# Extractions, CBCT Scans, and the Standard of Care for Preventing Injuries

**Prepared by:**
**Dr. Hugo C. Campos, DMD, DDS, MS, Diplomate ABOMR, Associate Professor,**
**Division Director of Oral & Maxillofacial Radiology Department of Diagnostic Sciences,**
**Tufts University School of Dental Medicine**

## Introduction

Extractions are one of the most common procedures performed by dentists and oral and maxillofacial surgeons, representing approximately 37 percent of all procedures. The most common teeth to be extracted are the third molars, followed by non-restorable teeth, supernumerary teeth, and premolars for orthodontic treatment. Some of the indications for extractions of the third molars are pericoronitis, impaction of molars, orthodontic indications, and advanced carious lesions. Factors such as location at the posterior maxilla or mandible and proximity to important anatomical structures contribute to a high rate of complications during the extractions, estimated at about 3 percent to 30 percent. Some of the most common complications when teeth are extracted include hemorrhage, infection, edema, trismus, tooth/jaw fracture, alveolar osteitis, ecchymosis, tooth displacement into the adjacent anatomical spaces, disruption of the floor of the maxillary sinuses, and nerve damage.

Panoramic radiographs and intraoral periapical radiographs are the most common radiographic imaging techniques recommended for the evaluation of teeth to be extracted. These radiographic images are recommended in the majority of cases where there is no superposition of the roots of the molars to the inferior alveolar nerve canal or the floor of the maxillary sinuses. Cone Beam Computed Tomography (CBCT) is recommended when conventional radiographs indicate a close relationship between the roots of the molars to the floor of the maxillary sinuses and the mandibular canal and surgical removal of the tooth is indicated.[1,2]

The purpose of this paper is to review the most common complications during or after the extraction of maxillary and mandibular teeth and the importance of a correct selection of radiographic imaging technique to plan any modification on the extraction/surgery to minimize the risk of possible complications.

## Complications in the Mandible

According to Kim and Lee,[3] one of the most common and severe complications when mandibular third molars are extracted is the damage to any of the branches of the mandibular nerve, lingual nerve, inferior alveolar nerve canal, or buccal nerve causing dysesthesia or paresthesia. This may be produced by postoperative swelling compression or cutting bur shearing. If the patient refers to nerve disturbances for more than nine months, with a relevant cutoff at six months, it should be considered permanent damage.

Radiographic evaluation is required for the treatment planning and decision of the technique to be used for the extraction of the mandibular third molars. Panoramic radiograph is considered the first imaging technique choice for the evaluation of mandibular third molars.

Some of the signs that need to be considered when evaluating mandibular third molars in panoramic radiographs include interruption of the cortices of the inferior alveolar nerve canals, the curvature of the canal, and the darkening of the roots. These signs may indicate a close contact of the roots of the mandibular molars to the inferior alveolar nerve canal (Fig. 1). However, the presence or absence of these radiographic findings is not always a reference to possible injuries of the inferior alveolar nerve canal, indicating the limitations of a two-dimension imaging technique such as the panoramic radiograph. When there is a minimal superimposition of the roots of the mandibular third molars to the inferior alveolar

## CONTENTS

Figure 1

nerve canal it is recommended to use advanced imaging modalities such as CBCT.[3, 4, 5]

According to Qi et al, the frequency of injuries of the inferior alveolar nerve canal during extractions of mandibular third molars ranges from 0.4 percent to 8 percent, with less than 1 percent reporting permanent damage. However, the chance of injury could be more than 10 percent when extractions are performed in high-risk patients.

Some of the factors that are related to IAN injury include age, depth of impaction, angulation, the proximity of the roots to the IAN canal, and the shape of the IAN canal in the coronal plane. This information can be evaluated with a CBCT.[6]

CBCT allows the dentist to determine the proximity of the roots to the inferior alveolar nerve canal. There is more chance to have nerve damage when there is direct contact of the roots of the molars to the cortices of the inferior alveolar nerve canal. If the cortical border of the inferior alveolar nerve canal is absent, it may indicate that there is direct contact between the roots of the molar and the inferior alveolar nerve canal and there is more risk of damage or exposure of the inferior alveolar nerve canal. Numerous studies indicate that there is more risk of damage or exposure of the IAN canal when it is located lingual to the roots of the mandibular third molars, due to compression of the nerve during the procedures to extract the third molar. Authors recommend in this case coronectomy before tooth dislocation.[3,5]

## Complications in the Maxilla

Third molar is the most indicated tooth to be extracted in the maxilla. Factors to be considered for the extraction of maxillary third molars are the relative depth of the impacted maxillary third molar, the position of the third molar and adjacent second molar, and the position of the third molar in relation to the maxillary sinus. One of the most common complications, when maxillary third molars are extracted is oroantral communication. If this is not managed properly, the patient may have other complications, including sinus infection. According to Lewusz-Butkiewicz, Kaczor, and Nowicka, oroantral communication of 2mm or less can heal spontaneously within 48 hours after extraction; if the oroantral communication is greater than 3-4mm it will not heal by itself without a proper intervention.[7]

There is no parameter to be used to predict the possibility of an oroantral communication during the extraction of a maxillary third molar. Generally, a panoramic radiograph is used to evaluate the proximity of the roots of maxillary third molars to the floor of the maxillary sinus. (Fig. 2) When the distance is less than 2mm, the dentist should warn the patient of possible complications, including oroantral communication.[8]

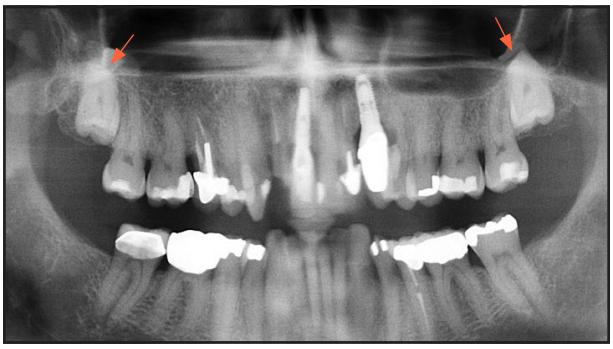

Figure 2

When dentists are evaluating maxillary third molars to be extracted on panoramic radiographs, and it is difficult to determine the distance of the roots of these teeth to the floor of the maxillary sinus due to superimposition of anatomical structures or distortion of the image related to magnification, the use of CBCT should be considered to reduce possible complications during the extraction. (Fig. 3)

If, after the extraction of a maxillary tooth, the dentist suspects the presence of an oroantral communication, it is recommended to take a CBCT scan to evaluate the size of the defect and the presence of any root fragments displaced into the maxillary sinus to plan the appropriate treatment and avoid possible infection in the maxillary sinus. (Fig. 4)

Other teeth which are indicated for extraction are supernumerary teeth. Liu et al state that the incidence of supernumerary teeth ranges from 0.1 percent to 3.6 percent. More than 90 percent of all supernumerary teeth are found in the maxilla, especially at the anterior maxilla. Some of the clinical complications related to supernumerary teeth in the maxilla include root resorption of adjacent teeth, impaction of teeth, and odontogenic cysts. For that reason, supernumerary teeth are recommended for extractions.

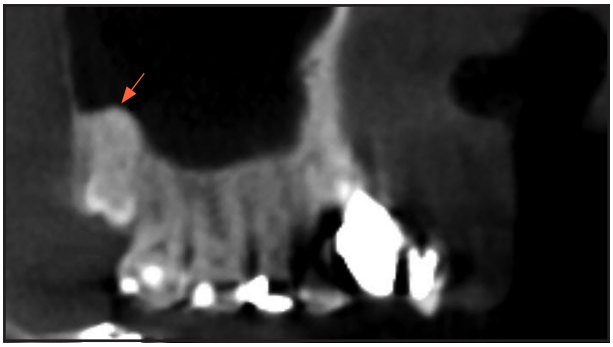

Figure 3

One of the aspects to be evaluated when a mesiodens is going to be extracted is the proximity of the supernumerary tooth to the nasopalatine duct. Sometimes the supernumerary tooth can be close to the nasopalatine duct, and also can be embedded in it. (Fig 5)

Panoramic radiographs can give important information about the presence of a supernumerary tooth, however, this 2D imaging technique cannot provide relevant information such as proximity of the supernumerary tooth to adjacent roots or anatomical structures such as the floor of the nasal cavity or nasopalatine duct. CBCT allows the dentist and oral maxillofacial surgeon to evaluate the proximity of the supernumerary tooth to the nasopalatine duct and plan the access and operative approach to reduce the risk of injury of the nasopalatine nerve. In some cases, the nasopalatine nerve needs to be transected during the operation, which may lead to sensory disorders in the anterior hard palatal region.[9]

## Use of CBCT to Evaluate Teeth to Be Extracted

For many years, computed tomography was used to evaluate maxillary and mandibular molars that were in close proximity to anatomical structures or present variations of the anatomy that could compromise the extraction. It is necessary to consider that computed tomography presents a higher radiation dose and lower resolution compared to CBCT.

Despite the similarities in the type of images that are obtained with computed tomography and CBCT, these two radiographic imaging techniques present some differences.

CBCT, as its name indicates, has a cone-shaped beam, covering the area to be evaluated in a single rotation. In contrast, computed tomography requires multiple rotations around the area of interest. For that reason, CBCT has a lower radiation dose than computed tomography, however, it is more radiation exposure than panoramic and intraoral periapical radiographs. For that reason, CBCT is not recommended as a routine imaging technique; it needs to be used as a supplement when more information is required that is not available in 2D images.

CBCT has a higher spatial resolution, offering more detail in the scan. This is important when it is necessary to evaluate the proximity of the roots of the molars to the floor of the maxillary sinus or the inferior alveolar nerve canal or supernumerary tooth to the nasopalatine duct.

CBCT is one of the most recent tools used in oral and maxillofacial radiology to evaluate impacted teeth and their proximity to adjacent teeth and also important landmarks such as maxillary sinuses, the floor of the nasal cavity, the nasopalatine duct, and the inferior alveolar nerve canal. One of the biggest advantages is the capacity to visualize bucco-lingual position, the number

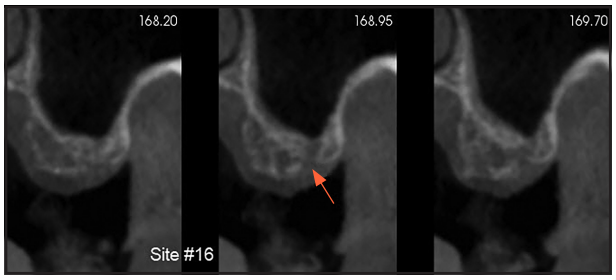

Figure 4

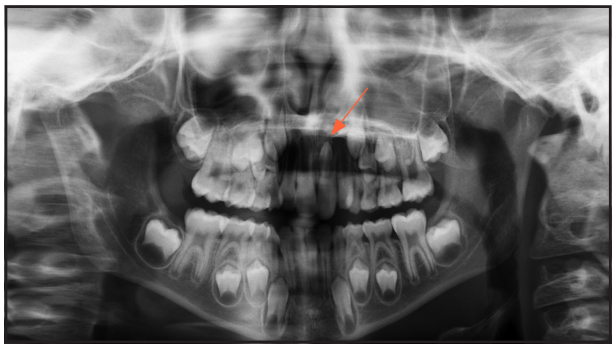
Figure 5

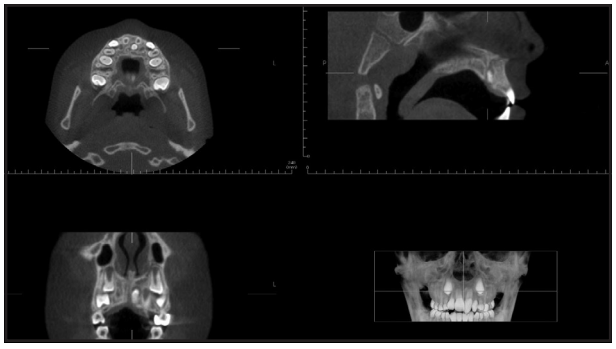
Figure 6

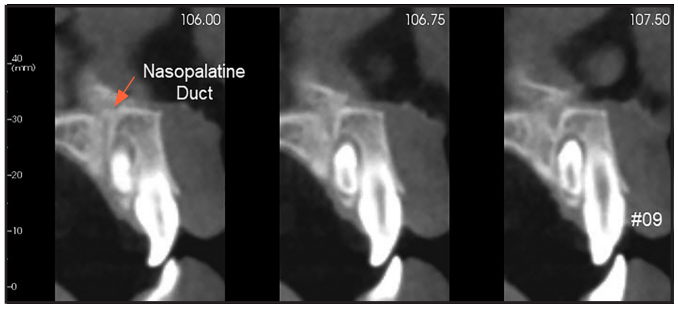

Figure 7

of roots, the variation of the anatomy of the roots, the proximity to the maxillary sinus, the inferior alveolar nerve canals, and adjacent teeth in three different planes with no superposition, and the ability to create reconstructed images as panoramic reconstruction, cross sections, and volume rendering.[3] (Fig. 6, 7)

The use of this advanced imaging technique in combination with an experienced dentist or oral and maxillofacial surgeon could reduce or eliminate the risk of complications including oroantral communication and permanent neuro-vascular damage.[10]

CBCT should be reserved for high-risk cases, such as teeth in close proximity to adjacent teeth or anatomical

structures such as the floor of the maxillary sinuses, naso-palatine duct, floor of the nasal cavity or inferior alveolar nerve canals. This will provide important information to the dentist or oral and maxillofacial surgeon, with the potential to change the treatment decision or surgical technique to avoid any possible complication.

It is not recommended as a routine method to evaluate teeth to be extracted. Dental professionals should evaluate the location and proximity of the tooth to be extracted in a panoramic radiograph or periapical radiograph. If the tooth/teeth are in close proximity to another tooth or anatomical structure, and this may produce a possible complication, then CBCT is justified to be taken.[9]

## Discussion

A large number of complications during extractions could be avoided if dentists adopted certain safety measures, such as the evaluation of 2D radiographic images and advanced imaging techniques in order to recognize factors that might lead to adverse events.

Panoramic radiographs alone do not provide enough information about the proximity of the roots of maxillary and mandibular teeth to important anatomical structures, such as maxillary sinuses and inferior alveolar nerve canals due to superposition in the radiographic image.

Numerous authors recommend using CBCT instead of panoramic radiographs to evaluate the proximity of the teeth to maxillary sinuses and inferior alveolar nerve canals, and also to evaluate the number and shape of roots that cannot be evaluated in 2D images. This information may lead to a better treatment plan, reducing surgical time and possible complications. CBCT images cannot prevent all possible complications during the extraction of teeth, however, CBCT images can provide information that cannot be obtained in panoramic radiographs, allowing the dental professional to plan or modify in advance the protocol to avoid possible complications or permanent damage.[3, 11]

## Conclusion

Extractions are a common procedure in dentistry, and while they are usually routine, there is always a risk of injury. Injuries can range from minor soft tissue damage to more severe nerve damage or even a fractured jaw.

The use of CBCT scans before high-risk extractions allow for a more detailed view of the patient's anatomy, enabling dentists to assess the risk of potential injury and plan accordingly, minimizing the risk of injury.

When dentists or oral and maxillofacial surgeons find possible risks during the extraction of teeth, they need to communicate clearly with their patients about the risks and benefits of extractions, as well as any alternatives that may be available. Patients should be fully informed about what to expect during and after the procedure, and any potential risks or complications should be thoroughly explained.

To conclude, CBCT scans have become an essential tool in the standard of care for preventing injuries during high-risk dental extractions. The three-dimensional view of the patient's anatomy provides dentists with a more accurate assessment of the risk of injury and enables them to plan and execute the extraction more safely and effectively. However, it is also essential for dentists to adhere to a strict standard of care and communicate clearly with their patients, ensuring that extractions are performed with the highest level of safety and efficacy.

## References


1.- Kiencało A, Jamka-Kasprzyk M, Panaś M, Wyszyńska-Pawelec G. Analysis of complications after the removal of 339 third molars. Dent Med Probl. 2021 Jan-Mar;58(1):75-80. doi: 10.17219/dmp/127028. PMID: 33789003.

2.- Suomalainen A, Apajalahti S, Vehmas T, Ventä I. Availability of CBCT and iatrogenic alveolar nerve injuries. Acta Odontol Scand. 2013 Jan;71(1):151-6. doi: 10.3109/00016357.2011.654254. Epub 2012 Feb 9. PMID: 22320436.

3.- Kim HG, Lee JH. Analysis and evaluation of relative positions of mandibular third molar and mandibular canal impacts. J Korean Assoc Oral Maxillofac Surg. 2014 Dec;40(6):278-84. doi: 10.5125/jkaoms.2014.40.6.278. Epub 2014 Dec 26. PMID: 25551092; PMCID: PMC4279971.

4.- Sarikov R, Juodzbalys G. Inferior alveolar nerve injury after mandibular third molar extraction: a literature review. J Oral Maxillofac Res. 2014 Dec 29;5(4):e1. doi: 10.5037/jomr.2014.5401. PMID: 25635208; PMCID: PMC4306319.

5.- Bigagnoli S, Greco C, Costantinides F, Porrelli D, Bevilacqua L, Maglione M. CBCT Radiological Features as Predictors of Nerve Injuries in Third Molar Extractions: Multicenter Prospective Study on a Northeastern Italian Population. Dent J (Basel). 2021 Feb 21;9(2):23. doi: 10.3390/dj9020023. PMID: 33669928; PMCID: PMC7924829.

6.- Qi W, Lei J, Liu YN, Li JN, Pan J, Yu GY. Evaluating the risk of post-extraction inferior alveolar nerve injury through the relative position of the lower third molar root and inferior alveolar canal. Int J Oral Maxillofac Surg. 2019 Dec;48(12):1577-1583. doi: 10.1016/j.ijom.2019.07.008. Epub 2019 Jul 28. PMID: 31362896.

7.- Lewusz-Butkiewicz K, Kaczor K, Nowicka A. Risk factors in oroantral communication while extracting the upper third molar: Systematic review. Dent Med Probl. 2018 Jan-Mar;55(1):69-74. doi: 10.17219/dmp/80944. PMID: 30152638.

8.- Lim AA, Wong CW, Allen JC Jr. Maxillary third molar: patterns of impaction and their relation to oroantral perforation. J Oral Maxillofac Surg. 2012 May;70(5):1035-9. doi: 10.1016/j.joms.2012.01.032. Epub 2012 Apr 10. PMID: 22494509.

9.- . Liu J, Li X, Ma L, Pan J, Tang X, Wu Y, Hua C. A Hypothesis and Pilot Study of Age-Related Sensory Innervation of the Hard Palate: Sensory Disorder After Nasopalatine Nerve Division. Med Sci Monit. 2017 Jan 29;23:528-534. doi: 10.12659/msm.899189. PMID: 28132066; PMCID: PMC5295179.

10.- Robbins J, Smalley KR, Ray P, Ali K. Does the addition of cone-beam CT to panoral imaging reduce inferior dental nerve injuries resulting from third molar surgery? A systematic review. BMC Oral Health. 2022 Nov 3;22(1):466. doi: 10.1186/s12903-022-02490-x. PMID: 36329417; PMCID: PMC9635162.

11.- Mabongo, Mzubanzi & Thekiso, Maphefo. (2019). Does additional information provided by cone beam computed tomography (CBCT) and a consequent modification of surgical technique reduce the possibility of inferior alveolar nerve injury? A pilot study. South African Dental Journal. 74. 10.17159/2519-0105/2019/v74no2a2.


MALPRACTICE INSURANCE
BY DENTISTS, FOR DENTISTS®

**For further information on EDIC Risk Management or to a request a lecture on dental malpractice risks for your dental school or organization, please contact EDIC's Risk Manager/Chief Risk Officer, Katie Panikian, JD, CPCU, ARM, at kpanikian@edic.com or call 508.475.0955. Eastern Dentists Insurance Company, Malpractice Insurance, "By Dentists, For Dentists"®**

Provided by Eastern Dentists Insurance Company (EDIC), June 2023. The information contained is only accurate to the day of publication and could change in the future.