Reliability on OPG in diagnosing the indistinct Pathology around the Mandibular Impacted Third Molar In comparison to Cone Beam Computed Tomography.

Introduction

Impacted third molars are frequently encountered in routine dental practice and according to Later Peterson1 impacted teeth is the teeth that fails to erupt into the dental arch within the expected time. The third molars impaction rate is higher, when compared with other teeth. Impactions of mandibular third molars are the common ailment associated with diverse challenging degree of trans-alveolar operation and risk of complications, together with iatrogenic trigeminal nerve injury. Several studies have shown that impacted tooth have been associated with some pathologic condition such as pericoronitis, swelling, carious lesions, bone loss and resorption of the adjacent teeth2.

The prevalence of third molar impaction ranges from 16.7% to 68.6% 3. The research done by Hospital University Sains Malaysia showed that the prevalence of mandibular third molar impaction in Malaysia was 56.7%4. Hence removal of erupted and impacted third molars are considered when they cause great pain, infection, if associated with periapical pathology, carious or harmful to the health of adjacent teeth 5.

Conventional radiography at all times is a first line evaluation method to study the state of impaction, morphology, and number of roots in addition to any related pathological lesions around the impacted third molar. The objective of using radiography is to reduce post-operative complications such as pain, infection, too much bleeding and reduced mouth opening and sensory disturbances to the nerves i.e. the inferior alveolar nerve (IAN), the buccal nerve and the lingual nerve6.

Orthodoxly, the first choices of radiographs are either IOPA or OPG [7]. Although two-dimensional (2D) radiological studies provide appropriate information, they have limitations, such as representing the size and location of a lesion in the bucco-lingual plane, showing characteristics of the surface (smooth or rough), also involves sources of misinterpretation like image enlargement, distorted/blurred images, and overlapping of complex maxillofacial structures. As a result, we may require a higher level of radiographic technique. Hence, three-dimensional (3D) radiographic technique is apt in order to improve the diagnosis and treatment of these lesions. [8]

Cone beam computed tomography (CBCT) is a medical imaging technique consisting of X-ray computed tomography where the X-rays are divergent, forming a cone. Previous studies have reported that CBCT is more accurate than conventional methods such as panoramic radiography for determining the relationship between impacted third molars and the IAC 9, 10, 11 and 12. Hence, the current study emphases on the imaging modality that could be best relied upon to assess the pathological conditions that would influence the position impacted third molars in relation to its surrounding vital structures, thus decreasing the post-operative complications.

Materials and Methods

Source of data

A prospective cross sectional study was conducted with a sample of 73 individuals, aged between 18-40 years, irrespective of their sex, with impacted lower third molars. Impacted mandibular third molars are the common ailment with diverse challenging degree of trans-alveolar operation and risk of complications, hence imaging of only lower third molars were considered in our sample. Patient consulting for third molar extraction were subjected to digital OPG on standard basis.

CBCT scans produce an adequate image quality of the maxillofacial region using lower radiation doses than CT developed for medical applications1. In addition, CBCT units can be appropriately adjusted regarding the exposure parameters and field of view to optimize the radiation dose according to the diagnostic requirements13, 14.

Hence those individuals, whose OPG findings displayed some pathologies (like proximity to inferior alveolar nerve, periapical radiolucency etc) were later subjected to CBCT. Since the peak incidence of pathologies associated with mandibular third molars occurs between the age group of 20 - 30 years of life and lowest incidence of pathology (10%) occurring in the oldest age group of patients, our age group in the current study is approximately between 18-40 years.

Current study was conducted at Oral Radiology Department of AIMST University and the patients were recruited from outpatients attending Reception /Diagnostic Clinic of AIMST University.

Inclusion criteria included

* Patient aged between 18-40 years
* Patient who have impacted mandibular third molar with complete crown and root formation
* All patients who were evaluated for the surgical removal of their impacted mandibular third molars, including symptomatic and asymptomatic third molars and all type of impactions irrespective of the positions.

Exclusion criteria included

* Patients who have mandibular third molar with incomplete or premature root formation.
* Patients who are medically compromised and suffering with systemic illness.
* Non - cooperative patients who are unwilling for data collection procedures.
* Patient who have impacted third molar with other impacted tooth (impacted canine)
* Patient who have clinical signs of systemic infection.
* Patients who had traumatic injuries (bone, dental, or alveolar fracture) and/or associated with intraosseous lesions.
* Patient who underwent radiotherapy and chemotherapy.
* Pregnant patients
* Tooth with restoration, intracanal post, or orthodontic or surgical screw) around the area of interest leading to artifacts, risking the CBCT image quality.

Methodology

Digital Radiograph OPG (Orthopantogram) and CBCT was carried out with the approval of the Ethical Committee and informed consent from all volunteers.

Patient with impacted third molar was subjected to OPG using Soredex Cranex 3DX, operating at paramaters of 70 kV, 12.6 mA, with an exposure time of 16.4s

Reduction of effective organ dose to the thyroid gland and esophagus to 15.9 µSv (48.7% reduction) and 1.4 µSv (41.7% reduction), respectively on using thyroid collar is suggested without interference in diagnostic information and image quality15, 16, 17. Hence both thyroid collar and lead apron were used during a CBCT examination and conventional radiography for patient’s protection.

Then the patients were subjected to CBCT imaging after explaining the procedure using Soredex Cranex 3DX operating at parameters of 89kV, 7mA, 0.124mm voxel size, 0mm thickness (TH) and resolution of Auto WL-556 and WW-3307, with an exposure time of 15-17s. Field of view 50 x 50mm included a single mandibular third molar in one scan. Each patient was exposed only once for a single impacted third molar with suspected pathologies.

Digital Radiograph and Cone Beam Computed Tomography were evaluated on ScanoraTM software by 3 observers independently using software enhancement tools according to their own preference and final assessment was done by a maxillofacial radiologist. Disagreements on any findings were settled with discussion and the final best findings were entered in the given Performa. The impacted third molars in the radiographs were evaluated for following variables (pathologies) in both OPG and CBCT.

* External Root Resorption (ERR)
* Relation with Inferior Alveolar Nerve Canal.

The data was analysed by Kappa Test and the OPG and CBCT findings were compared using Wilcoxon Signed Rank Test. The significance level was set at 0.1.

Results

Inferior Alveolar Nerve Canal Relation

Out of 73 subjects, 5 of them showed darkening of roots indicating absence of cortication/resorption which were confirmed with CBCT but additional 8 subjects (total 13 subjects) showed resorption of IAN cortical plate in CBCT, which wasn’t evident in OPG. On the contrary 43 of them presented with impingement of third molar on the IAN in OPG, which was completely absent in CBCT that showed sufficient amount of distance between the third molar and IAN in all the subjects. Among 14 subjects who presented contact or approximation of third molar with the canal in OPG, only 7 cases turned out to be actually approximating the canal according to CBCT(as seen in Table 1). The significance level was p <0.1. Conventional radiographs with some pathologies like darkening of roots, overlapping or impinging on IAN, may be normal when seen in 3D view with exception. Thus panoramic features may not significantly contribute to the prediction of exposure.

External root resorption

OPG showed overlapping and impinging of third molar with the adjacent tooth in 25 and 13 subjects respectively. While CBCT showed only 3 overlapping cases with zero impinging cases, this could be attributed to patient’s position that results in overlapping of structures. On the contrary 8 cases presented with ERR in OPG, which was again confirmed by CBCT with additional of 25 cases (total 33cases) showing ERR. This indicates that approx. double the cases were found with ERR in 3D imaging which appeared to be normal in OPG (as seen in Table 2). The significance level was p <0.1.

Discussion

Preoperative identification of potential risk factors for IAN exposure or injury is essential for safe surgical treatment of the mandibular third molars18. A precise radiographic diagnosis is essential to evaluate the possible outcomes related to unerupted third molars. In oral and maxillofacial surgery, panoramic radiography will be requested initially to assess unerupted third molars and estimate the risk of inferior alveolar nerve damage19, since panoramic radiograph stands out as a valuable imaging choice because it shows tooth morphology, tooth angulation, and radiographic signs of proximity to the mandibular canal, all of which are delivered with low radiation doses and at low cost20. However the accuracy remains compromised which is obvious since OPG is a 2-dimensional radiograph and involves several potential sources of misinterpretation21. Thus current paper focuses on to what extent or percentage the OPG is compromising on the diagnosis and the treatment outcome, which is very essential for the betterment of the treatment results. Some studies (Sedaghatfar et al. and Sinha P)22,23 assessed darkening of roots, diversion of canal, narrowing of canal, presence of cortication, and interruption of white line seen on IOPAR, OPG were correlated for the proximity and involvement with CBCT findings for the same and confirmed the poor reliability of radiographic signs of IOPAR along with sensitivity and specificity of these features ranging from 42% to 75% and 66% to 91%, respectively in OPG and CBCT. Which was similar in present study that confirms poor reliability of above radiographic signs in OPG. Another study (Matzen LH) 24 confirms interruption of the radiopaque borders of the canal and/or diversion of the canal and/or narrowing of the lumen of the canal was present in the OPG images, suggests 1.6 times the probability that a direct contact was seen in the CBCT, which again was true with our study stating that some amount of pathologies seen in OPG was confirmed by CBCT but additional pathologies was noted in CBCT which went unnoticed in OPG. Whereas H. Ghaeminia 25 concluded that use of CBCT does not translate into a reduction of IAN injury and other postoperative complications, after removal of the complete mandibular third molar. On the contrary the sensitivity and specificity were 93% and 77% for cone-beam CT, and 70% and 63% for panoramic images, respectively in predicting the exposure after extraction by Weeraya Tantanapornkul, et al 26. Indicating Cone-beam CT was significantly superior to panoramic images in both sensitivity and specificity. Agreeing with others (AZIZAH AHMAD FAUZI, Sedaghatfar et al. and Sinha P) 22,23 and 27 our study too confirms the CBCT superiority over OPG in diagnosing pre-operative pathologies too along with the agreement that OPG too confirms some percentage of pathologies.

External root resorption to be written

Assessment of root resorption and changes in root surface morphology usually requires 3-dimensional information, especially at the early stages. The present study has highlighted the finding that CBCT allowed evaluation of the relationship between the second and third molars 3d image is necessary to assess root resorption at early stage. The present study has highlighted the finding that CBCT allowed evaluation of the relationship between the second and third molars. In 33 cases, ERR of the second molars was observed on the CBCT images, but only 8 cases showed ERR on the panoramic radiographs. Similar results were found by Alqerban et al in a study on canine impaction. Comparing panoramic radiographs with 2 CBCT units, these investigators detected more lateral incisor root resorption using the 3-dimensional images. Another study (Anne Caroline Costa Oenning) reveals 35 cases with ERR of the second molars on the CBCT images, but not on the panoramic radiographs. They also stated that Mandibular third molars in mesioangular and horizontal inclinations were more likely to cause resorption of the adjacent teeth, which was again true in the present study.

Alqerban A, Jacobs R, Fieuws S, et al: Comparison of two cone

beam computed tomographic systems versus panoramic imaging

for localization of impacted maxillary canines and detection

of root resorption. Eur J Orthod 33:93, 2011

Anne Caroline Costa Oenning, Frederico Sampaio Neves, Phillipe Nogueira Barbosa Alencar, Rodrigo Freire Prado, Francisco Carlos Groppo, and Francisco Haiter-Neto. External Root Resorption of the Second Molar Associated With Third Molar Impaction: Comparison of Panoramic Radiography and Cone Beam Computed Tomography. J Oral Maxillofac Surg 72:1444-1455, 2014

Most of the available data on ERR of second molars associated with unerupted third molars have come from case reports and retrospective studies of panoramic and periapical radiographs(anne caroline,knutsson, Akarslan, Girdler NM) .

In addition, very few comparisonal studies has been performed of panoramic imaging and CBCT, especially related to the amount of extra information provided by 3-dimensional images. Therefore, the aim of the present study was to compare panoramic radiographs and

CBCT images for the assessment of ERR of second molars associated with impacted third molars

Knutsson K, Brehmer B, Lysell L, et al: Pathoses associated with

mandibular third molars subjected to removal. Oral Surg Oral

Med Oral Pathol Oral Radiol Endod 82:10, 1996

Akarslan ZZ, Kocabay C: Assessment of the associated symptoms,

pathologies, positions and angulations of bilateral

occurring mandibular third molars: Is there any similarity?

Oral Surg Oral Med Oral Pathol Oral Radiol Endod 108:e26,

2009

Girdler NM: The unpredictability of impacted third molar

development—The danger of passive observation. Br Dent J

168:92, 1990

Nemcovsky et al found a greater prevalence of root resorption (24.2%) in a sample of 186 periapical radiographs of completely nonerupted third molars because partially erupted teeth could extend the inflammatory process to lower resistance areas without calcified tissues, thus reducing the pressure on the roots of the second molar. In the present research, unlike the study by Nemcovsky et al, partially erupted third molars and completely nonerupted teeth were included.

Nemcovsky CE, Libfeld H, Zubery Y: Effect of non-erupted 3rd molars on distal roots and supporting structures of approximal teeth: A radiographic survey of 202 cases. J Clin Periodontol 23:810, 1996.

Fryback and Thornbury have introduced a six-tiered hierarchical model of efficacy of diagnostic imaging. The model includes studies at six levels, and the evidence increases with each level. Levels 1–3 include studies on low evidence levels mainly regarding the technical capabilities of a radiographic method and the diagnostic accuracy of the related images. Levels 4–6 include studies on a higher level of evidence and assess the diagnostic impact of a radiographic method on the treatment of the patient in addition to the outcome for the patient and society including cost calculations. Only very few high-evidence studies on the efficacy of CBCT for radiographic examination of mandibular third molars exist and,

L H Matzen and A Wenzel. Efficacy of CBCT for assessment of impacted mandibular third

molars: a review – based on a hierarchical model of evidence. Dentomaxillofacial Radiology (2015) 44, 20140189

Fryback DG, Thornbury JR. The efficacy of diagnostic imaging. Med Decis Making 1991; 11: 88–94.

Conclusion

in conclusion, periapical or PAN examination is sufficient in most cases before removal of mandibular third molars. However, CBCT may be suggested when one or more signs for a close contact between the tooth and the canal are present in the two-dimensional image—if it is believed that CBCT will change the treatment or the treatment outcome for the patient.

Even with the knowledge that CBCT may be more accurate in displaying the relationship between the tooth and the mandibular canal than 2D methods, the decision-making process must be assessed to explore whether the information from CBCT changes the surgeon’s diagnostic thinking, that is, treatment planning.

The guidelines indicate that a conventional radiographic methodshould precede CBCT for this task.

Patient outcome - post-operative complications have been reported after surgical intervention such as excessive bleeding, trismus, swelling, dry socket and infection, surgeons treatment planning, all the studies suggested that cbct is accurate in all the above cases.