

EVALUATION OF PANORAMIC X-RAY VERSUS CONE BEAM COMPUTERIZED TOMOGRAPHY IN SURGICAL REMOVAL OF HORIZONTALLY IMPACTED MANDIBULAR THIRD MOLARS

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ABSTRACT

INTRODUCTION: Computerized scanning technology has been in use for 30 years. Originally, it was called Computerized Axial Tomography or CAT. Today, with advances in miniaturization and computer software and a revolution in imaging, CAT scan technology has been moved from the hospital to the private dental office in the form of Cone Beam Computerized Tomography (CBCT), which will be an alternative radiographic study over the standard panoramic images.

OBJECTIVES: This study evaluated the advantage of CBCT over panoramic X-ray in surgical removal of horizontally impacted mandibular third molars.

MATERIALS AND METHODS: This study was conducted on twenty patients selected from the Out-patient Clinic of the Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University, diagnosed by horizontally impacted mandibular third molar class II position B. All patients were diagnosed clinically and radiographically. Patients were divided randomly in two groups, 10 patients were diagnosed preoperatively by CBCT film (study group) and the other 10 patients were diagnosed by panoramic radiographic film (control group). Intraoperative and postoperative evaluation was carried out to monitor postoperative pain, inferior alveolar nerve paresthesia, trismus and postoperative edema at 3rd, 7th and 15th day.

RESULTS: Patients in the study group experienced statistically significant less pain and less postoperative edema than those in the control group ($p=0.05$, and $p=0.048$ respectively). There was no statistically significant difference between the two groups regarding the trismus and no patients in both groups suffered of alveolar nerve paresthesia.

Less postoperative pain was diagnosed in the study group than in the control group. No inferior alveolar nerve paresthesia was found in the two groups. There was no significant difference between the two groups regarding the trismus. Less postoperative edema was found in the study group than in the control group.

CONCLUSIONS: CBCT showed higher specificity to the inferior alveolar nerve localization as compared to panoramic x-ray. Hence, it is recommended that CBCT imaging is to be considered included in the diagnostic work-up prior to surgical removal of deeply impacted third molars.

KEY WORDS: mandibular third molar impaction, horizontal impaction, Cone Beam Computed tomography.

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INTRODUCTION

Third molars are among the most frequently extracted teeth in the young adults. Some of the indications for its extraction include presence of pain, pericoronitis, carious lesions, cysts or tumors and root resorption of the adjacent teeth (1).

Extraction of the third molars may traumatize the inferior alveolar neurovascular bundle. The current literature indicates that temporary loss of sensation related to third molar extraction ranges from 0.4% to 22 %, while permanent damage to the neurovascular bundle occurred in about 1% of the cases (1). Injury to the inferior alveolar canal during third molar surgery depends upon several factors as the location and contact of the canal to the tooth, degree and orientation of impaction, bone mass and density, age of the patient, and skill of the surgeon. Apart from neurovascular damage, other complications included infection and jaw fracture. These various complications lead to the highest number of malpractice suits against oral surgeons (2,3).

To reduce these complications, radiographic examination is essential to evaluate the degree and orientation of impaction, deflection of the root, location of the canal, relationship of the canal to the roots, and thickness of the cortical plates (4).

Panoramic radiography is one of the most common imaging methods for preoperative planning of third molar extractions. Based on two-dimensional (2D) radiographs, unfortunately traditional images such as periapical and panoramic radiographs can only provide limited information about the status of the third molars and their relationship to the canals (5).

Three dimensional (3D) images provide superior and more detailed information compared with conventional 2D plain radiographs. In the past decade, development of cone beam computed tomography system had led to an increase in its clinical use in dentistry and its specialties, it provides lower doses of radiation, low cost, better volume reconstruction and the high resolution bone details (1,4).

With CBCT, the impacted teeth can be seen in several views (coronal, sagittal, axial or horizontal) in addition to the panoramic view. This makes it possible to obtain the precise location of the impacted teeth, and its relation to the adjacent neurosensory bundle. Also CBCT makes possible to define the type of impaction, the follicle size, the inclination of the long axis of the tooth, the relative buccal and palatal positions, the amount of bone covering the teeth and its approximation and relation to adjacent teeth and anatomical structures (5,6).

Thus CBCT provided more conservative access to surgical field, allowing the clinician to make a formed decision and accurate treatment plan to the tooth to be extracted, with greater bone preservation and reduced procedure time. So it decreases postoperative complications and give good prognosis (7,8).

In view of this possibility, this study evaluated the advantage of CBCT over panoramic X-ray in surgical removal of horizontally impacted mandibular third molars.

MATERIALS AND METHODS

Patient selection and evaluation

Cross sectional study was conducted on twenty patients at the out-patient clinic of Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University. All patients were diagnosed as having horizontal mandibular third molar indicated for extraction. They also were examined radiographically for the determination of the inferior alveolar nerve position and its relationship to the important anatomical structures.

The Inclusion criteria included; Patients who were confirmed by diagnosis to have horizontally impacted mandibular third molar class II position B (9). While the exclusion criteria included; medically compromised patients, bad oral hygiene and mentally retarded patients.

The patients were randomly divided into two groups, each group included ten patients: Randomization was performed by assigning random numbers from random number tables to patients.

1. **Control group:** patients were examined preoperatively by panoramic radiographic film.
2. **Study group:** patients were examined preoperatively by panoramic x-ray and CBCT film.

Preoperative phase

Preoperative clinical examination was performed for all patients: Patients data were collected; name, gender and age, medical and dental history were taken and the oral mucosa overlying the impacted tooth was examined for color, texture, firmness and thickness.

Preoperative evaluation for all patients included panoramic x-ray for the control group (fig.1) looking for radiographic risk predictor signs. Seven radiographic risk predictor signs were assessed on the panoramic radiographs.

1. Darkening of the root: Loss of root density in a tooth that is impinged upon by the canal.
2. Interruption of the white line: Discontinuity of the superior radio-opaque line that constitutes the superior border of the inferior alveolar canal.
3. Diversion of the canal: A change in the direction of the canal while crossing the mandibular third molar.
4. Deflection of the root: An abrupt deviation of roots near the canal.
5. Narrowing of the root: Narrowing of the tooth roots where the canal crosses.
6. Narrowing of the canal: An abrupt decrease in the width of the canal while it crosses the root apices.
7. Dark and bifid root apex: A loss of root density in a tooth that is impinged upon by the canal with bifid apex of the root.

While for the study group (fig.2) preoperative evaluation included panoramic x-ray and cone beam computerized tomography (CBCT). CBCT images were used to assess the buccolingual position of the mandibular canal relative to the third molar, the proximity of the roots to the canal. The

distance between impacted molar roots and the inferior alveolar nerve were measured directly from the CBCT and compared with that measured on the panoramic x-ray using a ruler.



Figure 1: Preoperative panoramic X- ray film showing Horizontal impacted third molar.

Digital panorama scan (auto mode at exposure level -1) is used and CBCT scanner (auto mode at exposure level -1, at KV 90 and 8mA). Morita Vera View Epocs 3D R100 made in Japan is the CBCT scanner used.

Informed consent

Appropriate institutional ethical clearance and written informed consents were obtained from all patients.

Surgical procedure

All patients were operated under local anesthesia through inferior alveolar nerve block technique with Mepecaïne-L (Mepevacaine Hydrochloride 2%, Levonordefrin 1:200000, Alexandria Co. for pharmaceutical & chemical industries, Alexandria, Egypt). A buccal extended mucoperiosteal flap was done using Bard Parker blade number 15. The flap was reflected to expose the alveolar bone. Bone guttering was done using surgical bur, then decapitation was done using surgical bur. Elevation of the impacted tooth was performed according to the radiographic findings in of each group using the appropriate elevator. The bone in the areas of the elevation was smoothed with bone file. The wound was irrigated with a sterile saline solution. Then the flap was being reapproximated and sutured using 3-0 black silk sutures. (Fig. 3, 4)

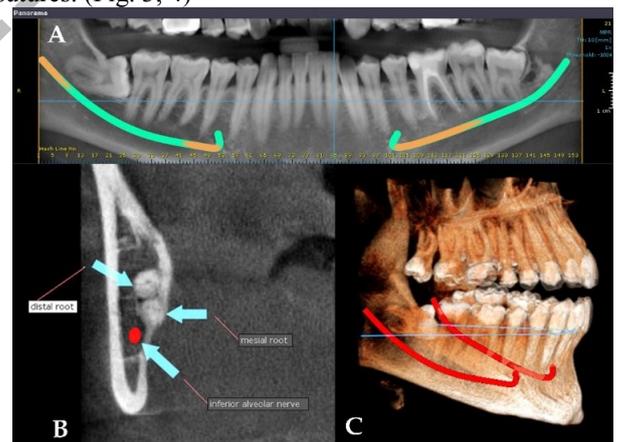


Figure 2: Preoperative CBCT for study group. a) Showing panoramic view of the CBCT b) Showing cross sectional view of CBCT, c) showing 3D view of CBCT

Postsurgical phase

Postoperative instructions were given to all the patients including cold packs on the first day, then warm mouth chlorhexidine gluconate solution (Hexitol mouth wash, the Arab Drug Co., Cairo, Egypt) as a mouthwash for a period of

five days starting from the second day. Antibiotics were prescribed to all patients in the form of 1 gm of Amoxicillin 875 mg and Clavulanate acid 125 mg (Augmentin 1 gm Smithline Beecham Pharmaceutical Co., Bentford, England) twice a day for five days post-operatively and non-steroidal anti-inflammatory drug in the form of diclofenac potassium 50 mg (Cataflam 50mg tablets, Novartis Pharma AG, Basle, Switzerland) three times daily for 7-10 days. Sutures were removed after 7 days postoperatively.

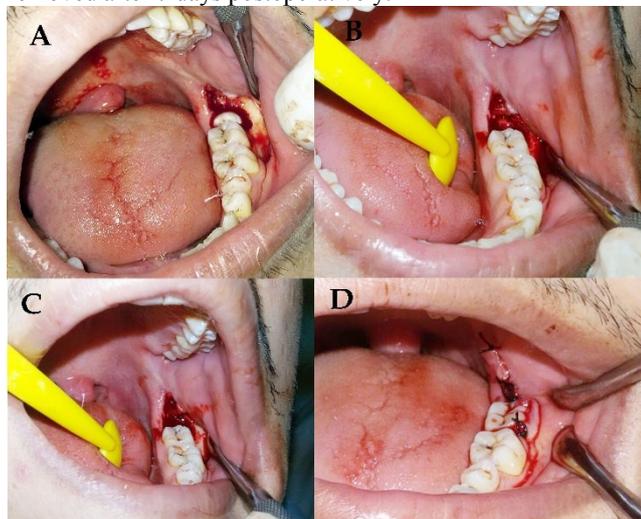


Figure 3: Surgical procedure for study group. a) Reflection of the flap and exposure of the surgical site and bone guttering, b) Elevation of the crown from the socket, c) The empty socket after root elevation, d) Sutured flap edges

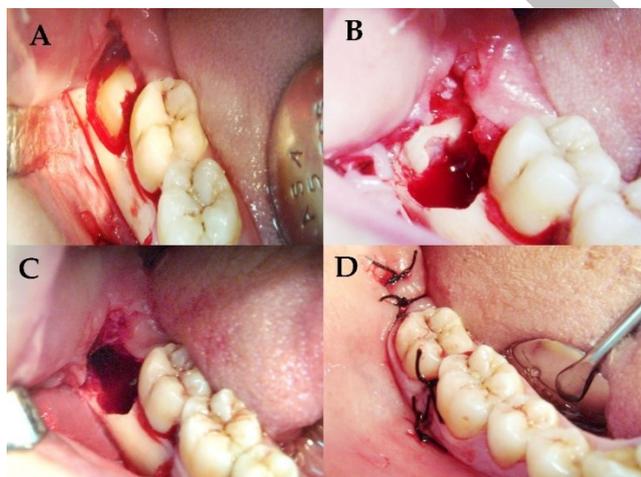


Figure 4: Surgical procedure for control group. a) Reflection of the flap and exposure of the surgical site and bone guttering, b) Elevation of the crown from the socket, c) The empty socket after root elevation, d) Sutured flap edges

Postoperative evaluation

Pain

Pain and discomfort were examined using visual analogue scale (VAS). Patients were asked to assess the level of their average pain by placing a mark on a horizontal line that was 10 cm long (9) on the third, seventh and fifteenth day.

Inferior alveolar nerve paresthesia

Inferior alveolar nerve paresthesia was examined by clinical assessment of patient symptoms and static light touch test on the third, seventh and fifteenth day. This is done by brushing the skin with a hair brush from an unaffected region of the face to the affected area. The patient is instructed to raise his or her hand, when the brush can no

longer be detected or the sensation of the brush changes significantly (9).

Postoperative edema

Postoperative edema was evaluated through the percentage of facial swelling by measuring the distance from the corner of the mouth to the tip of the tragus (horizontal measurement) and the distance from the outer canthus of the eye to the angle of the mandible (vertical measurement) are measured by flexible ruler. The horizontal measurement plus vertical measurement is divided by two (10).

Degree of trismus

Maximal interincisal opening was measured using Caliper applied between the upper and the lower central incisors, at the midline (11).

STATISTICAL ANALYSIS

The statistical analysis was performed to evaluate pain score, edema and trismus using ANOVA.

RESULTS

The present study involved 20 patients who were indicated for the removal of a horizontally impacted mandibular third molar class II position B.

The age of the patients ranged from 18-30 with a mean of 25.8± 6.12 years, there was no statistically significant difference between the two groups regarding age.

Demographic data table (1) shows that the selected patients were randomly divided into two groups, a study group and a control group, regarding age it was found the age ranged from 18-29years with a mean of 25.6±6.25 years in study group, while in control group the age ranged from 19-30 years with a mean of 26.1±5.88 years, on comparing the two group it was found that there was no significant difference between the two groups regarding age.

Regarding gender, it was found that the male represented 40.0% of the study group while the female represented (60.0%) of them, on the other hand in control group the male and female were equal each represented 50.0%.

Table (1): Demographic data of the two groups.

	Study group	Control group
Age		
Range	18 – 29	19 – 30
Mean	25.6	26.1
S.D.	6.25	5.88
T		0.98
P		0.322
Sex		
Male	4 (40.0%)	5 (50.0%)
Female	6 (60.0%)	5 (50.0%)
X ²		0.42
P		0.622

Radiographic distance between impacted mandibular third molar roots and inferior alveolar canal

Table 2 shows the comparison between cone beam and panoramic x-ray in the radiographic distance between impacted mandibular third molar roots and inferior alveolar canal for the study group, with a mean value for the measurement from the impacted molar roots to the inferior alveolar nerve using CBCT at 2.47±0.76 mm and a mean value of this measurement from the panoramic x-ray at 1.50±1.35 mm. On comparing the two measurements it was

found that measurements were statically significant at $p \leq 0.05$ from the CBCT than from the panoramic x-ray.

Pain index

Table 3 shows the pain score at different periods of follow up in the two groups, in study group the mean value of VAS at 1st day was 3.20 ± 0.92 , and decreased significantly at 3rd day to 1.90 ± 0.74 , while at 7th day the mean VAS was 0.50 ± 0.53 , and decreased significantly, at 15th day to 0.1 ± 0.32 . In control group the mean VAS at 1st day was 3.50 ± 1.08 and decreased at 3rd day to 2.50 ± 0.85 , while at 7th day the VAS was 1.00 ± 0.94 , and decreased at 15th day to 0.20 ± 0.42

On comparing the two groups it was found that VAS at 3rd day was statistically significantly lower in the study group than in the control group ($p=0.05$).

Table (2): Comparison between cone beams with panoramic X-ray in the Radiographic distance between impacted mandibular third molar roots and inferior alveolar canal for the study group:

	Cone Beam (mm) (n= 10)	Panoramic X-ray(mm) (n= 10)	Z	p
Min. – Max.	0.72 – 3.80	0.0 – 5.0		
Mean ± SD.	2.47 ± 0.76	1.50 ± 1.35	2.293*	0.022*
Median	2.53	1.0		

*: Statistically significant at $p \leq 0.05$

Trismus

In the study group the mean measurement for trismus was as follow; before surgery 4.84 ± 0.62 cm, at 3rd day 3.98 ± 0.60 cm, at 7th day 4.54 ± 0.60 cm and finally at 15th day it was 4.84 ± 0.62 , the change in trismus at different period of follow up in study group was insignificant. In the control group the mean measurements for trismus was as follow; before surgery 4.73 ± 0.72 cm. at 3rd day 4.08 ± 0.74 cm, at 7th day 4.44 ± 0.72 cm, and at 15th day was 4.63 ± 0.69 cm. There was no statistically significant difference in the measurements for trismus when compared between the two groups.

Edema

Table 3 show the edema score at different period of follow up in the two groups, in study group, at 3rd day it was found that the mean edema score was 9.715 ± 4.94 cm, this score decreased significantly at 7th day to be 5.08 ± 5.10 cm, and at 15th day it was significantly decreased to be 0.91 ± 1.92 cm. In control group the edema score at 3rd day was 11.40 ± 6.02 cm, and decreased significantly to be 6.84 ± 3.11 cm at the 7th day, and at 15th day the mean score of edema was 1.71 ± 1.11 cm.

On comparing the two groups at 3rd and 7th days, it was found that the edema was significantly higher in control group than the study group. At the 15th day the two groups were matched regarding the edema score.

Paresthesia

No paresthesia occurred in the two groups.

DISCUSSION

Inferior alveolar nerve (IAN) injury is a serious complication during extraction of mandibular third molars.

Risk factors for injury include surgeon’s experience, age and sex of the patient, operative tissue damage, postoperative edema and surgical procedures (10). It has been reported that the most important factor for inferior alveolar nerve injury is the anatomical relationship between the impacted third molar and the inferior alveolar canal (11,12). However, other authors have emphasized that multiple factors, including surgeon’s experience, surgical technique, institutional setting, and anatomical and radiographic factors are associated with an increased risk of inferior alveolar canal (IAC) damage (13,14).

Table (3): Pain and edema scores at different period of follow up in the two studied groups.

	Pain score				Edema score		
	1 st day	3 rd day	7 th day	15 th day	3 rd day	7 th day	15 th day
Study group							
Range	2 - 5	1 - 3	0 - 1	0 - 1	2.3 - 18.6	0 - 16.3	0 - 4.7
Mean	3.20	1.90	0.50	0.10	9.715	5.08	0.91
S.D.	0.92	0.74	0.53	0.32	4.94	5.10	1.92
P1		0.0012*	0.001*	0.0001*		0.012*	0.003*
Control group							
Range	2 - 5	1 - 4	0 - 3	0 - 1	2.3 - 20	1 - 9.8	0 - 2.9
Mean	3.50	2.50	1.00	0.20	11.40	6.84	1.71
S.D.	1.08	0.85	0.94	0.42	6.02	3.11	1.11
P1		0.036*	0.012*	0.01*		0.009*	0.001*
P2	0.256	0.05*	0.080	0.278	0.045*	0.048*	0.077

P1 comparison between different period of follow up in relation to base line at 1st day.

P2 comparison between study group and control group at the same time of follow up.

Accurate preoperative evaluation is necessary for successful surgery because the oral surgeon must know the angle and/or type of impacted third molar to select a suitable procedure and to prevent inferior alveolar nerve injury and perforation and fracture of the mandible. Panoramic radiography is a standard diagnostic tool for initial assessment of the relationship between the impacted mandibular third molar and the inferior alveolar canal. Because this method produces two-dimensional (2D) images, it cannot provide information in axial, coronal and sagittal planes. Therefore, cone beam computerized tomography (CBCT) is considered as a more reliable imaging method in the preoperative assessment of mandibular third molars (8,10,14).

This study was conducted on twenty patients selected from the Out-Patient Clinic of Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria University. They had horizontal impacted mandibular third molar class II position B indicated for extraction.

The patients were divided into two equal groups; in the study group, the patients were imaged by panoramic x-ray and CBCT film, while in the control group they were imaged by panoramic radiographic film.

Previous studies (13) had shown that the amount of information obtained from three dimensional analyses is significantly greater than from conventional periapical and panoramic radiography and consequently this may have an influence on the treatment plan. In contrast to conventional radiography, the CBCT displays a complete and detailed three dimensional (3D) overview of the facial skeleton. This overview can greatly help surgeons to visualize and plan the

surgical approach, which cannot be replicated with 2D imaging that the conventional radiology offers (10).

The knowledge of the exact location of the IAN bundle is a very important factor since this information provides knowledge about regions where safe and quick removal of bone should be possible and danger zones where special care must be used (14).

In the current study in the control group the location of the inferior alveolar nerve is determined by specific findings that are observed on the panoramic image. These findings include darkening of the roots, interruption of the white line of the inferior alveolar canal, narrowing of the inferior alveolar canal and diversion of the mandibular canal. This was in agreement with Eyrich G et al (14), and Also, Ghaemina et al (8) as they found that there was a significant association between the above panoramic radiograph findings and inferior alveolar nerve exposure, a finding that has been supported by several other authors (15-17). Those authors concluded that the diversion of inferior alveolar canal (IAC), darkening of the root and interruption of the white line were significantly related to inferior alveolar nerve injuries. Regarding the mandibular canal diversion our findings were in agreement with the study of Neves et al (18) in which mandibular canal diversion had lower importance in predicting the association of the canal and root (19).

The present study confirms the high diagnostic potential of CBCT, which is able to provide images characterized by a high quality of the details. The interpretation of the pictures and the identification of little structures, such as inferior alveolar canal cortex and fine radicular apices. CBCT images provide a reliable insight of bucco-lingual relationships between tooth and IAC, which cannot be achieved with panoramic radiography.

In 99% of cases there was some cortical or cortical and cancellous bone between nerve and roots with a maximum thickness of 3.8 mm. This datum means that in 1 out to 2 cases of overlap in lateral projection, such as in panoramic radiograph, the two structures are not in proximity. This study too confirms that the panoramic evaluation often overestimates the risk, by giving the suspect of a close proximity that in the reality does not exist. A precise knowledge of the exact course of the IAC may modify the surgical approach, showing where it is safer to remove bone and in which direction luxate the roots (20).

This information ahead of surgery led to better planning as regards reduction of resistance, tools required, and the decision to electively leave the fine root fragments in case it was fractured. Moreover, informing the patient with this potential risk ahead of surgery. This result is in agreement with previous studies (21).

Regarding the postoperative pain, our study revealed that patients in the study group had less pain and lower VAS when compared to patients in the control group. These findings go with findings of similar studies (22).

Regarding inferior alveolar nerve injury, this was evaluated by clinical assessment of patient symptoms and static light touch test. No inferior alveolar nerve injury was reported in any of patients in both groups. The reduction in the incidence of the injury to the inferior alveolar nerve found in the study was in agreement with Renton et al (23).

The present study showed that edema was significantly higher in patients in the control group when compared to patients in the study group; this was in the 3rd and 7th

postoperative day. At the 15th day the two groups were matched regarding the edema score.

The difference in edema and postoperative pain between the two groups may be attributed to excessive bone removal, extended duration of the surgical procedure, prolonged tissue retraction which took longer duration in the control group than the study group due to the lack of preoperative surgical plan, which were considered by de Santana-Santos et al (24).

Regarding the post-operative trismus, the present study showed that there was no significant difference between the two studied groups regarding the trismus.

CONCLUSIONS

Cone beam computerized tomography showed higher specificity to the inferior alveolar nerve localization as compared to panoramic x-ray. Hence, it is recommended that cone beam computerized tomography imaging is to be considered included in the diagnostic work-up prior to surgical removal of deeply impacted third molars.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

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