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RESEARCH

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The association of third molars with mandibular incisor crowding in a group of the Yemeni population in Sana'a city: cone-beam computed tomography

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Abstract

Background Multiple factors contribute to mandibular incisor crowding. However, the role of wisdom teeth in these irregularities remains a controversial issue among clinicians. Therefore, this study aimed to determine the potential association between mandibular incisor crowding and the presence or absence of lower wisdom teeth using CBCT image analysis.

Materials and methods A total of 64 CBCT images of adult patients were recruited. These CBCT images were classified into two groups according to the presence or absence of the lower wisdom teeth on the panoramic view. After the classification, the severity of crowding was calculated by utilizing Little's irregularity index. Points such as A point, Nasion, and B point (Supramentale) were identified on the software program. The significance level was set at $P < 0.05$.

Results There was no statistically significant correlation ($P = 0.780$) in the crowding of the mandibular incisor among the groups with the presence or absence of the lower wisdom teeth. Group 1 (with wisdom teeth) was 5.85 ± 4.05 mm, classified as a moderate irregularity; similarly, group 2 (without wisdom teeth) showed moderate irregularity with a mean value of 5.32 ± 3.12 mm. There was an incisor crowding with a severe irregularity in 18 patients (28.1%), a minimal irregularity in 15 patients (23.4%), a moderate irregularity in 14 patients (21.9%), a very severe irregularity in 10 patients (15.6%), and a perfect alignment in 7 patients (10.9%).

Conclusions The presence and absence of lower wisdom teeth do not influence the mandibular incisor crowding.

Keywords Third molars, Wisdom teeth, Mandibular incisor crowding, CBCT

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Introduction

Tertiary crowding, also known as late crowding, refers to irregularities and is usually noticed in the middle of adolescence or late teenage years[1]. Late crowding of mandibular incisors is a prevalent issue that occurs more frequently than maxillary crowding. Notably, over 40% of people generally have moderate to severe mandibular incisor crowding [2]. Several factors, including growth-related changes, race, muscle imbalance, periodontal condition, bone adaptation, tooth dimension, masticatory force, etc., may be responsible for anterior crowding and relapse after orthodontic treatment [1, 3, 4].

The relationship between third molars and mandibular anterior crowding has been discussed for a long time in literature; however, no definitive conclusions can be drawn [2, 3, 5]. In individuals who had orthodontic treatment, some studies failed to find a relationship between mandibular anterior crowding and third molars [4]. Nevertheless, the other studies conducted on individuals with or without prior orthodontic treatment did not confirm this finding. Several factors contribute to this phenomenon, necessitating further studies to determine the etiology of mandibular anterior crowding [1].

Compared to their European colleagues, a higher percentage of American orthodontists might suggest the preventative extraction of wisdom teeth [4]. To avoid unwanted incisor irregularities, maxillofacial surgeons were more likely to advocate mandibular wisdom tooth removal [4].

However, insufficient evidence supports the hypothesis that the third molar extraction prevents relapse after orthodontic treatment or late crowding [1, 4].

Cone beam computed tomography (CBCT) is widely utilized in orthodontics, especially in complex clinical cases, for evaluation and treatment planning. It can produce high-resolution images with submillimeter accuracy in considerably shorter scanning times. It's usually described as accurate and reliable for linear measurements, and studies have shown that it usually includes lower levels of radiation dose than traditional computed tomography (CT) techniques. CBCT-synthesized panoramic views exhibit the benefit of having no geometric distortion, magnification, or structural overlap like conventional two-dimensional images [6]. Most of the studies that evaluated the correlation between anterior crowding and the mandibular third molar used two-dimensional imaging techniques, such as orthopantomograms and cephalograms; furthermore, they applied cast analysis methods such as Little's irregularity index (LII). A limited number of studies have utilized CBCT for evaluation [1, 7].

Yemen, located in the southwest of the Arabian Peninsula, is considered a developing country. One study in Yemen conducted among dentists found that 72% believed mandibular third molar eruption contributes to anterior teeth crowding and recommended prophylactic extraction to prevent anterior crowding [8]. However, it is important to note that this evidence is not particularly strong, as it is based on a survey of professional opinions rather than on clinical or empirical data. Surveys can reflect beliefs or practices that may not always align with scientifically validated outcomes, highlighting the need for more robust studies to confirm such claims. To our knowledge, there haven't been any studies done on the Yemeni population regarding the relationship between wisdom teeth and mandibular incisor crowding. Therefore, the objective of this study is to evaluate the association between the absence or presence of mandibular third molars and the incidence of mandibular incisor crowding in a group of the Yemeni population in Sana'a city using CBCT images. The null hypothesis is that the mandibular third molars do not significantly differ in the consequence of mandibular incisors crowding.

Materials and methods

Study design

This retrospective observational cross-sectional study. A total of 64 CBCT images of adult patients were recruited from an imaging center in Sana'a City (the Capital of Yemen) between March 2023 and January 2024. These CBCT images were categorized into two groups: group I, in which the third molars were present, and group II, in which the third molars were absent, with 32 images in each group. The inclusion criteria for this study were as follows: patients with Class I skeletal pattern (ANB angle between 2° and 4°), all permanent teeth present, aged between 18 and 30 years, and both lower third molars were either present or absent. Additionally, subjects with healthy periodontium as indicated by their records and good-quality radiographs. The exclusion criteria were patients with unilateral mandibular third molar, the presence of interproximal caries, interproximal anterior restorations, crowns, or bridges, subjects with dental anomalies in size, morphology, or number, impacted teeth other than third molars, the presence of deciduous teeth, and any history of previous orthodontic treatment (Supplementary Figure).

Before the commencement of the study, ethical approval from the Medical Ethics Committee of the Faculty of Dentistry at Ibn Alnafis University was obtained (Ref #: 171/2023). Also, this study was conducted in accordance with the guidelines of the Declaration of Helsinki, and informed consent was obtained from each of the participants.

Data collection

CBCT scans were conducted with subjects positioned upright using the following parameters: scanning time of

15.0 s, field of view measuring 15 × 15 cm, tube voltage ranging from 50 to 99 kV, tube current varying from 4 to 16 mA, and voxel size set between 0.2 and 0.3. The scans were performed using the PaX-i3D Green (model name: PHT-60 CFO; Vatech Co., Hwaseong, Korea) imaging device. The resulting data was exported in DICOM multifile format and analyzed using three-dimensional image analysis software (Ez3Di 2009; Ewoosoft, Co., Ltd., Hwaseong, Korea). Processing of the CBCT images was conducted on a 64-bit Windows 10 system. Visualization of all images occurred on a DELL Precision 7720 UHD Graphics 17-inch screen with a resolution of 1920 × 1080 pixels in a dimly lit environment. To ensure optimal visualization, adjustments to contrast, sharpness, and brightness were made using the software's image processing tools.

Construction of the multiplanar windows

In the beginning, the multiplanar windows (coronal plane, sagittal plane, axial plane, & 3D plane) were reconstructed on all planes. First, determining the tooth to be measured the anatomical contact point on the 3D plane, then transfer to the axial plane and make the point of instruction of the lines on the incisal edge of the tooth to be measured. After that, it transfers to the coronal plane of the tooth in which the line passes through the long axis from the tooth tip to the root apex while ensuring that the sagittal plane also passes through the tooth tip to the root apex [9], Fig. 1.

CBCT assessment

The samples were classified into two groups (I and II) by looking for the absence or presence of the lower wisdom teeth on the panoramic view. After classification, the severity of crowding was calculated using Little's irregularity index [10]. Points such as A point, Nasion, and B point (Figs. 2, 3 and 4), and Little's irregularity index were identified on the software program (Ez3Di 2009; Ewoosoft, Co., Ltd., Hwaseong, Korea) according to their definitions found in the literature [10–12]. The measurement parameters included the following: A Point-Nasion-B Point angle, Class I skeletal pattern, Mandibular plane formed by connecting Gonion (Go) to Menton (Me), Mandibular Plane angle (SN-MP); the angle between the Sella-Nasion (SN) line and the Mandibular Plane (MP), and Little's Irregularity Index (LII). More details about definitions and scores used in the current study are presented in Table 1 [10, 13–15].

Reconstruct the images in axial slices with a thickness of 0.1 mm to detect the anatomical contact points and

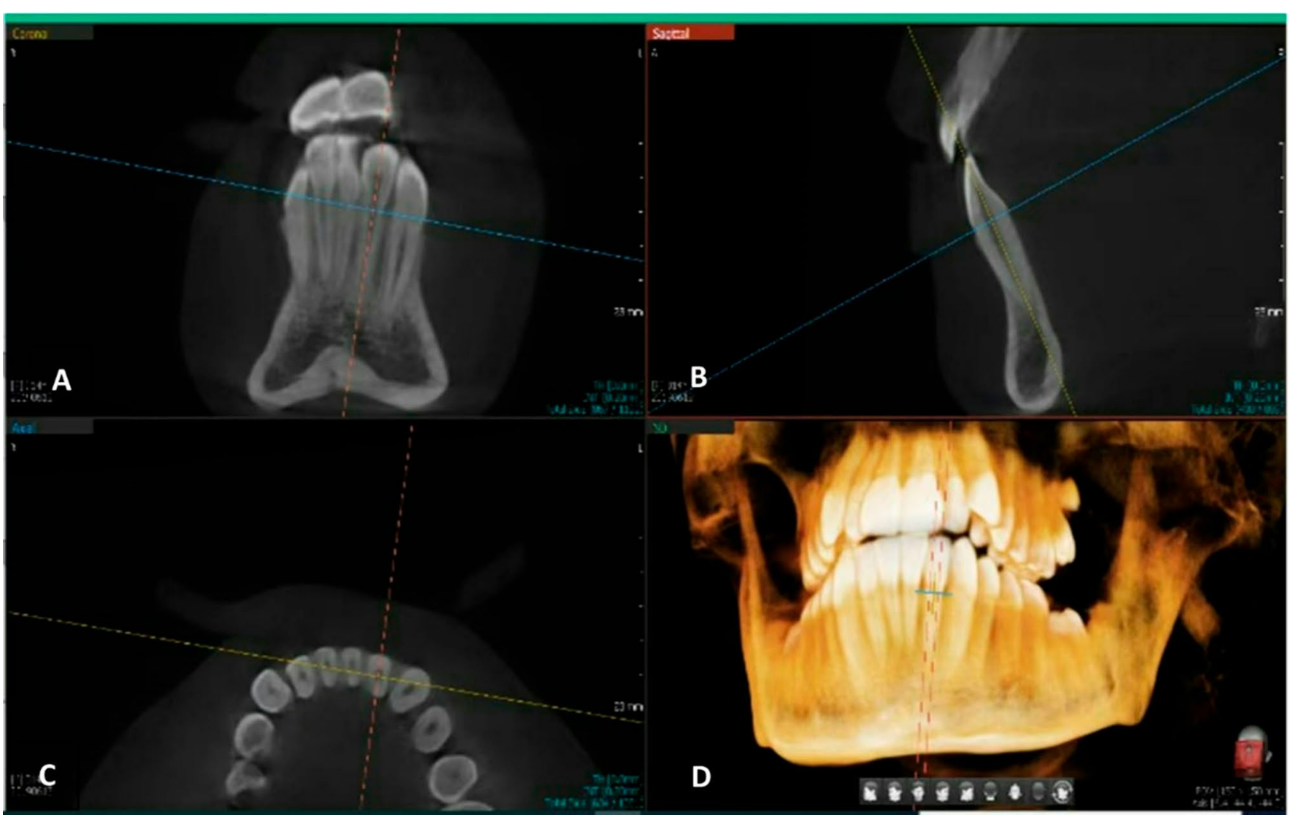

Fig. 1 Construction of multiplanar windows of the CBCT-based length measurements, Coronal plane (**a**), Sagittal plane (**b**), Axial plane (**c**), and 3D plane (**d**)

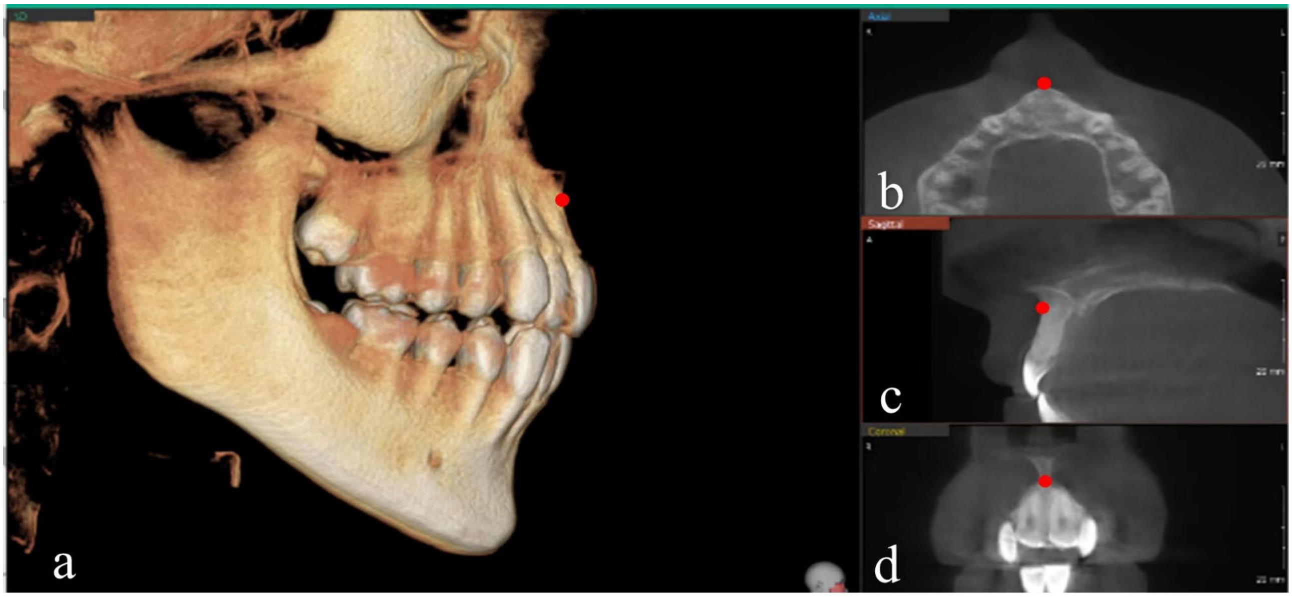

Fig. 2 Point A on the multiplanar windows, 3D plane (**a**), Axial plane (**b**), Sagittal plane (**c**), and Coronal plane (**d**)

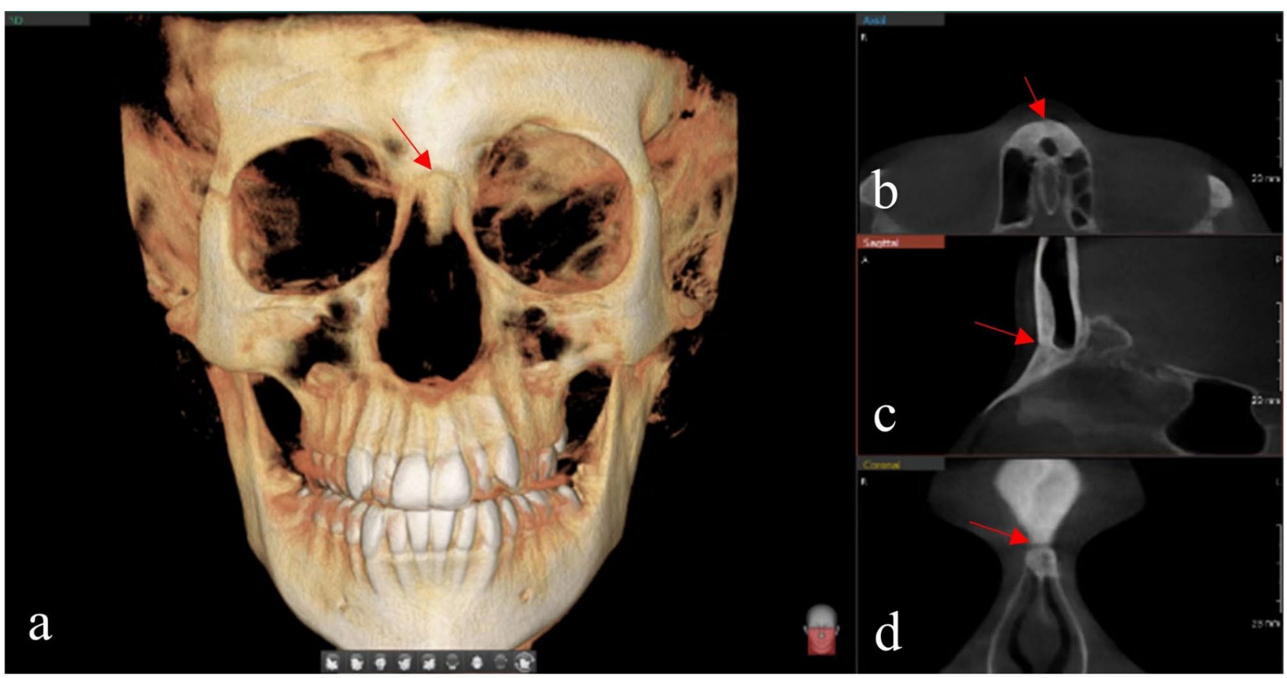

Fig. 3 Nasion on the multiplanar windows, 3D plane (**a**), Axial plane (**b**), Sagittal plane (**c**), and Coronal plane (**d**)

identify the anatomical contact points of the six mandibular anterior teeth on the CBCT slices (Fig. 5), measure the linear displacement of these contact points from their ideal positions using the ruler tool from the software. And sum up the displacement values to obtain the LII Little's irregularity index.

Data analysis

SPSS software version 21. was used for all data analysis (IBM Corp., Armonk, NY, USA). We performed descriptive statistics and Pearson correlation analysis to confirm the association between age and lower third-molar groups with lower incisor irregularities. The incisor irregularity according to gender was evaluated using the independent t-test. Also, the Chi-square test was used to detect significant differences between vertical facial

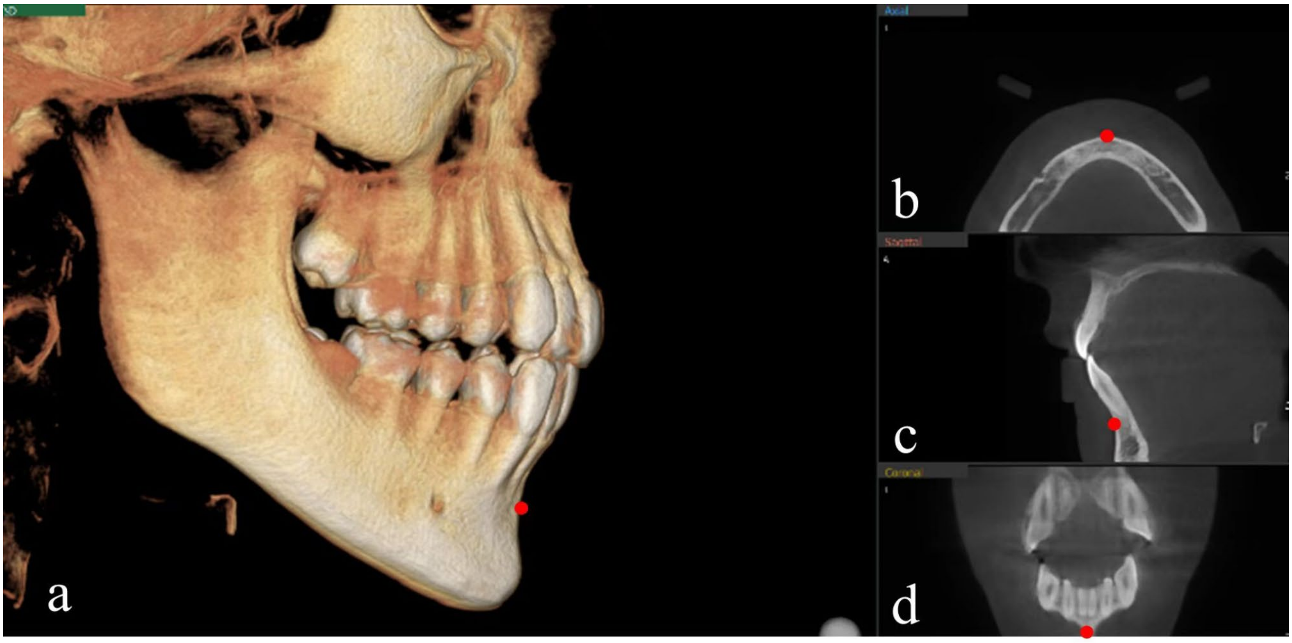

Fig. 4 Point B on the multiplanar windows, 3D plane (**a**), Axial plane (**b**), Sagittal plane (**c**), and Coronal plane (**d**)

patterns and lower third-molar groups. We performed descriptive statistics and Pearson correlation analysis to confirm the association between age, vertical growth pattern, and lower third-molar groups with lower incisor irregularities. Two weeks after the initial analysis, 25% of the CBCT samples were randomly chosen for re-analysis by the same orthodontist (S.A.) to measure intra-observer reliability. The intra-observer reliability was tested using the intraclass correlation coefficient (ICC). The significance level was set at ($P < 0.05$).

Results

Of the 64 CBCT scans analyzed, 29 (45.3%) were males and 35 (54.7%) were females. The patients ranged in age from 18 to 30 years, with a mean age of 20.56 ± 6.45 years for females and 23.12 ± 8.83 years for males. With 6.07 ± 3.66 mm over 5.21 ± 3.57 mm, the males have a higher incisor irregularity than the females, although it was not statistically substantial ($P = 0.379$) (Table 2).

Regarding wisdom teeth are present or not, the age of the patient does not affect the incisor irregularity ($P = 0.496$). Two groups were created from the sample: group I ($n = 32$) with a lower third molars and group II ($n = 32$) without a lower third molars. Group I was 5.85 ± 4.05 mm, classified as a moderate irregularity; similarly, group II showed moderate irregularity with a mean value of 5.32 ± 3.12 mm. There was an anterior crowding with a severe irregularity in 18 patients (28.1%), a minimal irregularity in 15 patients (23.4%), a moderate irregularity in 14 patients (21.9%), a very severe irregularity in 10 patients (15.6%), and a perfect alignment in 7 patients (10.9%). Regarding the wisdom teeth groups, there was an insignificant negative correlation between lower wisdom and lower incisor crowding ($P = 0.780$) (Table 3). The prevalence of hyperdivergent was 56.2% with an average value of 41.31 ± 3.36, whereas for normodivergent, it was 39.1% with an average of 34.80 ± 1.77. The vertical facial patterns showed an insignificant relationship with lower third molar group (p-value = 0.536); a Chi-square test was used. Results showed a positive correlation between lower incisor irregularities and the mandibular plane angle, with a p-value of 0.041.

Discussion

The impact and relationship between late mandibular incisor crowding occurrence and the presence or absence of third molars have been a long-standing question. Despite various studies, a definitive causal association remains unclear [2]. In addition, the debate about the influence of the third molar on incisor crowding is attributed to various factors, including the timing of the third molar eruption and anterior crowding [1]. Some studies suggest that crowding of the mandibular incisors may occur due to mesial forces exerted by the lower third molars [3, 16], while other reports indicate that these forces do not contribute to incisor crowding [17]. Therefore, further studies are warranted. Based on the findings of our study, the presence or absence of mandibular third molar teeth did not have a significant impact on mandibular incisor crowding. Therefore, we accepted the null hypothesis.

Table 1 Definition of the points and parameters used in the study

Landmark	Abb.	Definition
A Point (Subspinale)	A	Refers to the most concave point of the anterior maxilla, between the anterior nasal spine and the prosthion.
Nasion	N	Refers to the most anterior point on the frontonasal suture in the midsagittal plane.
B Point (Supramental)	B	Refers to the most concave point of the mandibular symphysis, between the infradental and the pogonion.
A point-Nasion- B point	ANB	Refers to a cephalometric measurement that describes the relationship between the maxilla and the mandible when viewed Antero posteriorly. ANB angle from 2° to 4°: Indicates skeletal Class I malocclusion. ANB angle more than 4°: Indicates skeletal Class II malocclusion. ANB angle of less than 2°: Indicates skeletal Class III malocclusion.
Skeletal Class I malocclusion	Class I	This is a normal skeletal relationship between the maxillary and mandibular jaws, also known as a balanced bite, with a straight appearance in profile when viewed Antero posteriorly. However, there may be crowding, misalignment of the teeth, crossbite, or other positional or rotational aberrations.
Sella	S	Centre the sella turcica.
Mandibular plane	MP	Formed by connecting Go to Me.
Gonion	Go	The most posterior and inferior point on the angle of the mandible.
Menton	Me	The most inferior point on the chin.
Mandibular plane angle (SN-MP)		Sella-Nasion to mandibular plane angle: The SN-MP measurement was utilized to categorize the subjects into three vertical facial patterns: (1) Hyperdivergent (SN-MP greater than 37°). (2) Normodivergent (SN-MP between 27° and 37°). (3) Hypodivergent (SN-MP less than 27°).
Little's Irregularity Index (LII)		Little's Irregularity Index is an index used in the field of Orthodontics to measure the crowding of the Mandibular anterior arch. The index was first proposed by Robert M. Little in 1975 in his paper The Irregularity Index: A quantitative score of mandibular anterior alignment. The index takes the anatomical contact points of anterior Incisors into account. A contact point is created by touching of edges of two different teeth. During mandibular crowding, teeth are often rotated, and displaced either palatally or buccally. The Little's irregularity index measures the horizontal linear displacement of anatomic contact points of each mandibular incisor from the adjacent anatomic point and sums the five displacements together. Once summed, the value represents the degree of anterior irregularity. The index consisted of the following scores: • 0 - Perfect Alignment • 1–3 - Minimal irregularity • 4–6 - Moderate irregularity • 7–9 - Severe irregularity • 10 - Very severe irregularity

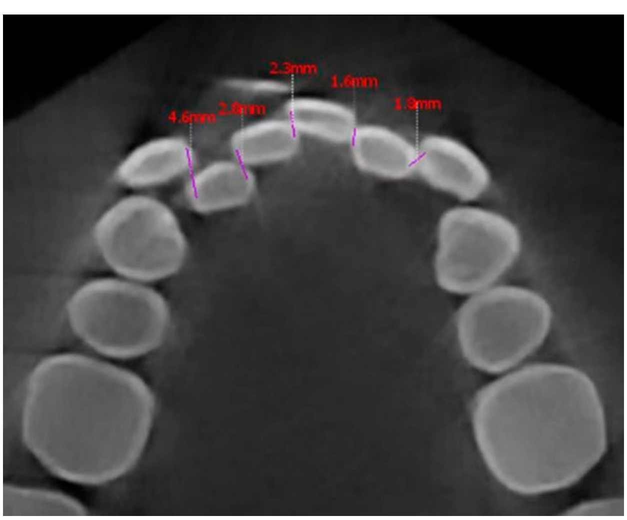

Fig. 5 Measurement of Little's irregularity index using CBCT axial view

Table 2 The irregularity and third molar distribution by gender

			Third molar		
		Incisor crowding (LII)	**Present**	**Absence**	**Total *N* (Percentage)**
Gender	Male	6.07 ± 3.66	15	14	29 (45.3)
	female	5.21 ± 3.57	17	18	35 (54.7)
	total	5.59 ± 3.60	32	32	64(100)
	P-value	0.379			

Our study identified the association between mandibular anterior crowding and the presence or absence of wisdom teeth in the evaluated groups; there was no statistically significant correlation in the little irregularity index analysis. In other words, the current study confirmed that there's no association between mandibular third molars and mandibular incisor crowding; this finding is consistent with previous studies [18–21]. Furthermore, Zigante et al. 2021 found that the long-term incidence of anterior crowding is unaffected by the presence or absence of mandibular third molars [22].

Table 3 Association of third molar status with the Little's irregularity index (LII)

				Severity N(Percent)					
		Mean ± SD	**Min-Max**	**Perfect alignment**	**Minimal irregularity**	**Moderate irregularity**	**Severe irregularity**	**Very severe irregularity**	**Total**
Third molar status	with 3rd molars	5.85 ± 4.05	0–13.1	4(12.5)	8(25)	5(15.6)	8(25)	7(21.9)	32(100)
	without 3rd molars	5.32 ± 3.12	0–10.4	3(9.4)	7(21.9)	9(28.1)	10(31.2)	3(9.4)	32(100)
	Total	5.59 ± 3.60	0–13.1	7(10.9)	15(23.4)	14(21.9)	18(28.1)	10(15.6)	64(100)
	P-value (Pearson's Correlation)	0.780							

Conversely, a study indicated that wisdom teeth influence anterior crowding [7]. A statistically significant relationship between lower incisor crowding and third molars was reported by Kahl-Nieke et al. [23] Similarly, Richardson found more crowding attributed to the impacted third molars; nevertheless, tooth sizes may impact this crowding [24].

The present study found a positive correlation between lower incisor irregularities and mandibular plane angle, suggesting that increasing the mandibular plane angle resulted in increased crowding. Based on their study, Satra et al. [25] found that patients with a clockwise rotation of the mandible had significantly more crowding, which is consistent with our results. Understanding the different factors that significantly influence mandibular crowding, including vertical growth patterns, may highlight the relatively limited contribution of wisdom teeth to crowding.

In orthodontics, the association of wisdom teeth with lower anterior crowding relapse remains debatable; many clinicians claimed that the wisdom teeth's potential mesial force was the cause of this relapse. Since the final objective after orthodontic treatment is to maintain the result, numerous clinicians extract the third molars to avoid a potential crowding relapse or to align the second molar. However, the recent systematic review disapproved of the prophylactic extraction of wisdom teeth [4].

The etiology of the irregularities in the mandibular incisors has been attributed to several other factors, including dental factors such as premature loss of deciduous teeth and tooth dimensions, as well as periodontal conditions. When there is a reduction in arch length. Furthermore, muscle imbalances, distribution of occlusal force, and parafunctional and functional pressure on the lips, tongue, and cheeks [3].

When it comes to general factors like sex, the current study showed that males had a higher Little's index of irregularity than females, although the differences were not statistically significant. The current study is consistent with those of previous studies [22, 26]. However, other studies have found a significant difference between both genders [27, 28]. These variations might have various causes, depending on the size of the sample and ethnicity. In this study, Pearson's correlation test failed to find an association between age and Incisor crowding, regardless of the presence or absence of wisdom teeth. Conversely, a study found that crowding increased with age [22]. In terms of race, Caucasian individuals reported crowding more frequently than Afro-American individuals [29].

Regardless of the impact of wisdom teeth, differences in race can also influence jaw size and tooth dimensions, which may contribute to anterior crowding [3].

Khat chewing (also known as qat or kat) is a prevalent habit in Yemen [30], with individuals often chewing for several hours daily, typically on one side of the mouth. It has been reported to cause various issues in the oral and dental tissues [31]. These effects, including destructive changes in the periodontium and bone loss, can disrupt the forces that stabilize the teeth, potentially leading to anterior crowding and difficulty in mouth opening [32, 33]. Moreover, Khat chewing can impact dental occlusion, particularly in terms of cuspal wear and anterior guidance. These alterations in occlusion are recognized as one of the predisposing factors for the development of temporomandibular disorders [34]. Moreover, the width and thickness of mandibular condyles in the Khat chewer were larger than NonKhat chewer with a statistically significant difference [35]. Other studies demonstrated that Khat users may exhibit a range of behavioral and physical signs and symptoms. These can include irritability, changes in sleep patterns, elevated blood pressure, excitability or hyperactivity, mood swings, reduced appetite, and weight loss [36]. Also, long-term abuse of khat can result in more severe health issues, such as hallucinations, delusions, manic behavior, aggression, depression, and even suicidal thoughts [37]. One limitation of this study is that it did not focus on the potential impact of Khat chewing, a common habit in Yemen known to affect oral health. Another limitation is the small sample, which is restricted to a single ethnicity; a larger sample size might produce more reliable and accurate outcomes. Also, we acknowledge age as a potential confounding factor, as wisdom tooth eruption may not be complete by age 18. Further studies should stratify participants by age or eruption stage, and explore how the presence or absence of wisdom teeth interacts with vertical facial patterns.

Conclusion

Within the limitations of the present study, it can be concluded that the presence or absence of mandibular third molar teeth does not play a significant role in mandibular incisor crowding.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12903-025-05733-9.

Supplementary Material 1

Acknowledgements

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Author contributions

K.A., R.I., S.A., and A.M.A. contributed to data collection, interpretation of data, designing the study, and writing the original manuscript. S.A.E has critically revised the manuscript. All authors have approved the final manuscript before its submission.

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Data availability

The datasets used and/or analyzed during the study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

Sana'a University's ethical committee ethically approved this study for medical research, which was conducted in accordance with the guidelines of the Declaration of Helsinki. Written informed consent was obtained from all patients in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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