Impaction can be defined as a tooth that is prevented from erupting ultimately into its normal functional position by either bone, tooth, or fibrous tissue within the expected time. Many etiological factors might be related to impaction including long, tortuous path of eruption, tooth size and arch length discrepancies, arch width deficiencies, and microform. In addition, familial tendency, genetics, population differences, abnormal position of the tooth bud, presence of an alveolar cleft, and cystic or neoplastic formation were found to have a strong causative effect on impaction. Impacted tooth is a common condition that affects more than 70% of the world's population according to recent global figures. It was reported that the mandibular third molar is the most commonly encountered impacted tooth followed by upper third molar and maxillary canines. Nevertheless, there is a scarcity in the published literature regarding the incidence of impacted lower third molar with different skeletal facial pattern in Egypt [1], [2], [3].

The third molar varies more than the other molars in terms of shape, size, timing of eruption, and even tendency toward impaction. The rate of third molar impaction is higher than other teeth in modern populations. The mandibular third molar is by far the most frequently impacted tooth after the maxillary third molar. They account for 98% of all impacted teeth [4], [5], [6].

Shortage of space between the second molar and the ramus has long been identified as a major factor in the etiology of mandibular third molar impaction. Björk *et al*. noted that in subjects with mandibular third molar impaction, the alveolar arch space behind the second molar was reduced in 90% of the cases. It has been reported that the space necessary for the third molar is diminished by several factors, including backward direction of eruption of the dentition [7], [8].

The study by Nanda noted that brachyfacial patients exhibited a prolonged period of facial growth in contrast to dolichofacial patients. It would be interesting to observe if this additional growth means that it is more likely for changes in impaction status to occur in brachyfacial subjects over time [9].

Finally, due to the above-mentioned controversies, further studies should be done to evaluate the incidence of mandibular third molar impaction.

Materials and Methods

Materials

Study design

This study was designed as an observational, cross-sectional, and retrospective study.

Setting

Participants

The subjects included panoramic and lateral cephalometric radiographs of Egyptians above 20 years old.

Studied population

Panoramic and lateral cephalometric radiographs were recruited from the orthodontic department clinics in multiple universities in Egypt for 6 months from January to June of 2021. The study was conducted on 207 panoramic and lateral cephalometric radiographs. The College Research Committee approved it Faculty of Dentistry, Cairo University, Egypt.

Eligibility criteria

Panoramic and lateral cephalometric radiographs enrolled in this research included the following criteria:

Inclusion criteria

1. Egyptian patients with impacted mandibular 3rd molar.
2. Age: Above 20 years old.
3. Sex: Both sexes were included.
4. Full permanent dentition.

Exclusion criteria

The exclusion criteria include one or more of the following:

1. Previous orthodontic treatment.
2. Patient with cleft palate or mandible.
3. Radiographs of poor quality or artifacts.
4. Any hereditary diseases or syndromes such as Down's syndrome or cleidocranial dysostosis.
5. Any disease, trauma, or fracture of the jaw that might have affected the normal growth of permanent dentition.

Sample size calculation

A power analysis was designed to have adequate power to apply a statistical test of the null hypothesis that there is no relation between anteroposterior and vertical skeletal patterns and the position and rate of impacted lower third molars. According to the results of Shokri *et al*. [5] in which the prevalence of impacted third molar (16.06%) – and by adopting a confidence interval of (95%), a margin of error of 5% with finite population correction; the predicted sample size (n) was a total of (207) cases. Sample size calculation was performed using Epi Info for Windows version 7.2.

Population definition

Panoramic and lateral cephalometric radiographs were recruited from the orthodontic department clinics in multiple universities in Egypt for 6 months from January to June of 2021.

Steering committees

The study protocol was revised and approved by the center of Evidence-Based Committee, Faculty of Dentistry, Cairo University on March 3, 2020.

The protocol was approved by the council of Orthodontics, Faculty of Dentistry, Cairo University on March 3, 2020.

The study proposal was reviewed and approved by the Research Ethics Committees of the Faculty of Dentistry, Cairo University, Egypt, on April 30, 2020, with approval number April 1, 2020.

Declaration of interests

Non-financial competing interests: The study was a part of a MSc degree in Orthodontics, Faculty of Dentistry, Cairo University.

No financial conflict of interests was to be declared. The study was self-funded by the principal investigator.

Methods

WebCeph™ is an online orthodontic and orthognathic platform for dental clinicians. It is designed and coded by an orthodontist. It was used to trace the lateral cephalograms and orthopantomograms. The orthopantomograms and lateral cephalograms were inserted to the software and it traced them automatically. Manual editing was done to improve some landmarks. Three anteroposterior measurements were taken from the lateral cephalograms which were termed as ANB, A-B difference, and Wits appraisal, Figures 1, 2 and 3.

These angles were used to determine different skeletal patterns. If two or more of these angles were normal, the patient was categorized as skeletal Class 1. If two or more of these angles were above normal, the patient was categorized as skeletal Class 2. If two or

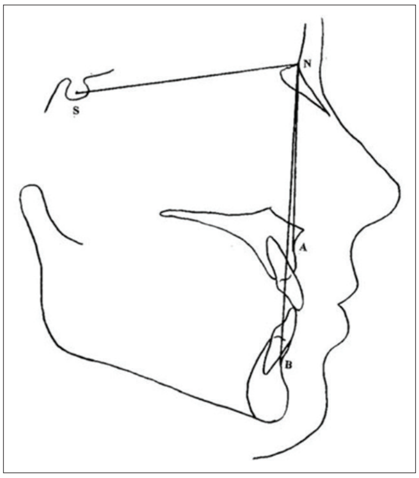

Figure 1: A diagram representing assessment of ANB angle

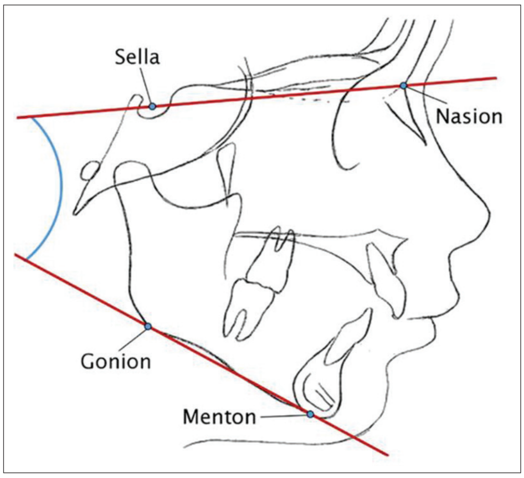

Figure 4: A diagram representing assessment of SN/MP angle

more of these angles were low, so the patient was categorized as skeletal Class 3.

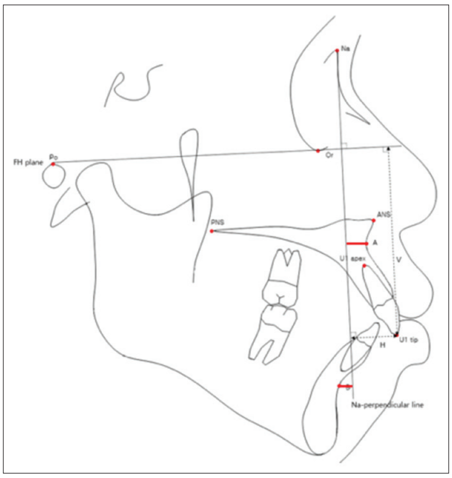

Figure 2: A diagram representing assessment of A-B difference

Three vertical angles were measured from the lateral cephalograms which were SN/MP, MMPA, and FMPA, Figures 4 and 5.

These angles were used to determine different skeletal facial types. If two or more of these angles were normal, the patient was categorized as mesiofacial. If two or more of these angles were above normal, the patient was categorized as dolichofacial. If two or more of these angles were low, the patient was categorized as brachyfacial.

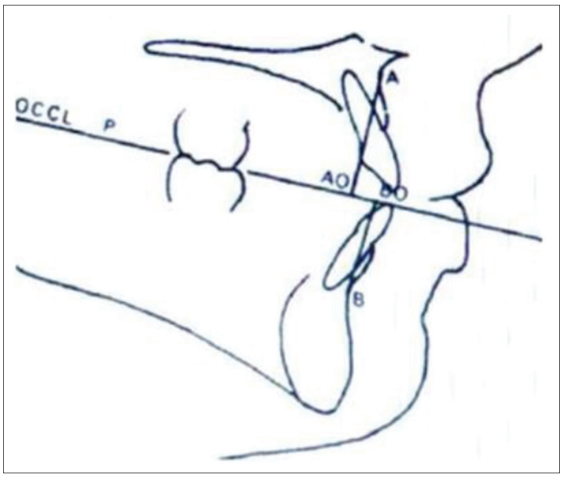

Figure 3: A diagram representing assessment of Wits appraisal

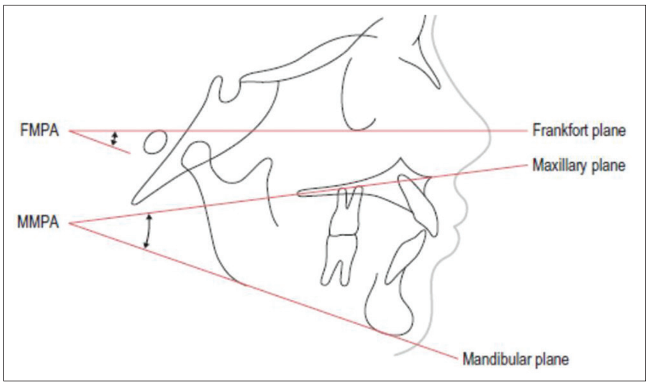

Figure 5: A diagram representing assessment of MMPA and FMPA

The angulation of mandibular third molar impaction was determined by β angle according to Winter's classification Table 1; which is the angle formed between intersecting long axis of mandibular second molar and mandibular third molar drawn through

Table 1: Winter's classification of mandibular third molar angulations

Mandibular third molar angulations	β angle
Distoangular	≤–11°
Vertical	–10 –10°
Mesioangular	11–79°
Horizontal	≥80°

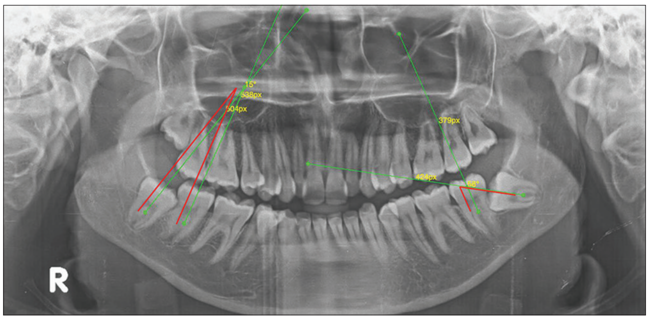

Figure 6: Orthopantomogram showing β angle

Table 2: Skeletal landmarks used for lateral cephalometric analysis

Landmark	Definition
Subspinale (A point)	The deepest point of the anterior curve of the maxilla between the ANS and the *dental* alveolus.
Supramentale (B point)	The deepest point in the concavity along the anterior border of the mandibular symphysis.
Nasion (N)	Anterior most midpoint of the anterior contour, summit of the frontonasal suture.
Sella (S)	Center of the pituitary fossa in the middle cranial fossa-midpoint of the sella turcica.
Gonion (Go)	The midpoint on the angle of the mandible, halfway between the corpus and ramus.
Menton (Me)	The most inferior point on the mandibular symphysis.
Porion (Po)	Most superior point of the external auditory meatus.
Orbitale (Or)	The most inferior point of infraorbital rim.
ANS	The tip and most anterior point of the anterior nasal spine of the maxilla.
PNS	The tip and most posterior point of the posterior nasal spine of the palatine bone.

ANS: Anterior nasal spine, PNS: Posterior nasal spine.

the midpoint of occlusal surface and midpoint of root bifurcation, Figure 6. Skeletal landmarks, reference lines and planes, vertical and anteroposterior measurements used for lateral cephalometric analysis were traced and measured using WEBCEPH™ software as shown in Figure 7 and Tables 2-5.

Table 3: Reference lines and planes used for lateral cephalometric analysis

Reference lines and planes	Abbreviation	Definition
Frankfurt horizontal plane	FHP	Plane through Orbitale and anatomical porion points.
Palatal plane (maxillary plane)	PP	Plane connecting the anterior nasal spine to the posterior nasal spine.
Mandibular plane	MP	Plane through gonion and menton points.
Sella-nasion line	S-N	Line between the sella and nasion points.
Occlusal plane	OP	Line between anterior and posterior points of occlusion.
Nasion-perpendicular line	N-perp	Line from nasion point to the chin perpendicular to Frankfurt plane.

Initial screening of the sample measurements was done by the principal investigator (A.Z). All the measurements were done by the same observer twice (A.Z) and by another observer (H.D) for a sample of lateral cephalograms and orthopantomograms for the assessment of the intra- and inter-observer reliability. Measurements were tabulated into Excel sheet (version 2021).

Table 4: Anteroposterior skeletal measurements used for lateral cephalometric analysis

Measurement	Abbreviation	Unit	Definition
ANB	ANB	Degree (°)	Angle between points A, N, and B.
Maxillary position	A-NP	Millimeter (mm)	Linear distance between point A and nasion-perpendicular line.
Mandibular position	B-NP	Millimeter (mm)	Linear distance between Point B and Nasion-perpendicular line.
A-B difference	A-B diff	Millimeter (mm)	(B-NP) subtracted from (A-NP).
Wits appraisal	Wits appraisal	Millimeter (mm)	The difference between A perpendicular to occlusal plane and B perpendicular to occlusal plane.

Measurements were based on the study of Sapkota *et al*. [8] which assessed the position of impacted mandibular third molar in different vertical skeletal facial types in Nepalese samples with age range from 16 to 33 years. However, in the present study, the position of impacted mandibular third molar was assessed in different vertical and anteroposterior skeletal facial types and the patients age was above 20 years old to be sure that impaction will occur (Ryalat *et al.*, 2018) [10], [11].

Table 5: Vertical skeletal measurements used for lateral cephalometric analysis

Measurement	Abbreviation	Unit	Definition
Mandibular plane inclination	MP/SN	Degree (°)	The angle between the SN plane and the mandibular plane.
Maxillary mandibular Plane angle	MMPA	Degree (°)	The angle between the palatal plane and the mandibular plane.
Frankfurt mandibular plane angle	FMPA	Degree (°)	The angle between the Frankfurt horizontal plane and the mandibular plane.

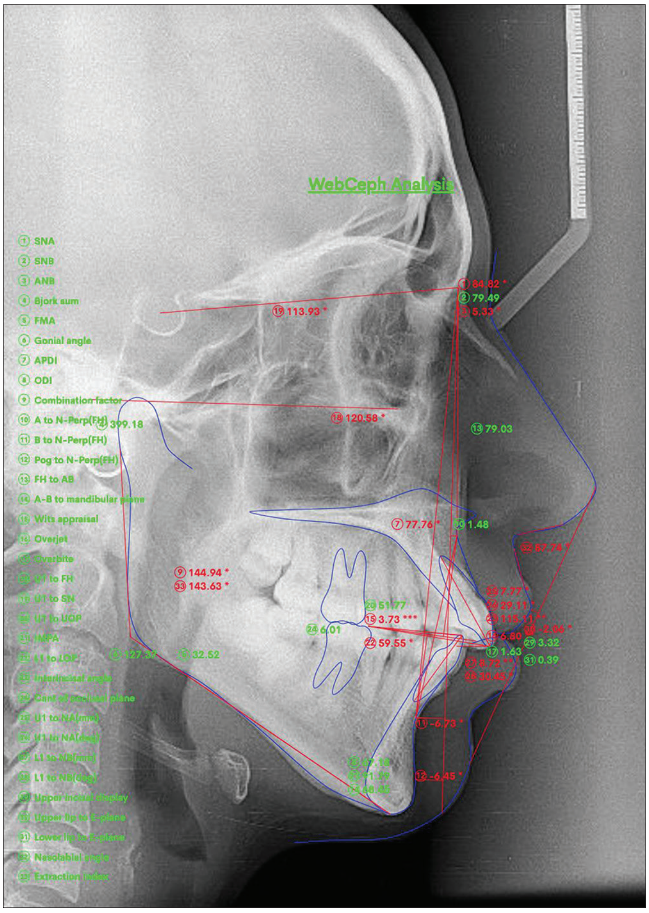

Figure 7: Lateral cephalogram showing WEBCEPH™ analysis

Statistical analysis

1. Statistical analysis was performed with R statistical analysis software version 4.1.2 for Windows[1].
2. Categorical data were presented as frequency and percentage values; all data are presented in 7 Tables and 7 graphs.
3. Associations between categorical data were analyzed using Fisher's exact test.
4. The significance level was set at $p \leq 0.05$.

Results

This study was conducted to evaluate the position and incidence of impaction of mandibular third

1 1R Core Team (2021). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

molars in different anteroposterior and vertical skeletal patterns among Egyptian population. The results are represented under the following subtitles:

1. Incidence of impacted third molar
2. Third molar angulation
3. Distribution of anteroposterior skeletal patterns
4. Distribution of facial types
5. Association between anteroposterior skeletal pattern and facial type
6. Association between anteroposterior skeletal pattern and impaction angulation
7. Association between facial type and impaction angulation

Incidence of impacted third molar

Frequencies (n) and percentages (%) for incidence of impacted third molar are presented in Table 6 and Figure 8.

Table 6: Frequencies (n) and percentages (%) for incidence of impacted third molar

Impacted third molar	n	%
Unilateral	80	38.6
Bilateral	127	61.4

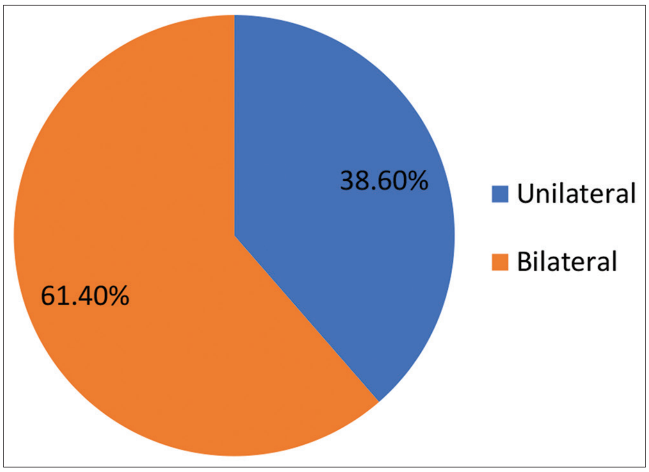

Figure 8: Pie chart showing incidence of impacted third molar

In 207 analyzed cases, impacted third molars were detected in 80 (38.6%) cases unilaterally and

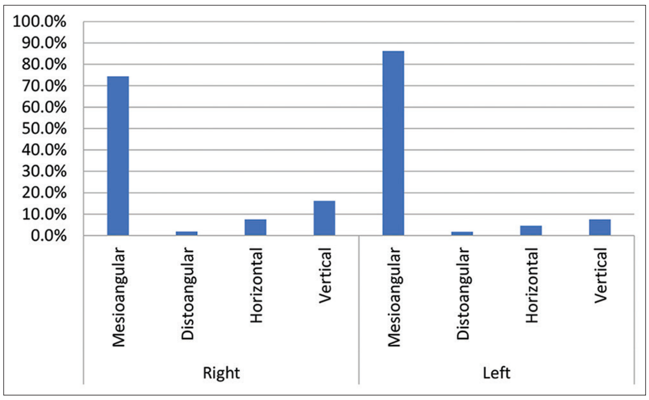

Figure 9: Bar chart showing third molar angulation

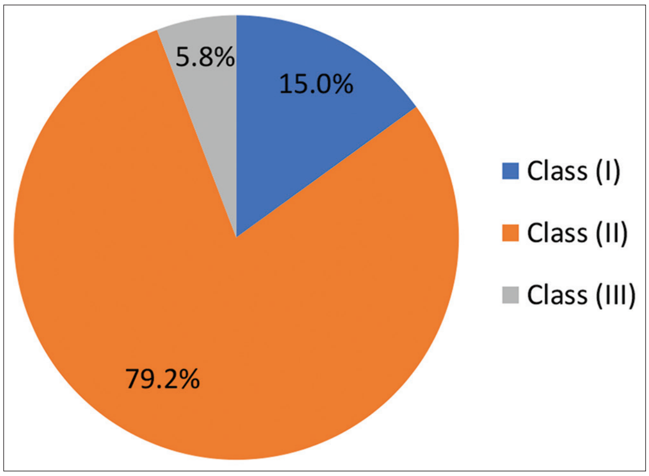

Figure 10: Pie chart showing distribution of anteroposterior skeletal patterns

127 (61.4%) bilaterally.

Third molar angulation

Frequencies (n) and percentages (%) for third molar angulation are presented in Table 7 and Figure 9.

Table 7: Frequencies (n) and percentages (%) for third molar angulation

Side	Third molar angulation	n	%
Right (n = 160)	Mesioangular	119	74.4
	Distoangular	3	1.9
	Horizontal	12	7.5
	Vertical	26	16.2
Left (n = 174)	Mesioangular	150	86.2
	Distoangular	3	1.7
	Horizontal	8	4.6
	Vertical	13	7.5

One hundred and sixty molars were found in the right side, 119 (74.4%) of which had mesioangular angulation, 3 (1.9%) had distoangular angulation, 12 (7.5%) were horizontal, and 26 (16.2%) were vertical.

Out of 174 impacted third molars found in the left side, 150 (86.2%) had mesioangular angulation, 3 (1.7%) had distoangular angulation, 8 (4.6%) were horizontal, and 13 (7.5%) were vertical.

Distribution of anteroposterior skeletal patterns

Frequencies (n) and percentages (%) for distribution of anteroposterior skeletal patterns are presented in Table 8 and Figure 10.

Table 8: Frequencies (n) and percentages (%) for distribution of skeletal patterns

Anteroposterior skeletal pattern	n	%
Class (1)	31	15.0
Class (2)	164	79.2
Class (3)	12	5.8

Table 9: Frequencies (n) and percentages (%) for distribution of facial types

Facial type	n	%
Brachycephalic	50	24.2
Mesocephalic	95	45.9
Dolichocephalic	62	30.0

Out of the analyzed 207 cases, 31 (15.0%) were skeletal class (1), 164 (97.2%) were class (2), and 12 (5.8%) were class (3).

Distribution of facial types

Frequencies (n) and percentages (%) for distribution of facial types are presented in Table 9 and Figure 11.

Out of the analyzed 207 cases, 50 (24.2%) were brachycephalic, 95 (45.9%) were mesocephalic, and 62 (30.0%) were dolichocephalic.

Association between anteroposterior skeletal pattern and facial type

Frequencies (n) and percentages (%) for the association between skeletal pattern and facial type are presented in Table 10 and Figure 12.

Table 10: Frequencies (n) and percentages (%) for the association between skeletal pattern and facial type

Facial type	Class (1)		Class (2)		Class (3)		p-value
	n	%	n	%	n	%	
Brachiocephalic	14	45.2	33	20.1	3	25.0	0.018*
Mesocephalic	13	41.9	75	45.7	7	58.3	
Dolichocephalic	4	12.9	56	34.1	2	16.7	

*Significant (p ≤ 0.05) ns; non-significant (p > 0.05).

There was a significant association between anteroposterior skeletal pattern and facial type (p = 0.018), with the majority of cases with skeletal class (1) having brachiocephalic face 14 (45.2%), while most of the cases with skeletal class (2) and (3) having a mesocephalic face 75 (45.7%) and 7 (58.3%), respectively.

Association between anteroposterior skeletal pattern and impaction angulation

Frequencies (n) and percentages (%) for the association between skeletal pattern and impaction angulation are presented in Table 11 and Figure 13.

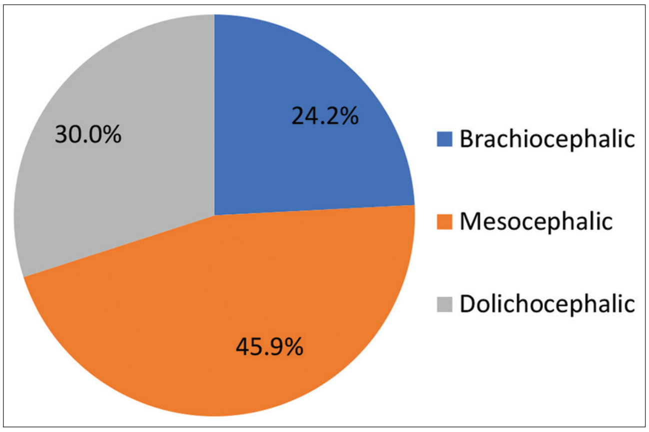

Figure 11: Pie chart showing distribution of facial types

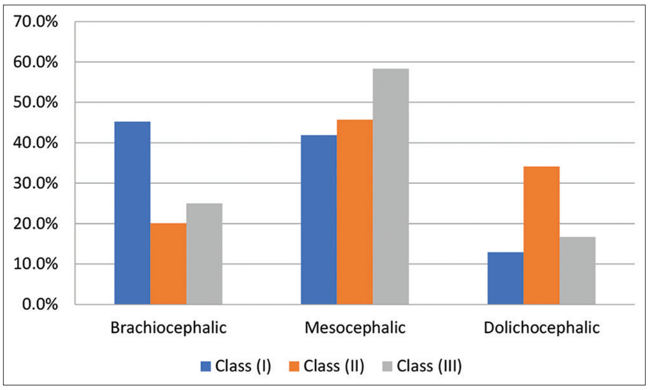

Figure 12: Bar chart showing the association between anteroposterior skeletal pattern and facial type

Table 11: Frequencies (n) and percentages (%) for the association between anteroposterior skeletal pattern and impaction angulation

Side	Impaction angulation	Class (1)		Class (2)		Class (3)		p-value
		n	%	n	%	n	%	
Right (n = 160)	Mesioangular	21	75.0	91	74.6	7	70.0	0.683^{ns}
	Distoangular	1	3.6	2	1.6	0	0.0	
	Horizontal	1	3.6	11	9.0	0	0.0	
	Vertical	5	17.9	18	14.8	3	30.0	
Left (n = 174)	Mesioangular	24	85.7	119	86.9	7	77.8	0.420^{ns}
	Distoangular	0	0.0	2	1.5	1	11.1	
	Horizontal	2	7.1	6	4.4	0	0.0	
	Vertical	2	7.1	10	7.3	1	11.1	

*Significant (p ≤ 0.05), ns: Non-significant (p > 0.05).

On the right and left sides, there was no significant association between anteroposterior skeletal pattern and impaction angulation (p > 0.05) with the majority of cases of all skeletal patterns having a mesioangular impaction.

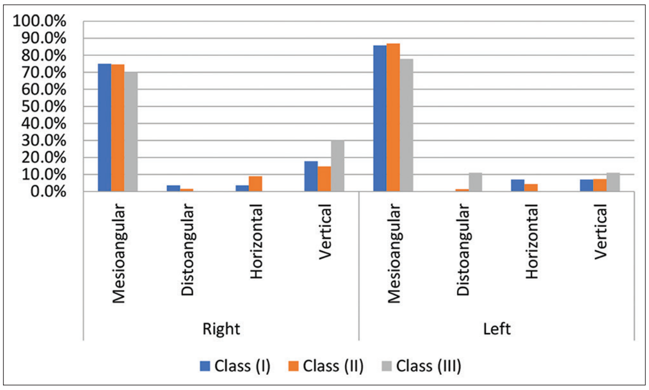

Figure 13: Bar chart showing the association between anteroposterior skeletal pattern and impaction angulation

Association between facial type and impaction angulation

Frequencies (n) and percentages (%) for the association between facial type and impaction angulation are presented in Table 12 and Figure 14.

On the right and left sides, there was no significant association between facial type and impaction angulation (p > 0.05) with the majority of cases of all facial types having a mesioangular impaction.

Table 12: Frequencies (n) and percentages (%) for the association between facial type and impaction angulation

Side	Impaction angulation	Brachiocephalic		Mesocephalic		Dolichocephalic		p-value
		n	%	n	%	n	%	
Right (n = 160)	Mesioangular	27	64.3	61	75.3	31	83.8	0.188[ns]
	Distoangular	1	2.4	2	2.5	0	0.0	
	Horizontal	4	9.5	4	4.9	4	10.8	
	Vertical	10	23.8	14	17.3	2	5.4	
Left (n = 174)	Mesioangular	37	82.2	67	90.5	46	83.6	0.135[ns]
	Distoangular	0	0.0	2	2.7	1	1.8	
	Horizontal	4	8.9	0	0.0	4	7.3	
	Vertical	4	8.9	5	6.8	4	7.3	

*Significant ($p \leq 0.05$) ns; non-significant ($p > 0.05$).

Discussion

Initial screening of the sample was done to ensure that all requirements were met. The principal investigator was in charge of the measurements (A.Z). For the purpose of assessing intra- and inter-observer reliability, a sample of lateral cephalograms and orthopantomograms was measured twice by the same observer (A.Z) and once by another observer (H.D) to avoid bias and to ensure accuracy.

For early detection and treatment of impacted teeth, practitioners need to know the incidence of impacted teeth. In teenagers and adults, dental impaction most commonly affects third molars and upper canines. The lower third molar is the most commonly impacted tooth followed by the upper third molar [12].

The etiology of impactions is multifactorial, the most evident of which is the lack of space for the third molar to erupt due to the short mandibular length. Shorter mandibular length in dolichofacial patients predisposes to impaction. Dolichofacial faces had a higher rate of mandibular third molar impaction (49.2%), compared to mesofacial faces (40.2%) and brachyfacial faces (10.6%) [13], [14].

In various populations, mandibular third molar impaction ranges from 18 to 32%. The third molar (90%) was shown to be the most often impacted tooth, with a higher frequency in the mandible (60%) than in the maxilla (30%) [15], [16].

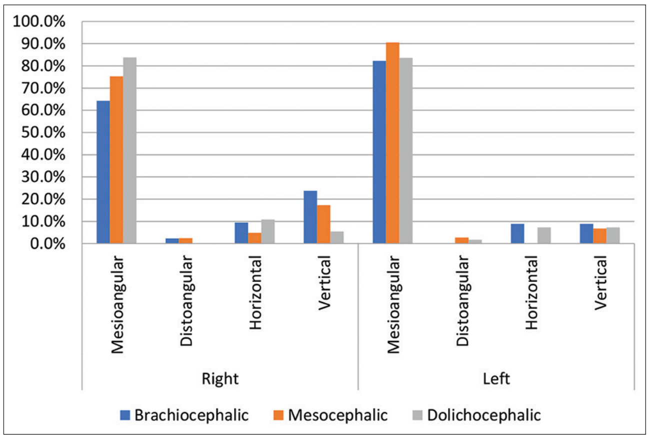

Figure 14: Bar chart showing the association between facial type and impaction angulation

The alveolar arch space distal to the second molar was diminished in 90% of cases of mandibular third molar impaction. The provision of sufficient space is linked to mandibular growth. Premolar extractions were found to have a favorable effect on growing maxillary third molar angulations on both the right and left sides in the previous studies. The previous research has linked three skeletal characteristics to space insufficiency for third molar eruption: Short mandibular length, vertically directed condylar growth, and backward directed dentition eruption [17], [18].

Reviewing the literature, there were no studies done on the Egyptian population to evaluate the position and incidence of impacted mandibular third molar in different skeletal facial patterns. Consequently, the aim of this retrospective study was to evaluate the position and incidence of impacted mandibular third molar in different anteroposterior and vertical skeletal patterns. This could give an insight and provide useful clinical information regarding orthodontic diagnosis and treatment planning.

The sample in the present study was selected from Egyptian patients with impacted mandibular third molar, their age was above 20 years to ensure that the common chronological age for eruption of third molars has passed although the previous studies were done on patient above 16 years only [19]. Both sexes were included with full permanent dentition. Patients with previous orthodontic treatment were excluded from this study as orthodontic treatment may affect the eruption of the mandibular third molars. Patients with clefts were excluded as well. Radiographs with poor quality were eliminated as their data may be misleading [20].

WEBCEPH™ software was used to trace the lateral cephalograms and orthopantomograms to ensure accuracy and standard measurements although the previous studies used manual measurements [21]. Radiographs of poor quality or artifacts were excluded from the study. The anteroposterior relationship of maxillary and mandibular apical bases was measured using ANB, A-B difference, and Wits assessment, despite earlier research only measuring ANB [22]. If two or more of these angles were normal, so the patient was categorized as skeletal Class 1. If two or more of these angles were above normal, so the patient was categorized as skeletal Class 2. If two or more of these angles were low, so the patient was categorized as skeletal Class 3.

The vertical relationship was determined by measuring the SN/MP, MMPA, and FMPA angles, despite the fact that most earlier research only measured one angle [8], [23], [24]. If two or more of these angles were normal, so the patient was categorized as mesiofacial. If two or more of these angles were above normal, so the patient was categorized as dolichofacial. If two or more of these angles were low, so the patient was categorized as brachyfacial.

The angulation of mandibular third molar impaction was determined by β _angle; which is the angle formed between intersecting long axis of mandibular second molar and mandibular third molar drawn through the midpoint of occlusal surface and midpoint of root bifurcation [25], [26]. If β angle is ≤ –11°, the mandibular third molar angulation is distoangular. If β angle is 10–10°, the mandibular third molar angulation is vertical. If β angle is 11–79°, the mandibular third molar angulation is mesioangular. If β angle is 10–10°, the mandibular third molar angulation is vertical. If β angle is ≥80°, the mandibular third molar angulation is horizontal [8].

In this study 207 analyzed cases, impacted third molars were detected in 80 (38.6%) cases unilaterally and 127 (61.4%) bilaterally. Most patients had bilateral impaction. Unilateral impaction may be due to congenital absence or extraction. This result is identical to the result of [8] who found that rate of mandibular third molar impaction was more bilaterally 52.66% than unilateral impaction 11.11% [8].

Out of 334 impacted mandibular third molars, 269 had mesioangular angulation, 39 had vertical angulation, 20 had horizontal angulation, and six were distoangular. The most common type of angulation is the mesioangular and the least type is the distoangular. This result is identical to the result of Shokri *et al*. [5], Sapkota *et al*. [8] found that the mesioangular position was the most common position, followed by the horizontal, vertical, and distoangular positions Shokri *et al*. [5]. Vilela and Vitoi [14] found that the vertical position was most prevalent followed by mesioangular position [27]. Ventä and Turtola; Quek *et al.*, 2003; and Sandhu and Kaur, 2005, reported that the mesioangular position was the most prevalent one [28], [29], [30].

Regarding anteroposterior plane, impacted mandibular third molar was present mostly in Class 2 patients (79.2%) then in Class 1 patients (15%) and least in Class 3 patients (5.8%) only and this is may be due to insufficient anteroposterior dimension of the alveolar process in the third molar region.This result is different from the result of Abu Alhaija *et al*. who found that higher incidence of lower third molar impaction was found in subjects with a class 3 skeletal pattern [31].

Regarding vertical plane, impacted third molar was 45.9% in the mesocephalic facial type, 30% in dolichocephalic one, and 24.2% in brachycephalic type. This result is different from Sapkota *et al.*, 2018, which found that mandibular third molar impaction was most in dolichocephalic facial type (49.2%) then mesocephalic (40.2%) and least in brachycephalic type (10.6%). Bashir *et al.,* 2016, found that impaction was most common in mesiofacial and dolichofacial patients and overall impaction rate was more in females [32].

Regarding anteroposterior and vertical planes, the majority of cases with skeletal Class 1 had brachiocephalic face 14 (45.2%), while most of the cases with skeletal Classes 2 and 3 had a mesocephalic face 75 (45.7%) and 7 (58.3%), respectively. The highest percentage of impaction was in Class 2 mesocephalic cases.

Results were different from some previous studies due to racial differences and differences in the study's methodology, including sample selection, the definition of the impacted tooth, and the individual's age [8], [32]. Limitation of this study was the sample size and sample type; thus, wider population groups should be studied in Egypt in further research. Because orthodontic patients are more likely to have malocclusion and possible crowding, they are more likely to have mandibular third molar impaction than the general population [11]. The findings cannot be generalized because the study was conducted on a small sample. The duration of an eruption and its impaction status are unpredictably variable.

Conclusion

From the results of the present study, the following conclusions could be withdrawn:

1. A higher incidence of lower third molar impaction was found in subjects with a Class 2 skeletal pattern.
2. A higher incidence of lower third molar impaction was found in subjects with a mesocephalic facial pattern.
3. A correlation was detected between the facial form and the incidence of mandibular third molar impaction.
4. In almost all skeletal facial types, the mesioangular position of the impacted mandibular third molar was the most prevalent position.

References

1. Brakus I, Filipovic Zore I, Boric R, Siber S, Svegar D, Kuna T. Analysis of impacted and retained teeth operated at Department of oral surgery, school of dental medicine, Zagreb. Coll Antropol. 2010;34 Suppl 1:229-33.
PMid:20402324
2. Santosh P. Impacted mandibular third molars: Review of literature and a proposal of a combined clinical and radiological classification. Ann Med Health Sci Res. 2015;5(4):229-34. https://doi.org/10.4103/2141-9248.160177
PMid:26229709
3. Bishara SE, Andreasen G. Third molars: A review. Am J Orthod. 1983;83(2):131-7. https://doi.org/10.1016/s0002-9416(83)90298-1
PMid:6572040
4. Bishara SE. Third molars : A dilemma ! Or is it ? Am J Orthod Dentofac Orthop. 1999;115(6)628-33. https://doi.org/10.1016/s0889-5406(99)70287-8

PMid:10358244

5. Shokri A, Mahmoudzadeh M, Baharvand M, Mortazavi H, Faradmal J, Khajeh S, *et al*. Position of impacted mandibular third molar in different skeletal facial types: First radiographic evaluation in a group of Iranian patients. Imaging Sci Dent. 2014;44(1):61-5. https://doi.org/10.5624/isd.2014.44.1.61

   PMid:24701460

6. Björk A, Jensen E, Palling M. Mandibular growth and third molar impaction. Acta Odontol Scand. 1956;14(3):231-72. https://doi.org/10.1043/0003-3219(1991)061<0223:MGATMI>2.0.CO;2

   PMid:1928824

7. Nanda SK. Patterns of vertical growth in the face. Am J Orthod Dentofac Orthop. 1988;93(2):103-16. https://doi.org/10.1016/0889-5406(88)90287-9

   PMid:3422525

8. Sapkota MR, Bhatta S, Shrestha S, Shrestha RM. Position of impacted mandibular third molar in different skeletal facial types. Orthod J Nepal. 2018;7(2):15-9. https://doi.ORG/10.3126/ojn.v7i2.20154

9. Ryalat S, AlRyalat SA, Kassob Z, Hassona Y, Al-Shayyab MH, Sawair F. Impaction of lower third molars and their association with age: Radiological perspectives. BMC Oral Health. 2018;18(1):58. https://doi.org/10.1186/s12903-018-0519-1

   PMid:29618350

10. Dewel BF. Clinical observations on the axial inclination of teeth. Am J Orthod. 1949;35(2):98-115. https://doi.org/10.1016/0002-9416(49)90111-6

    PMid:18110477

11. Breik O, Grubor D. The incidence of mandibular third molar impactions in different skeletal face types. Aust Dent J. 2008;53(4):320-4. https://doi.org/10.1111/j.1834-7819.2008.00073.x

    PMid:19133947

12. Smailienė D, Trakinienė G, Beinorienė A, Tutlienė U. Relationship between the position of impacted third molars and external root resorption of adjacent second molars: A retrospective CBCT study. Medicina (Kaunas). 2019;55(6):305. https://doi.org/10.3390/medicina55060305

    PMid:31238599

13. Bashir S, Rasool G, Afzal F. Incidence of mandibular 3 Rd molar impactions in different facial types of orthodontic patients. Pak Oral Dental J. 2016;36(2):1-3.

14. Vilela EM, Vitoi PA. Study of position and eruption of lower third molars in adolescents. RSBO. 2011;8(4):390-7.

15. Quek SL, Tay CK, Tay KH, Toh SL, Lim KC. Pattern of third molar impaction in a Singapore Chinese population: A retrospective radiographic survey. Int J Oral Maxillofac Surg. 2003;32(5):548-52.

    PMid:14759117

16. Sandhu S, Kaur T. Radiographic evaluation of the status of third molars in the Asian-Indian students. J Oral Maxillofac Surg. 2005;63(5):640-5. https://doi.org/10.1016/j.joms.2004.12.014

    PMid:15883938

17. Ventä I, Turtola L, Ylipaavalniemi P. Radiographic follow-up of impacted third molars from age 20 to 32 years. Int J Oral Maxillofac Surg. 2001;30(1):54-7. https://doi.org/10.1054/ijom.2000.0002

    PMid:11289622

18. Abu Alhaija ES, Albhairan HM, Alkhateeb SN. Mandibular third molar space in different antero-posterior skeletal patterns. Eur J Orthod. 2011;33(5):570-6. https://doi.org/10.1093/ejo/cjq125

    PMid:21187531

19. Richardson ME. The etiology and prediction of mandibular third molar impaction. Angle Orthod. 1977;47(3):165-72. https://doi.org/10.1043/0003-3219(1977)047<0165:TEAPOM>2.0.CO;2

    PMid:268949

20. Eröz UB, Ceylan I, Aydemir S. An investigation of mandibular morphology in subjects with different vertical facial growth patterns. Aust Orthod J. 2000;16(1):16-22.

    PMid:11201956

21. Hattab FN, Abu Alhaija ES. Radiographic evaluation of mandibular third molar eruption space. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1999;88(3):285-91. https://doi.org/10.1016/s1079-2104(99)70029-6

    PMid:10503855

22. Kjaer I. Mechanism of human tooth eruption: Review article including a new theory for future studies on the eruption process. Scientifica (Cairo). 2014;2014:341905. https://doi.org/10.1155/2014/341905

    PMid:24688798

23. Lai CS. Bornstein MM, Mock L, Heuberger BM, Dietrich T, Katsaros C. Impacted maxillary canines and root resorptions of neighbouring teeth: A radiographic analysis using cone-beam computed tomography. Eur J Orthod. 2013;35(4):529-38. https://doi.org/10.1093/ejo/cjs037

    PMid:22828076

24. Shokri A, Mahmoudzadeh M, Baharvand M, Mortazavi H, Faradmal J, Khajeh S, *et al.* Position of impacted mandibular third molar in different skeletal facial types: First radiographic evaluation in a group of iranian patients. Imaging Sci Dent. 2014;44(1):61-5. https://doi.org/10.5624/isd.2014.44.1.61

    PMid:24701460

25. Smailienė D, Trakinienė G, Beinorienė A, Tutlienė U. Relationship between the position of impacted third molars and external root resorption of adjacent second molars: A retrospective CBCT study. Medicina (Kaunas). 2019;55(6):305. https://doi.org/10.3390/medicina55060305

    PMid:31238599

26. Bjork A. Variations in the growth pattern of the human mandible: Longitudinal radiographic study by the implant method. J Dent Res. 1963;42(1)Pt 2:400. https://doi.org/10.1177/00220345630420014701

    PMid:13971295

27. Al-Gunaid TH, Bukhari AK, El Khateeb SM, Yamaki M. Relationship of mandibular ramus dimensions to lower third molar impaction. Eur J Dent. 2019;13(2):213-21.

28. Al-Khateeb TH, Bataineh AB. Pathology associated with impacted mandibular third molars in a group of Jordanians. J Oral Maxillofac Surg. 2006;64(11):1598-602. https://doi.org/10.1016/j.joms.2005.11.102

    PMid:17052585

29. Aliaga-Del Castillo A, Janson G, Arriola-Guillén LE, Laranjeira V, Garib D. Effect of posterior space discrepancy and third molar angulation on anterior overbite. Am J Orthod Dentofac Orthop. 2018;154(4):477-86. https://doi.org/10.1016/j.ajodo.2017.12.014

    PMid:30268258

30. Farzanegan F, Goya A. Evaluation of mandibular third molar positions in various vertical skeletal malocclusions. J Dent Mater Tech. 2012;1(2):58-62.

31. Harputluoğlu S. Effects of removing inferior alveolar neurovascular structures on mandibular growth and the eruption of permanent dentition in puppies. Oral Surg Oral Med Oral Pathol. 1990;70(2):147-9. https://doi.org/10.1016/0030-4220(90)90107-4

    PMid:2290639

32. Cheng HC, Peng BY, Hsieh HY, Tam KW. Impact of third molars on mandibular relapse in post-orthodontic patients: A meta-analysis. J Dent Sci. 2018;13(1):1-7. https://doi.org/10.1016/j.jds.2017.10.005

    PMid:30895087