AL-AZHAR
Assiut Dental Journal

The Official Publication of The Faculty of Dental Medicine, Al-Azhar Assiut University, Egypt

AADJ, Vol. 6, No. 2, October (2023) — PP. 167:178
ISSN 2682-2822

Assessment of the Relationship Between the Impacted Mandibular Third Molar and Inferior Alveolar Canal Using Cone Beam Computed Tomography

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Codex : 02/2023/10

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ABSTRACT

Aim: Objectives: The present study was performed to evaluate radiographically and asses the relation between impacted mandibular third molar and inferior alveolar canal .**Subjects and Methods:** 100 patients were divided into two groups. Group I: According to gender Group II: According to age. Digital imaging and communication in medicine (DICOM) data of the patient was imported and analysed using Romexis software. After importing the patient data, patient axis and position were modified to be in a standard position. The axial cut was modified to be at the level of alveolar crest of the lower arch then a customized arch curvature and thickness were done to have a good form of reconstructed panoramic like view .**Results:** there was no statistical significant different between tow group on contact and proximity between IMTM and IAC .**Conclusions:** There is no difference in the contact between the nearest apex of impacted mandibular third molar and superior border of inferior alveolar canal between gender and age groups. There is no difference in the distance (proximity) between the impacted mandibular third molar and inferior alveolar canal between gender and age groups.

KEYWORDS

Impacted Mandibular Third Molar; Inferior Alveolar Canal, Cone Beam Computed Tomography, DICOM.

INTRODUCTION

Extraction of mandibular third molars is the most widely performed oral and maxillofacial surgery. Similar to other procedures, it has various types of postoperative complications including local edema, limited mouth opening, and pain [(1)]. However, temporary or permanent damage of the inferior alveolar nerve(IAN) is regarded as the most serious complication.The incidence of IAN injury ranges from 0.4 to 6% [(2)].

Damage to IAN occurs most frequently when the mandibular third molar has a close relationship with the mandibular canal. The horizontal and vertical positions of the mandibular canal and corresponding third molars is a key anatomic factor of IAN injury [(3)].

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Assessing the relationship between second, third molars and IAC is essential before taking decisions in practice. Therefore, imaging examination is the first step to assess the risk of IAN injury before operation [4].

Panoramic radiographs and cone beam computed tomography (CBCT) scans enable two - and three-dimensional assessments of the dento maxillofacial structures, respectively, panoramic radiographs mostly common used by oral and maxillofacial surgeons to view impacted third molars and to estimate the risk of inferior alveolar nerve injuries[5-7].

The accuracy of panoramic radiographic findings in predicting the relation between mandibular canal and impacted third molars has been studied and found that panoramic radiographs were effective in predicting direct contact between mandibular canal and impacted third molars and it is considered one of the efficient diagnostic tools for pre-operative assessment of impacted mandibular third molars [8].

Cone-beam computed tomography (CBCT) has been widely used in clinical work due to its three-dimensional capability. CBCT not only provides reconstruction images on axial, coronal, and sagittal sections, but also shows the three-dimensional structures of the teeth and surrounding tissues [9].

Cone beam computed tomography reduces the radiation dose as compared with conventional CT and offers high spatial resolution. Thus, it seems that the relationship of the mandibular third molar to the mandibular canal is assessed more accurately with CBCT imaging modality. CBCT was found to be useful in the preoperative diagnosis of lower third molars and considered is highly reliable in locating the mandibular canal[10].

The present study was to evaluate the possible variation of impacted lower third molar in relation to inferior alveolar canal in a selected Egyptian population by means of cone beam computed tomography (CBCT).

SUBJECTS AND METHODS

Study design and subjects

This study was designed as a cross-sectional retrospective descriptive study carried out on randomly convenience sampling selected 100 CBCT scans (female and male ranged in age from 18 - 60 years). The CBCT scans retrieved from Faculty of Dental Medicine – Al-Azhar University Assiute Branch for boys and the archive of several radiology centers between 2019-2020 as a part of diagnostic procedures for various reasons such as orthodontic treatment planning, implant placement or 3rd molar extraction.

Inclusion criteria:

- Age above 18 years.
- Fully or partially impacted lower third molar.
- Uni lateral or bilateral impactions.

Exclusion criteria:

- Children <18.
- Presence of any pathology .
- Fracture in the region of examination.
- Supernumerary or other impacted teeth as in premolar area.
- Inadequate image quality .

CBCT images:

Cone beam computed tomography (CBCT) images were grouped according to the following considerations:

I: According to gender.

- Male
- Female

II: According to age.

A: 18-40Y.

B: 41-60 Y.

Radiographic assessment:

Cone Beam Computed Tomography (CBCT) images were evaluated independently by three examiners with at least 2 years of experience on a computer monitor (21-inch LCD monitor with 1280 × 1024 resolution) in a quiet room with dim light condition. The observers could manipulate the contrast and brightness features and to use the software zoom tool.

Digital imaging and communication in medicine (DICOM) data of the patient was imported and analysed using Romexis software (Planmeca-Finland). After importing the patient data, patient axis and position were modified to be in a standard position. The axial cut was modified to be at the level of alveolar crest of the lower arch then a customized arch curvature and thickness were done to have a good form of reconstructed panoramic like view (Fig.1and 2).

Determination position of the inferior alveolar canal: Th position of IAC can be classified according to buccolingual direction into:

Buccal position: the IAC located near on the buccal side from the nearest point of the root.

Inter-radicular position: the IAC located between the roots .

Lingual position: the IAC located near on the lingual side from the nearest point of the root.

Apical position: the IAC located near on the apex from the nearest point of the root [77].

Determination of the inferior alveolar canal shape: canal shap can be classified into as:

Round shape: a shape that is curved and without sharp angles , all the ponds had the same round shape .

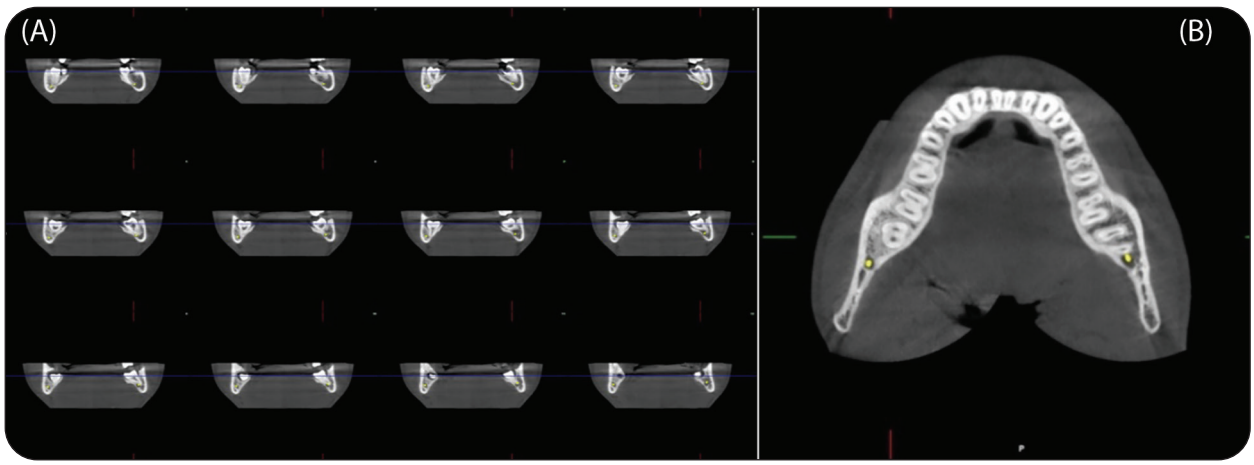


Fig. (1) Axial and coronal cuts showing how patient position was modified to be in a standard position and the customized arch curvature and thickness done to reconstruct a panorama like view.

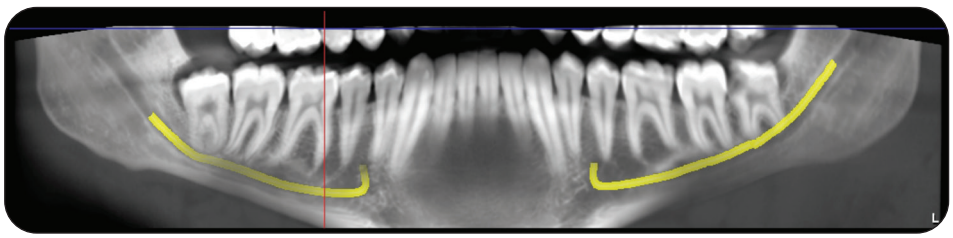


Fig. (2) Reformatted panorama like view based on customized tomographic layer done on the coronal cut. Serial crossectional cuts were done perpendicular on the arch and covering all of the impacted tooth with slice thickness of 1 mm.

Tear drop shape: something that is pointed at the top and round at the bottom like a dropping tear.

Oval shape: rather like an egg or an ellipse, which may be two or three- dimentional .

Determination of proximity and contact of the inferior alveolar canal to the root of impacted mandibular third molar: was rated as a contact or no contact that can determined on cross section from the nearest apical part of the root.

Determination of impacted type from reformate-panorama into: impacted mandibular third molar classified according to pell an georgy into[19]:

Vertical: the long axis of the impacted mandibular third molar was found to be parallel to the mandibular second molar.

Horizontal: the long axis of the impacted mandibular third molar was perpendicular to the mandibular second molar.

Distoangular: the long axis of the impacted mandibular third molar was directed to the distolingual position in relation to the mandibular second molar.

Mesioangular: the long axis of the impacted mandibular third molar was directed towards the mesial direction in relation to the mandibular second molar.

Determination of impacted position from reformate-panorama into: the position of impacted third molar can be classified based on the height of the occlusal plan of the adjacent second molar into[18]:

Position A: the highest portion of the tooth is on a level with/above the occlusal line.

Position B: the highest portion of the tooth is below the occlusal plane, but above the cervical line of the second molar.

Position C: the highest portion of the tooth is below the cervical line of the second molartooth in relation to the long axis of second molar.

Statistical Analysis

Numerical data were displayed as mean ± standard deviation (SD) values. Qualitative data were presented as frequencies and percentage.(Paired student t-test was conducted within each group, and unpaired t-test for comparing the two groups) . The significance level was set at $p \leq 0.05$. Statistical analysis was performed with Statistical package for social sciences (SPSS) software version 24.

RESULTS

Among 155 obtained CBCT images, a total of 55 scans were excluded mainly due to incomplete coverage of the region of interest, pathology or truma in molar area in adequate image quality caused by presence of implant or patient movement during exposure. The final evaluated images comprised of 100 CBCT belonging to 57 females and 43 males, with ages range from (18:60Y) were used to evaluate inferior alveolar canal (IAC), position, shape, it is proximity to the nearest root apex of the impacted mandibular third root also if there is contact between them or no, impaction type (mesio angular MA, horizontal H, vertical V and distoangular DA) and position type of the impacted mandibular third molar.

The mean and standard deviation values were calculated for each group in each test. Data were explored for normality using Kolmogorov-Smirnov and Shapiro-Wilk tests, qualitative data showed non-parametric (not-normal) distribution. While quantitative data showed parametric (normal) distribution.

Mann Whitney test was used to compare between two groups in non-related samples for qualitative data. Independent sample t-test was used to compare between two groups in non-related samples for quantitative data.

The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

» **According to gender :**

The result of frequencies and variable measurements of the inferior alveolar and impacted mandibular third molar were categorized into two groups as illustrated in table (2).

- Female CBCT ranges (n=57)
- Male CBCT ranges (n=43)

» **Canal-Position:**

In female CBCT images , the position of IAC showed that

- Inter-radicular canal position was found in 31 cases representing 54,4%.
- Buccal position was found in 16 cases representing 28.1%.
- Lingual position was found in 10 cases representing 17.5% .

While in male CBCT images

- Inter-radicular canal position was found in 21cases representing 48.8 %
- Buccal position was found in 17 cases representing 39.5%
- Lingual canal position was found in 5 cases representing 11.6 % cases on lingual position.

There was no statistically significant difference between females and males where (p=0.860).

» **Canal-Shape:**

In female CBCT image, the shape of IAC showed that

- Round shape of inferior alveolar canal type was the most common shape, it found in 32 cases present 56.1 %
- Oval shape in 22 cases present 38.6%
- Tear drop shape in 3 cases present 5.3 %.
- While in male images, the shape of IAC showed that
- Round shape of inferior alveolar canal type was found in 13 cases present 30.2 %.
- Oval shape was found in 28 cases present 65.1 %.
- Tear drop shape was found in 2 cases present 4.7 %.

There was a statistically significant difference between males and females where (p=0.019).

» **Proximity:**

- In female CBCT images the mean distance between the nearest root apex of impacted mandibular third molar and IAC was 1.059±0.49.
- In male the near distance between the nearest root apex of impacted mandibular third molar and IAC was 1.060 ± 0.41.

There was no statistically significant difference between males and females where (p=0.990).

» **Contact:**

In females CBCT images:

- A contact between the nearest root apex of impacted mandibular third molar and IAC was found in 22 cases.
- No contact was found in 35 cases.
- While in male CBCT images:
- A contact between the nearest root apex of impacted mandibular third molar and IAC was found in19 cases.
- No contact was found in 24 cases.

There was no statistically significant difference between males and females where (p=0.576).

» **Impaction type and position:**

a. Type:

In female CBCT images:

- Mesioangular type was found in 24 cases representing 42.1% .
- Horizontal type was found in 6 cases representing 10.5% (the least type).
- Vertical type was found in 13 cases representing 22.8%. representing
- Distoangular was found in 14 cases representing 24.6%.
- While in male CBCT images:
- Mesioangular type was found in 23 cases representing 53.5 %.
- Horizontal type was found in 7 cases representing 16.3%.
- Vertical type was found in 8 cases representing 18.6%.
- Disto angular was found in 5 cases representing 11.6% (the least type).

There was no statistically significant difference between males and females where (p=0.104).

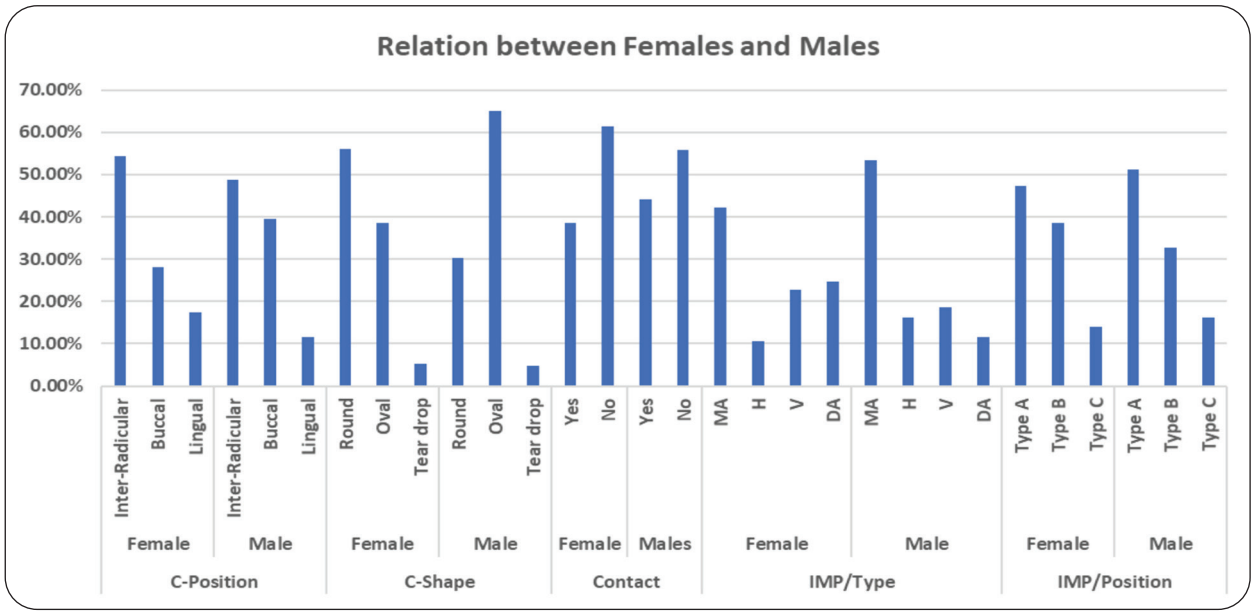
b. Position:

In female CBCT images:

The position of impacted mandibular third molar was found to be:

- Type A was found in 27cases representing 47.4% .
- Type B was found in 22cases representing 38.6%.
- type was found C in 8 cases representing 14%.
- While in male CBCT images,
- Type A was found in 22cases representing 51.2 %.
- Type B was found in 14cases representing 32.6%.
- Type C was found in 7cases representing 16.3% .

There was a statistically significant difference between males and females where (p=0.846).



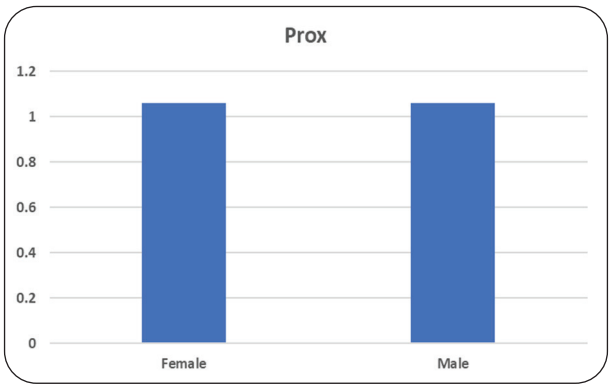


Fig. (3) Bar charts representing relation between females and males

» **According to ages:**

The results of frequencies and variable measurements of the IAC and impacted mandibular third molar were categorized into two group as illustrated in table (3):

- (18:40 Y) CBCT ranges (n= 85).
- (41:60Y) CBCT ranges (n=15).

While in detailed on table (3):

» **Canal-Position:**

In age (18-40y) images the position of IAC showed that

- Inter-radicular position was found in 44 cases representing 51.8%.
- Buccal position was found in 29 cases representing 34.1%.
- Lingual position was found in 12 cases representing 14.1%.

While in age (41-60y) images the position of IAC showed that

- Inter-radicular positio n was found in 8 cases representing 53.3%.
- Buccal position was found in 4 cases representing 26.7% .
- Lingual position was found in 3 cases representing 20% .

There was no statistically significant difference between males and females where (p=0.919).

» **Canal-Shape:**

In age (18-40y)

- Round type was found in 41 cases representing 48.2%.
- Oval type was found in 40 cases representing 47.15%.
- Tear-drop type was found in 4 cases representing 4.7%.

In age (41-60y)

- Round type was found in 4 cases representing 26.7%.
- Oval type was found in 10 cases representing 66.7%.
- Tear drop type was found in 1 cases representing 6.7%.

There was no statistically significant difference between males and females where (p=0.134).

» **Proximity:**

- In age (18-40y) recorded 0.47%.
- In age (41-60y) presented about o.45%.

So when comparing 2 group we found that there was no statistically significant difference between males and females where (p=0.867).

» **Contact:**

- In age (18-40y) images a contact between the nearest root apex of IMTM and IAC was found in36 cases representing 42.4%.
- While In age (41-60y) images a contact was found in 5 cases representing 33.3%.

There was no statistically significant difference between males and females(in two group) where (p=0.515).

» **Impction:**

a. Type:

In age (18-40y):

- Mesioangular type was found in 39 cases representing 45.9% .
- Horizontal type was found in 13 cases representing 15.3% .
- Vertical type was found in 15 cases representing 17.6%,
- Destoangular type was found in 18 cases representing 21.2%.

In age (41-60y) :

- Mesioangular type was found in 8 cases representing 53.3% .
- Horizontal type was found in 0 cases representing 0% .
- Vertical type was found in 6 cases representing 40%.
- Destoangular type was found in 1 case representing 6.7%.

There was no statistically significant difference between males and females where (p=0.617).

b. Position:

In age (18-40y) images :

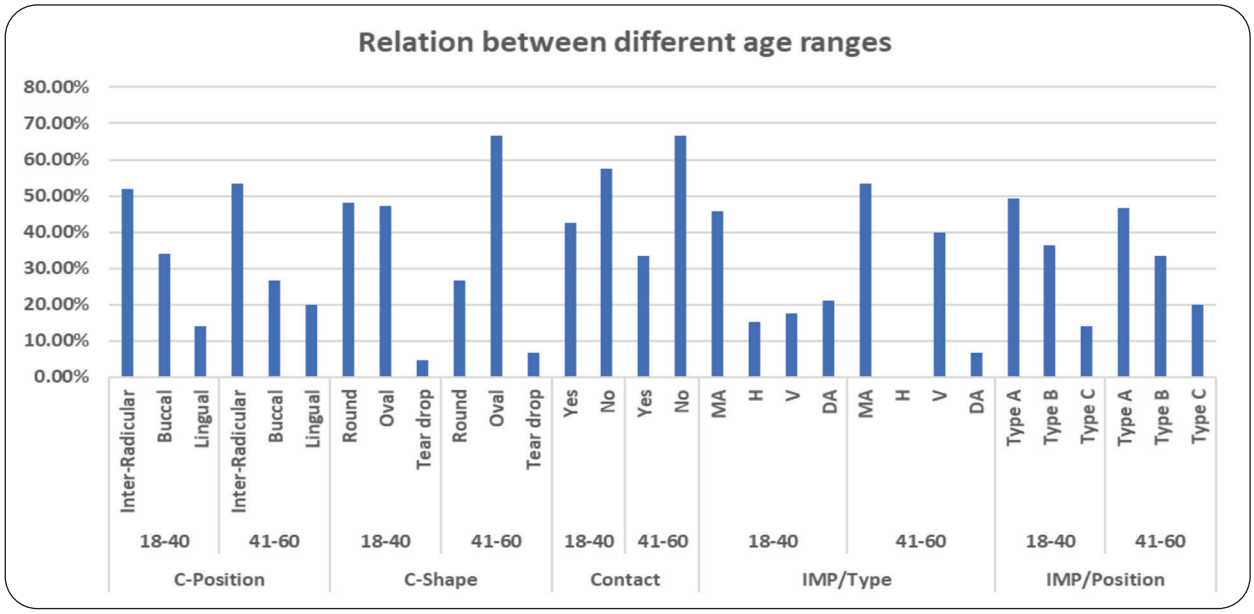
- Type A was found in 42 cases representing 49.4% .
- Type B type was found in 31 cases representing 36.5%.
- Type C type was found in 12 cases representing 14.1% .

In age (41-60y) images:

- Type A was found in 7 cases representing 46.7% .
- Type B was found in 5 cases representing 33.3% .
- Type C type was found in 3 cases representing 20%.

No statistically significant difference between males and females where (p=0.719).

Bar charts representing relation between age range .



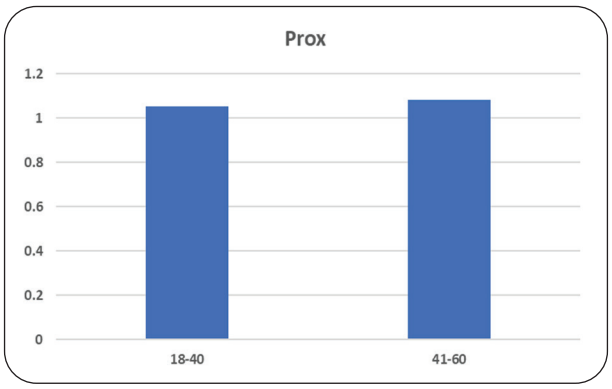


Fig. (5) Bar charts representing relation between age range

DISCISSION

This study carried out on Egyptian population focused on anatomical variations of mandibular canal and impacted mandibular third molar, this study aimed to assess the relationship between IMTM & IAC using CBCT.

The present study evaluated the IAC positions, shapes, its proximity and contacts to the nearest point on the tooth root and positions , types of IMTM in Egyptian population using CBCT which possess ability to acquire 3D reconstructions of the dento-maxillofacial region to evaluated the relationship between IMTM and IAC in different age and gender groups patients, with high levels of detail and considered a superior to other radiographic modalities as panorama and computed tomography CT[11].

The positions and types of IMTM in the right or left sides were evaluated from reconstructed (reformate) panoramic images while the IAC positions, shapes, proximity and contact from the cross section because these projections add further information that would not be appreciable on other sections[12].

Result of the present study showed that according to gender groups most canal position was of inter-radicular type and the least canal position of lingual type while the buccal position in the inter mediate between them. No significance difference on canal positions between males and females. While according to ages groups most canal position of inter radicular canal position and the least one of lingual position while the buccal position is intermediate between them. No significant difference on ages groups. Various researches which found that IAC located buccally to the IMTM in the most studied CBCT images. Another study found 26 from 53 teeth located lingual to the IMTM. This is also is controversy with the present study [13].

Anatomically IAC possess three shapes (round , oval and tear drop) . In the present study found that oval shape canal as the most common types and the least types is a tear drop. That agree with two CBCT studies found that oval shape canal as the most common types and the least is a tear drop shape from total cases[14]. A nother similar study evaluated CBCT images to determine the shape of IAC found that the shape of the IAC was categorized into 3 groups: round/oval, teardrop, and dumbbell from total number 145 there are 3 were dumbbell shape and 4 were round/oval and the remaining cases measure the tear drop shape [13,15].

In the present study the proximity between IMTM and the IAC which measured from the nearest point between the apex root of the impacted third molar and IAC in both groups was measured in millimeter and was found to be about 1.059 ±SD mm in females while in males present 1.060±SD mm, no statistical significant difference between females and males. While in different ages groups these distance was 1.054 ±SD mm in (18:40y) and 1.082±SD mm in (41-60y) . No significant difference between females and males on previous study and the average distance from the IMTM to the superior border of the IAC was 1.76 ± 0.96 mm in women and 1.69 ± 1.05 mm in men [12]. A similar study found that the mean distance from apex of IMTM roots to canal was1.99±SD mm. A nother study concluded that the average distance from tooth to canal is approximately 1 - 2 mm, and this value can be used for evaluation and prediction before surgical removal of the IMTM [16].

According to the findings in the present study, the incidence of root contact with the canal in CBCT images` which a significant risk factor for the occurrence of IAN exposure was found 38.6% in females CBCT and 44.2% in males CBCT images from total cases number , there was no statistical significant difference between both, While in ages groups there was a contact in 42.4% (18:40Y) while 33.3% on (41:60Y) from total number .

In the present study, generally, a mesioangular position of the impacted mandibular third molar was the most prevalent position (47%), followed by, vertical, distoangular and horizontal positions. In accordance to our findings, previous study showed that over 80% of the mandibular IMTM impactions in all superfacial types were in the mesioangular position. Another found that the vertical position was most prevalent, followed by mesioangular position, the mesioangular position found to be the most prevalent one in another studies [17-18].

CONCLUSIONS

- There is no difference in the contact between the nearest apex of impacted mandibular third molar and superior border of inferior alveolar canal between gender and age groups.
- There is no difference in the distance (proximity) between the impacted mandibular third molar and inferior alveolar canal between gender and age groups.
- The most canal position is the interradicular position and the least is the lingual position.
- The most canal shape is the oval shape and the least canal shape is the teardrop shape.
- The most impacted mandibular third molar type is the mesioangular type and the least is the vertical type.
- The most impacted mandibular third molar position is the position (A) and the least is the position (C).

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AADJ, Vol. 6, No. 2, October (2023) — PP. 178

تقييم العلاقه ما بين قناة الفك السفلى والرحي الثالثة السفلية المطمورة فى مجموعة من المصريين بإستخدام الأشعة المقطعية مخروطية الشكل

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الملخص :

الهدف: لقد صممت هذه الدراسة لتقييم العلاقه ما بين قناة الفك السفلى والرحي الثالثة السفلية المطمورة فى مجموعة من المصريين بإستخدام الأشعة المقطعية مخروطية الشكل فى كلا الجنسين (رجال و نساء) و ايضاً فى مختلف الأعمار (18:60سنة).

المواد والاساليب: أجريت هذه الدراسة على 100صورة إشعاعية مقطعية مخروطية الشكل لمرضى مترددين على أقسام أشعة الوجه و الفكين كلية طب الأسنان جامعة الأزهر (بنين أسيوط) ومن عدة مراكز أشعة خاصة. و لقد تم تصميم أشعة بانوراما من هذه الأشعة المقطعية مخروطية الشكل بإستخدام برنامج الروميكسيس وتم تقييم هذه الأشعة بإستخدام نفس البرنامج لتحديد وضعية ونوع الرحي الثالثة السفلية المطمورة. وتحديد شكل القناة ومكانها ومعرفة ما إذا كان هناك تلامس وبين أقرب نقطة من الرحي السفلية المطمورة وتم تقييم العلاقه ما بين قناة الفك السفلي والرحي الثالثة السفلية المطمورة

النتائج: توصلت هذه الدراسة إلى عدم وجود فرق احصائي بين الحالات.

الخلاصة: لايوجد اى فروق احصائيه فى المسافة بين اقرب نقطة لجذر الرحي الثالثة السفلية المطمورة و قناة الفك السفلي وشكل القناة و مكانها ونوع وشكل الرحي الثالثة السفلية المطمورة في مختلف الأعمارسواء بين الذكور والإناث.

الكلمات المفتاحية: والرحي الثالثة السفلية المطمورة ، قدرة مضغ، قناة الفك السفلى ، الأشعة المقطعية مخروطية الشكل ، دايكم