Available online at www.sciencedirect.com

ScienceDirect

Journal of the Chinese Medical Association 78 (2015) 617–622

www.jcma-online.com

Original Article

Use of panoramic radiography to predict postsurgical sensory impairment following extraction of impacted mandibular third molars

Chuan-Kuei Huang [a], Man-Tin Lui [a,b], Dong-Hui Cheng [a,b,*]

[a] *Oral and Maxillofacial Surgery, Department of Stomatology, Taipei Veterans General Hospital, Taipei, Taiwan, ROC*
[b] *School of Dentistry, National Yang-Ming University, Taipei, Taiwan, ROC*

Received January 14, 2015; accepted January 30, 2015

Abstract

Background: The purpose of this study was to use panoramic radiographic findings to predict postsurgical sensory impairment following the extraction of impacted mandibular third molars.
Methods: There were 120 patients enrolled in this study (55 male and 65 female). A total of 120 impacted mandibular third molars were included due to the proximity between the inferior alveolar nerve (IAN) canal and the roots of the impacted third molar on the panoramic radiograph. Seven radiographic signs were the predictor variables: (1) darkening of the root(s); (2) interruption of the radiopaque line of the inferior alveolar canal; (3) diversion of the inferior alveolar canal; (4) dark and bifid apex; (5) deflection of the root(s); (6) narrowing of the inferior alveolar canal; and (7) narrowing of the root(s). The outcome variable was the postoperative IAN sensory impairment. The retrospective cohort study model was used, and univariable and bivariable statistics was computed with the statistically significant level at $p \leq 0.05$.
Results: Three of the radiographic signs were statistically associated with IAN sensory impairment ($p < 0.05$). They include: (1) interruption of the radiopaque line [sensitivity = 0.92, specificity = 0.45, positive predictive value (PPV) = 0.17, negative predictive value (NPV) = 0.02]; (2) diversion of the IAN canal (sensitivity = 0.77, specificity = 0.84, PPV = 0.37, NPV = 0.03); and (3) narrowing of the IAN canal (sensitivity = 0.69, specificity = 0.65, PPV = 0.19, NPV = 0.05). However, the other four radiographic signs, namely darkening of the root(s), dark and bifid apex, deflection of the root(s), and narrowing of the root(s), were not statistically associated with IAN sensory impairment ($p > 0.05$).
Conclusion: There are three radiographic signs: (1) interruption of the radiopaque line; (2) diversion of the IAN canal; and (3) narrowing of the IAN canal. These signs are valuable in presurgical evaluation of the risk of postoperative sensory impairment after surgical removal of impacted mandibular third molar.

Keywords: inferior alveolar nerve; mandibular third molar; panoramic radiograph; sensory impairment

1. Introduction

Extraction of impacted mandibular third molars (M3s) is the most common minor dentoalveolar surgery in a dental office. Some complications may be encountered during the peri- and postoperative period. One of them is postsurgical sensory impairment, which is rare but possibly irreversible. Complication rates of IAN damage resulted from a mandibular M3 extraction have been reported to range from 0.5% to 5%, while permanent IAN damage was <1%.[1–3] To avoid these postsurgical complications, many risk factors associated with M3 removal have been suggested, including the surgeon's experience, method of anesthesia, patient's age, tooth morphology, and the root proximity to the IAN canal.

Conflicts of interest: The authors declare that there are no conflicts of interest related to the subject matter or materials discussed in this article.

* Corresponding author. Dr. Dong-Hui Cheng, Prosthodontics Division, Department of Stomatology, Taipei Veterans General Hospital, 201, Section 2, Shih-Pai Road, Taipei 112, Taiwan, ROC.
E-mail address: dhcheng@vghtpe.gov.tw (D.-H. Cheng).

http://dx.doi.org/10.1016/j.jcma.2015.01.009

The intimate anatomic relationship between the M3 root and the IAN has been proposed in the past decades to be one of the major risk factors[4,5] for postsurgical sensory impairment. Therefore, many imaging techniques have been developed to assess the precise anatomic location of the M3, such as the periapical film, dental panoramic film, cross-sectional plane tomography,[6] computed tomography (CT),[7–10] and magnetic resonance imaging (MRI).[11] Among these imaging techniques, only MRI provides the true anatomic position of the inferior alveolar neurovascular bundle. However, it is also the most expensive and time-consuming imaging technique. Consequently, MRI is not a practical imaging technique for preoperative assessment during routine impacted M3 removal surgery. All the other imaging techniques (periapical film, dental panoramic film, cross-sectional plane tomography, and CT) can only indirectly identify the anatomic location of the IAN by tracing the outer cortex of the IAN canal. Although the periapical film produces the most detailed image of the M3 root morphology and its surrounding structures at the highest resolution [14–20 line pairs (lp)/mm], the actual film placement is often hindered by the patient's gag reflex and other oral structures, such as the tongue base or the floor of mouth. Even though the periapical film is the least costly and the most readily available in every dental clinic, it is not routinely used for the evaluation of the anatomic relationship between the M3 root and the IAN canal. Cross-section plane tomography could be a good choice during the preoperative work-up, because it provides not only the proximity but also the buccolingual relationship between the M3 root and the IAN canal. However, it is not widely accepted by most dentists and oral maxillofacial surgeons probably due to its blurry image quality and the difficulty in differentiating between the IAN canal and the porosity of the bone marrow space.

By the early 2000s, CT was introduced and utilized in dentistry to evaluate the anatomic relationship between the M3 root and the IAN canal. More recently, the 3-dimensional reconstruction images showing the relationship between the M3 root and the IAN canal have become available using cone-beam CT.[12] Meanwhile radiation exposure is greatly reduced with cone-beam CT compared with conventional CT. New cone-beam CT represents an imaging modality that is near ideal for assessing the proximity between the M3 root and the IAN canal. Unfortunately, this technology is still not widely used in developing countries, perhaps because of the high costs associated with cone beam CT are often a deterrent to the practicing dentist. In addition, the possibility of more radiation exposure may also be of great concern to some patients. When taking into account the cost-benefit effect, and the information that the image itself provides, it is no surprise that panoramic radiography is still so commonly used by most dentists and oral surgeons for assessing the intimate relationship between the M3 root and the IAN canal.

The reliability of panoramic radiography for predicting the relationship between the M3 root and the IAN canal is still somewhat controversial.[13–20] Seven radiographic signs (Table 1) are proposed to predict postsurgical IAN injury during the removal of an impacted mandibular M3. According to the literature, the estimated sensitivity of the radiographic signs as a predictor for the IAN damage ranges from 66% to 79%, while the specificity ranges from 39% to 86%.[14,16,19] The visual proximity between the M3 root and the IAN canal on a panoramic radiograph is always suggestive of a higher risk of postsurgical IAN injury. Since most dentists use panoramic radiography as an assessment tool for impacted M3 removal surgery, the accuracy of this imaging modality needs to be closely examined.

Table 1
Radiographic signs of the intimate relationship between the M3 root and inferior alveolar nerve canal.

Radiographic signs	Description
Darkening of the M3 root	Radiolucency of the M3 root area, where M3 root and mandibular canal are superimposed
Interruption of the radiopaque line	Absence of continuity of mandibular canal cortex
Diversion of the mandibular canal	Obviously direction change of the mandibular canal in passage of the M3 root
Dark and bifid apex	Bifid and darkening of the M3 root, where mandibular canal is superimposed to it
Deflection of the root	Dilaceration root morphology of M3, where mandibular canal is contact or superimposed to it
Narrowing of the mandibular canal	Narrowing of the mandibular canal dimension where the canal and M3 root are contact or superimposed
Narrowing of the root	Narrowing of the M3 root, where the mandibular canal and M3 root are contact or superimposed
Other positive radiographic findings	Any other significant pathological change in M3 area

The purpose of this study is to determine whether a correlation exists between the radiographic risk factors and postsurgical sensory impairments. We hypothesize that the positive radiographic findings increase the possibility of postsurgical sensory impairment. Each individual parameter is statistically examined to testify its association with the sensory impairment with its respective sensitivity and specificity.[13–20]

2. Methods

A total of 120 patients, who consulted the Oral and Maxillofacial Surgery Department of Taipei Veterans General Hospital, Taipei, Taiwan for the extraction of impacted lower third molars from November 2008 to March 2009, were enrolled in this study. They were chosen due to close distance between the M3 root and the IAN canal on the panoramic radiograph. Informed consent was obtained from all of the patients. The sensory function of the IAN was assessed and confirmed to be intact for every patient before the surgical procedure. None of the patients had any neurological history. The epidemiological data collected included sex, age, and type of impaction tooth (Pell–Gregory Ramus and Occlusal Classification). Proximity was defined as either close (1 mm between M3 root and IAN canal upper cortex), in contact with (M3 root just touches the IAN canal upper cortex), or overlapping (M3 root superimposes the IAN canal). All M3s were removed by bur method with straight surgical handpiece. The surgical procedure was performed by three oral surgeons in the