The Need for Cone-Beam Computed Tomography Before Mandibular Third Molar Extraction as Assessed by General Practitioner Dentists vs. Oral Maxillofacial Surgeons

ABSTRACT

Background: Mandibular third molar extraction is a common operation in dento-maxillofacial surgery. However, the use of cone-beam computed tomography (CBCT) in addition to panoramic radiography to evaluate the proximity of the mandibular third molar to the mandibular canal to reduce the risk of damaging the inferior alveolar nerve is controversial. This study aimed to compare the capability of general practitioner dentists (GPD) to assess the need for CBCT with that of oral maxillofacial surgeons (OMS).

Methods: We retrospectively selected and analyzed 100 panoramic radiographs that were performed to determine the proximity to the mandibular canal of roots of mandibular third molars requiring extraction. The radiographs included 50 cases deemed by OMS to require CBCT and 50 cases deemed not to require CBCT based on the proximity of the root to the mandibular canal. Three GPD evaluated the radiographs, and the levels of agreement with the OMS as well as those among themselves were by descriptive statistics and Cohen's kappa coefficient.

Results: The Kappa agreement between each of the 3 GPD and the OMS were 0.6, 0.56, and 0.36. The average number of cases that did and did not warrant CBCT was 65/100 and 35/100 for the GPD.

Conclusions: The values of agreement between the GPD and the OMS regarding the indication for CBCT in mandibular third molar extractions were very low. Focused training in GPD in interpreting and assessing CBCT findings is strongly recommended.

Keywords: CBCT, mandibular third molar, extraction, panoramic radiography, oral maxillofacial surgeons**.**

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Introduction

Surgical extraction of the mandibular third molar is one of the most common operations in dento-maxillofacial surgery [1]. Damage to branches of the trigeminal nerve, including the inferior alveolar nerve (IAN), is one of the more serious complications of dental surgical procedures. The most common cause of IAN injury is reportedly mandibular third molar surgery [2]. Hillerup observed that the incidence of IAN involvement at 1-7 days after mandibular third molar surgery was 1%-5%, whereas persistent IAN involvement (still present >6 months since extraction) varied from 0.0% to 0.9% [3]. Preoperative radiological examination is essential to assist the surgeon in determining the risk of postoperative sensory impairment and modify the surgical technique to lessen the risk of IAN injury [4].

Panoramic radiography (nominal dichotomic) is a commonly used technique to radiologically evaluate the proximity of the mandibular third molar to the mandibular canal [5]. Rood et al. defined 7 radiological signs in panoramic radiography as indicative of close proximity of the mandibular third molar tooth to the mandibular canal [6]. When panoramic radiography indicates a close relationship between the IAC and the third molar, some authors have recommended performing an additional examination with conventional computed tomography (CT) to verify the relationship in a three-dimensional (3D) view [7]. Cone-beam CT (CBCT) technology makes it possible to perform highly accurate diagnostic imaging with a lower radiation dose compared with standard CT [8]. Ghaeminia et al. found that CBCT imaging significantly decreased the number of mandibular third molar teeth that had been classified as high risk for IAN injury by other imaging technologies, leading oral and maxillofacial (OMF) surgeons to choose an alternative surgical approach to one based upon information provided solely by panoramic radiography [4].

According to the current management protocol in the Israel Defense Force (IDF) dental system, soldiers with mandibular third molars that require extraction and have radiological signs in panoramic radiography as indicative of close proximity of the mandibular third molar tooth to the mandibular canal are referred by general practice dentists (GPD) to an OMF surgeon for consultation. When the OMF surgeon recommends CBCT before extraction, the soldiers return to the GPD assigned to their unit to obtain a referral for CBCT. These imaging studies are interpreted by OMF surgeons, who then advise the course of action.

The purpose of our study was to determine whether GPD is capable of adequately differentiating between cases that do and do not require referral for CBCT according to an OMF surgeon's decision.

Materials and Methods

The Ethics Committee of the Medical Corps (IDF- 2188-2021) approved this study. The database from which the study data were retrieved included 143 panoramic radiographs of soldiers who had been referred to an OMF surgeon for the purpose of extracting a mandibular third molar in Sheba Medical Center, Tel Hashomer. The GPD who serve in the IDF dental system and participated in this study are graduates of the Faculty of Dentistry at the Hebrew University of Jerusalem and have 2-5 years of experience. Determination of whether the root proximity to the mandibular canal required a pre-extraction CBCT was done by experienced board-certified OMF surgeons.

In 43 panoramic radiographs, no proximity of the mandibular third molar to the IAN was evidenced, so they were excluded. Also excluded were cases of mandibular third molar extraction whose documentation in the medical file failed to include the pre-extraction imaging methodology.

The remaining 100 panoramic radiographs were divided into two groups: one group of 50 studies in which an OMF surgeon had determined that a CBCT should be performed and another group of 50 studies in which an OMF surgeon determined that extraction could be safely performed without the need to perform a CBCT. We then randomized the images and presented them to 3 GPD, who decided if the patient should be referred to CBCT or if the extraction could proceed safely based on the panoramic radiograph alone.

The statistical analysis included descriptive statistics and Cohen's kappa coefficient, which was calculated with SPSS statistic software for each agreement between the GPD and the OMF surgeons' decision and between the 3 GPD themselves. A P value < 0.05 was

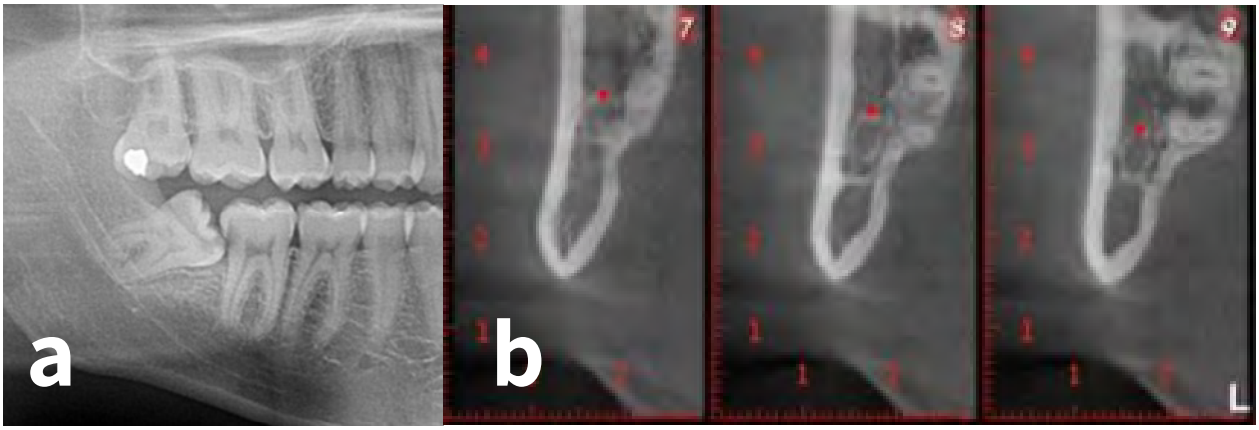

Figure 1a - Panoramic radiography indicating proximity between right and left mandibular third molar and the IAN.

Figure 1b - CBCT of the same patient indicating that there is no overlap between the roots of the right mandibular third molar and the IAN.

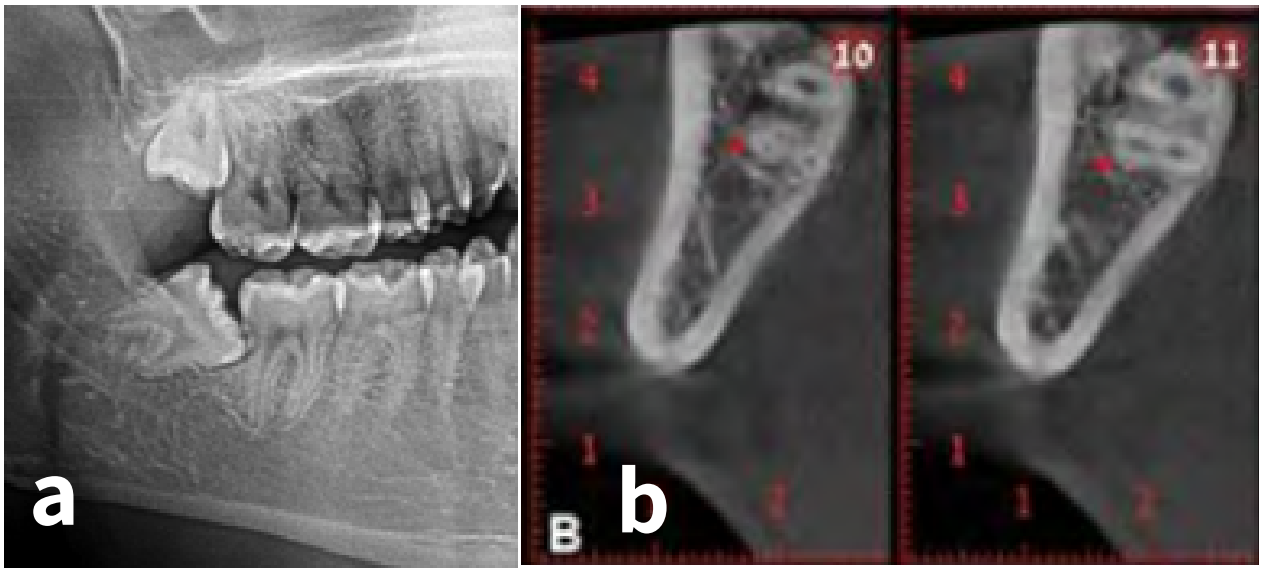

Figure 2a - Panoramic radiography indicating proximity between right and left mandibular third molar and the IAN.

Figure 2b - CBCT of the same patient indicating that there is overlap between the roots of the right mandibular third molar and the IAN.

considered significant for all analyses.

Results

All 3 GPD referred the patients to CBCT more frequently than the OMF surgeons. They referred an average of 65 cases (56, 64, and 76), yielding an average of only 35 cases, which they did not refer to CBCT (44, 36, and 24 cases). The 3 GPS did not refer an average of 4.667 cases to CBCT from the 50 cases that OMF surgeons did. They referred an average of 20 cases to CBCT from the 50 cases the OMF surgeons did not.

Discussion

We conducted this analysis to determine whether GPS was as competent as OMF in deciding whether or not candidates for mandibular third molar extraction required CBCT to more definitively evaluate risk for IAN injury. Our results revealed significant differences in judgment and the need to refine GPS's capability to interpret imaging studies correctly.

The extraction of mandibular third molars is one of the most common surgical procedures in dentistry [1]. A pre-extraction radiological examination is performed to evaluate the anatomy of the candidate's third molar and its relation to surrounding vital structures, such as the IAN. That radiological examination can assist the OMF surgeon in evaluating the risk of postoperative sensory injury and in modifying the surgical technique to reduce the risk of such injury [4]. Specifically, surgical removal of mandibular third molars is associated with trismus, pain, and injury to the IAN, and is the most common cause of IAN injury [2]. The incidence of IAN involvement 1-7 days after mandibular third molar surgery is 1%-5%, whereas persistent IAN involvement (present > 6 months) varies from 0.0% to 0.9% [3].

Panoramic radiography is a common and relatively simple technique for radiologically evaluating the position and anatomy of the mandibular third molar and its relation to the mandibular canal [5]. The mean absorbed dose of radiation to the brain and neck structure during panoramic radiography is 1.87-2.43 mGy [9]. Because panoramic radiography is two-dimensional, its accuracy in evaluating third molar root morphology and its proximity to the IAN is limited, unlike conventional CBCT, which affords a much more informative 3D view [7]. The mean absorbed dose to brain and neck structure during CBCT, however, is eight times greater than the average absorbed dose during panoramic radiography [9]. Notably, Pauwels et al. found that reducing the field of view, especially the height, in the mandibular molar area from 6x6 to 4x4 produced a dose reduction of 32%, which was as low as could be reasonably achieved [10].

Klatt et al. determined that preoperative CBCT does not reduce the risk of postoperative neurological damage, although it may lead to an adjusted and, therefore, less invasive surgical approach [11]. Those authors argued that CBCT should not be used for routine diagnostics to minimize radiation exposure to the patient. Rather, the surgeon's identification of radiological signs that indicate an increased possibility of IAN damage on a routine orthopantomography should indicate a need for CBCT diagnostics.

The use of CBCT for mandibular third molar extractions is controversial. Ghaeminia et al. showed that CBCT significantly decreased the number of mandibular third molars that were classified as being at high risk for IAN injury. Those authors concluded that CBCT findings lead OMF surgeons to choose surgical approaches different from the original one that had been based upon information provided solely by panoramic radiography [4]. Contrarily, Aravindaksha et al. found that CBCT imaging did not change the surgical planning and technique when its findings were compared with those of panoramic radiography [12]. However, they concluded that a large randomized clinical trial with a larger sample size should be performed in order to establish the actual usefulness of CBCT in reducing the prevalence of IAN injury [12].

The discovery of a significant risk of IAN damage due to root proximity to the mandibular canal changes the surgical approach for extracting the tooth. Coronectomy (intentional vital root retention) involves sectioning the crown from the roots below the cementoenamel junction and removing it while the roots that are in close proximity to the mandibular canal are left in place, thereby reducing the risk of iatrogenic nerve damage in a non-infected tooth [13].

The current protocol of the IDF dental system is to extract mandibular third molars that are close to the

mandibular canal after performing CBCT in accordance with OMF surgeon consultation. The GPD can only refer the soldier to surgical consultation, not directly to CBCT. If the OMF surgeon concludes that CBCT is warranted, the soldier receives an approval form and returns to the GPD who then applies for CBCT. An OMF surgeon interprets the eventual CBCT, and the surgical approach is decided upon.

According to the results in the present study, the GPD would not have referred an average of 4.667 operated cases to CBCT imaging, which an OMF surgeon referred. The GPD's decisions would, therefore, appear to have increased the risk of IAN damage during extraction in those cases. The GPD would have referred 20 cases to CBCT imaging, which the OMF surgeons did not. The GPD's decisions would, therefore, appear to have caused unnecessary radiation exposure in those cases.

It should be noted that the GPD who participated in this study had not received any surgical or postgraduate training since receiving their DMD degree. Moreover, each of them had less than an average of five years of clinical experience, which might have led them to overuse CBCT to minimize the risk of IAN damage. GP3 (Table 1), who is the youngest of the three GPDs with fewer than three years of clinical experience as a dentist, had the lowest Kappa, suggesting a strong connection between clinical experience and more discriminating use of CBCT imaging. Cederhag et al. examined the influence of OMF surgeons' experience in their referrals to routine radiographic imaging (intraoral x-ray, panoramic image, CBCT) before surgical extraction of mandibular third molars. Those authors investigated the difference between GPD, OMF surgeons, and OMF surgical residents and found that the average routine use of panoramic radiography before planning surgical removal of a third molar was 86% compared to 20% for routinely performing CBCT [14]. They also found that the extent of practical experience affected the preferred imaging modality, with the residents generally preferring panoramic radiographs, the GPD preferring intraoral radiographs when they concluded that more general information was needed, and the surgeons preferring 3D CBCT when they wanted more information on root anatomy than that supplied by 2D panoramic radiography. Their results also indicated that the more complicated the case, the greater the preference for CBCT by all groups.

There is a growing trend toward the use of CBCT in different dentistry specializations, such as endodontics and periodontics [15], but recent studies have shown that there is little, if any, benefit to CBCT in mandibular third molar extractions [11]. CBCT is not commonly performed for mandibular third molar extractions if the findings are not expected to change the surgical treatment plan. Destruction of the crown, caries, and infection, however, mandate complete extraction even if the roots of the tooth are in close proximity to the IAN, according to the panoramic image.

Our study has several limitations that bear mention, starting with its retrospective design. Secondly, we took the decisions of experienced board-certified OMF surgeons as standard for comparison to the decisions of three GPDs. Thirdly, we assumed that the three participating GPDs were representative of the GPDs who practice in the IDF system. Finally, the findings we present are derived from a single institution and may not apply to other providers of dental care.

We conclude that the IDF dental system's protocol should continue to stipulate that the authority to refer a patient to a CBCT is reserved for OMF surgeons. We also recommend that GPD be better trained in imaging in general and CBCT in particular to improve their ability to give informed referrals to their patients who present with the need for mandibular third molar extractions.

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Ethical approval: The study was approved by the institutional Ethics Committee of the IDF Medical Corps.

General dental practitioners' decisions		Oral and maxillofacial surgeons' decisions				Measure of agreement (Kappa)
		No CBCT needed		CBCT needed		
		Number	Row N%	Number	Row N%	
GP1	No CBCT needed	37	84.1%	7	15.9%	0.6
	CBCT needed	13	23.2%	43	76.8%	
GP2	No CBCT needed	32	88.9%	4	11.1%	0.56
	CBCT needed	18	28.1%	46	71.9%	
GP3	No CBCT needed	21	87.5%	3	12.5%	0.36
	CBCT needed	29	38.2%	47	61.8%	

Table 1 - Indication of CBCT referral according to three general dental practitioners and oral and maxillofacial surgeons

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