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# A retrospective analysis of complication rates in the surgical removal of complex lower third molars using preoperative cone beam computed tomography

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**Abstract**
**Background:** Among the exodontic surgeries, almost one-third are associated with inferior alveolar nerve damage subsequent to the extraction of lower third molars. The use of CBCT in the field of craniofacial surgery has demonstrated a substantial reduction in both intraoperative and postoperative problems
**Objective:** The purpose of this study was to find a correlation between the use of a CBCT prior to the surgical removal of lower mandibular third molars and the postoperative outcome in terms of neurological disorders.
**Methods:** In this retrospective study patients undergoing impaired 3rd molar extraction along with a preoperative CBCT plus preoperative orthopantomograph were evaluated. We investigated patient age, gender, intraoperative parameters including operation time, IAN exposure, and postoperative results like the requirement for medication, edema, and nerve sensitivity impairment to get complete information.
**Results:** Data of 130 patients evaluated in which 170 3rd molars were extracted. Procedure length was moderate (10 to 25 min) in 54% of patients. The intraoperative exposure of the IAN was documented in 9 cases (6.9%). The majority of patients (n=112) demonstrated a decrease in postoperative pain and edema after 7 days (86.2%). Only 18 instances (13.8%) had a prolonged healing phase. Ten cases (7.7%) with transient changed feelings were observed. Most people had a brief change in feeling in their IIIC teeth and mesio-angulated molars.
**Conclusion:** We did not observe any harm to the IAN bundle and postoperative feeling was always transitory. Preoperative CBCT does not minimise postoperative neurological damage, although it may lead to a less invasive surgical approach.

**Keywords:** Third molar, extraction, cone-beam computed tomography, radiography, inferior alveolar nerve

## Introduction
The extraction of mandibular third molars is a prevalent technique in the field of dentomaxillofacial surgery and has been performed for more than a century [1]. In the context of lower third molar surgery, the occurrence of inferior alveolar nerve (IAN) damage may be attributed to two primary causes. The first cause involves the compression or laceration of the IAN when the third molar root comes into contact with it during the process of elevation. The second cause entails direct injury to the IAN resulting from the use of sharp or rotary tools during root elevation or bone removal [2]. The incidence of nerve damage associated with lower third molar surgery has been documented to vary significantly. Specifically, the reported frequency of IAN deficit ranges from 0.2% to 8.4%, while lingual nerve (LN) deficit has been reported to range from 0.1% to 22% [3]. The trajectory of the IAN in relation to the root of the third molar has significant importance in the formulation of the surgical strategy. When there is close proximity between the IAN and the roots of the third molar, the option of performing a coronectomy may be considered as a surgical intervention to minimise the risk of neurological impairments [4]. Additionally, the fragmentation of the third molar might be employed as a technique to safeguard the IAN bundle. The accuracy of preoperative knowledge on the trajectory of the IAN directly impacts the efficacy of surgical planning. Numerous authors and dental organisations have formulated comprehensive recommendations and treatment protocols pertaining to the surgical extraction of mandibular third molars.

Prior to the extraction of the tooth, a comprehensive clinical assessment and, frequently, a radiographic examination are conducted to assess the positioning and anatomical characteristics of the third molar, as well as its proximity to adjacent important tissues [5]. This information assists the doctor in making therapeutic decisions with confidence and mitigates the likelihood of surgical problems. The field of dental radiography has witnessed substantial advancements in the past decade to fifteen years, with notable changes and developments in several aspects including indications, operational techniques, and perioperative medication [6]. Currently, there is a growing trend in the utilisation of cone beam computed tomography (CBCT), accompanied by a simultaneous decrease in the size and cost of CBCT systems. The use of CBCT in the field of craniofacial surgery has demonstrated a substantial reduction in both intraoperative and postoperative problems [7].

One potential advantage of using preoperative cone beam CT imaging is the potential for a more comprehensive treatment plan and a more accurate evaluation of risks in instances that are complicated in nature. Research has demonstrated that the use of Cone Beam Computed Tomography (CBCT) has a significant impact on the surgical technique employed by surgeons [8]. There exists substantial data, as previously noted, indicating that prior to the complete extraction of a mandibular third molar, the use of cone beam computed tomography (CBCT) does not result in a decrease in the occurrence of post-operative sensory abnormalities of the inferior alveolar nerve (IAN) as compared to standard panoramic imaging. This conclusion is supported by randomised controlled trials (RCTs) and is assigned a Grade A level of recommendation. The use of cone beam computed tomography (CBCT) did not result in a reduction in the duration of surgical procedures, the quantity of pain-relieving analgesics administered, or the occurrence of problems necessitating communication with the surgeon (Grade A) [8]. thereby, the use of a more comprehensive preoperative diagnostic analysis and tailored surgical methods is expected to result in a decrease in complications, thereby leading to a reduction in the incidence of injured inferior alveolar nerve (IAN) bundles. Additionally, the developmental stage of the roots of the third molar may contribute to a reduction in the incidence of injuries to the inferior alveolar nerve (IAN) bundle. Hence, the implementation of a Germectomy procedure has the potential to mitigate the likelihood of neurological impairments to the inferior alveolar nerve (IAN) bundle [9].

Based on the extant literature and empirical investigations, it is posited that the utilisation of preoperative CBCT is associated with a reduced incidence of iatrogenic injuries to the alveolar inferior nerve bundle during difficult third molar extractions. Consequently, this is expected to result in a decreased prevalence of postoperative neurological complications. The objective of this study was to evaluate the use of preoperative CBCT in the context of surgical extraction of difficult lower third molars. The primary objective was to determine the significance of its efficacy in mitigating the potential harm to the inferior alveolar nerve (IAN) and subsequent postoperative complications, such as neurological impairments.

## Materials and Methods

Our sample of patients was assembled for this retrospective review from an Indian dental private practise.

### Inclusion and exclusion criteria

Patients had to be older than 14 and in good physical and mental condition to meet the inclusion requirements. A preoperative CBCT was required in addition to a preoperative orthopantomograph (OPT). The OPT provided a CBCT imaging indication. The inferior alveolar nerve was at a higher danger of being damaged, and the OPT required to demonstrate radiologic evidence of this. The third molar root darkening, abrupt narrowing, interruption of the IAN canal's white line, displacement of the IAN canal by the root, and abrupt narrowing of at least one of the white lines representing the IAN canal close to the third molar root are examples of these symptoms [10]. Different oral surgeons with varying degrees of ability performed the evaluation of the preoperative OPT and CBCT, and they standardised the X-Ray examination before the evaluation. During surgery, at least one-third tooth on the mandible had to be removed. A defined removal strategy (buccal approach) was used during the procedure. Because of the challenging location of the teeth so close to the IAN, all teeth were extracted via osteotomy, which also involved the removal of bone and sectioning of the teeth.

A pre-existing neurological condition, severely diminished general or mental health, and simultaneous excision of teeth other than the third molars during surgery are all exclusion factors.

### Preoperative OPTs

Preoperative OPTs were assessed using the commonly used Pell and Gregory categorization system as well as the winter classification system [11, 12]. When analysing the CBCT, it is typical to categorise the tooth's location according to its impaction (impacted or not) and angulation (mesial, vertical, distal, and horizontal). The vestibular, caudal, and lingual characteristics of the nerve canal in regard to the tooth can be used to define the connection between the IAN and the lower third molar. It is fair to categorise the position of the nerve into a vestibular, vestibular touching, caudal, caudal touching, inter radicular, lingual, and a lingual touching nerve route as the goal is to evaluate the risk of surgery in relation to the nerve's position. All situations when there is no discernible gap between the nerve canal and the lower third molar are referred to as "touching".

### CBCT

The IAN canal's distance from the lower third molar's apex was measured using the CBCT. We investigated patient age, gender, intraoperative parameters including operation time, IAN exposure, and postoperative results like the requirement for medication, edema, and nerve sensitivity impairment to get complete information. Short procedures lasted less than 10 minutes, moderate procedures lasted between 10 and 25 minutes, and lengthy procedures lasted longer than 25 minutes. In addition, three categories of postoperative healing were identified: Normal, defined as no swelling or pain within seven days; delayed, defined as no swelling or pain from seven to 21 days; and highly delayed, defined as no swelling or pain within more than 21 days.

In this scenario, "permanent" might be defined as impaired feeling for more than six months. It is customary to distinguish between transient and permanent neurological injury to the IAN nerve bundle. We categorised the short-term harm into three categories: Seven to fourteen days, fourteen to thirty days, and more than thirty days.

## Results

Based on the data 130 patients matched the inclusion criteria. In the last five years, these people underwent surgery. A total of 170 third molars were extracted during this time by various dental surgeons. Three of these doctors have a combined surgical experience of more than 20 years. Less than five years of surgical experience separated the other three physicians. In our investigation, the CBCT and OPT resolution and quality were sufficient for analysing the relationship between the third molar roots and the IAN canal. In one instance, categorization was inaccurate due to a diseased follicular cyst, making it unable to define the nerve location. No unusual fractures have occurred in our patient population. Infection and haemorrhage following surgery have not been quantified.

### General results/epidemiology

There were 130 patients in the patient group, 57 of whom were men and 73 of whom were women. Patients were aged between 18 and 69 at the time of surgery. The median age was 35.4 years.

### Intraoperative data

**Procedure length:** The distance from the incision to the suture was measured. Moderately long operations made up 54.6% of all procedures (Table 1).

**Table 1:** Procedure length

| Time Required | n | % |
|---|---|---|
| Short (< 10 minutes) | 28 | 21.53846 |
| Moderate (10 to 25 min) | 71 | 54.61538 |
| Long (> 25 min) | 31 | 23.84615 |

**Exposure of the IAN:** The intraoperative exposure of the IAN was documented in 9 cases (6.9%).

### Postoperative data

**Postoperative swelling:** The majority of patients (n=112) demonstrated a decrease in postoperative pain and edema after 7 days (86.2%). Only 18 instances (13.8%) had a prolonged healing phase, with more than 25 days (8.1%) of postoperative discomfort.

**IAN disorders:** There were no reports of permanent neurological injury, which is characterised by altered or absent feelings in the IAN's innervation region for more than six months. Postoperative anaesthesia was usually temporary and would soon give way to hypoesthesia. Ten cases (7.7%) with transient changed feelings were observed. Within 30 days or fewer, 82.5% of patients with impaired feeling were back to full neurological function.

In two cases (15%), intraoperative exposure to the IAN was associated with a transient reduction in sensory function.

### Radiology data

### OPT diagnostics

**Pell and Gregory:** The distribution of the patient group's tooth locations according to Pell and Gregory. The largest number of extracted molar locations were IIB and IIIC. Most people had a brief change in feeling in their IIIC teeth (46%) followed by IB and IIB.

**Winter:** Lower third molars that were extracted were mostly mesio-angulated (45.5%). The most often reported transient changed feeling was with mesio-angulated molars.

### CBCT

**Nerve position:** The CBCT analysis revealed that vestibular touching (42 instances; 32.3%) and lingual touching (35 cases; 26.9%) accounted for the majority of nerve locations. In 98 instances, or 75.4% of all nerve placements, the lower third molar was touched. Most of the time, a lingual nerve location was in close proximity to the lower third molar. In 9 instances (7%), an interradicular nerve location was discovered.

**IAN separation from the third mandibular molar:** The IAN canal was typically 0.4 mm away from the third molar on the mandible. The greatest separation was 6 mm.

**IAN distance to clinical IAN exposure:** Preoperative CBCTs showed that the nerves in every reported patient with clinical IAN exposure were touching the tooth roots. A caudal contacting nerve location was seen in four individuals with clinical IAN exposure. Two instances with intraoperative IAN visibility (21.4%) were reported to have an interradicular course of the IAN.

**CBCT diagnostic to neurological disorder:** A substantial number of nerve sites were caudal touching in the group of 13 patients with postoperative impaired feeling (nine instances, 6.9%). Only one instance of inter radicular contact (7%) and three vestibular touching occurrences (23%) were reported. Every time, the CBCT revealed a 0 mm gap between the IAN and the lower third molar.

## Discussion

The objective of this study was to establish a potential association between the utilisation of CBCT before the surgical extraction of lower mandibular third molars and the subsequent postoperative prognosis with regard to neurological problems. The examination of this link is crucial as surgeons want dependable data to effectively communicate potential hazards associated with a surgical intervention to patients. Our hypothesis posited that the utilisation of preoperative three-dimensional radiography would result in a reduction in the incidence of iatrogenic nerve damage. In the present investigation, a total of 130 patients were included, of which 10 individuals (7.7%) experienced neurological impairment (IAN disorders) subsequent to the surgical procedure. Worldwide literature documented the incidence of iatrogenic nerve damage occurring during the extraction of lower mandibular third molars. Irrespective of the intricacy involved in the extraction process, existing research demonstrates a considerable variation in the risk associated with surgery, ranging from 0.8% to 8.4% [13]. In prospective research conducted in total of 1087 cases with surgical removal of the lower mandibular third molar the prevalence of transient neurological abnormalities was reported to be 4.1%, whilst irreversible neurological impairment was observed in 0.7% of cases [14]. Several study parameters in Jeries' research align with our study. In our perspective, the incidence of nerve injury in complicated instances using preoperative CBCT is at 2.6%, which may be considered rather elevated when compared to a risk of 4.8% observed in cases just employing OPT.

The clinical visualisation of the inferior alveolar nerve bundle during the surgical extraction of mandibular third molars is influenced by several aspects, such as the extent of jaw opening, bleeding that occurs during the procedure, and importantly, the specific position and pathway of the IAN.

There is connection between intraoperative exposure of the inferior alveolar nerve and the occurrence of neurological injury [15]. The findings of our investigation indicate that there is no statistically significant association between the two variables. The surgeon was able to visualise the inferior alveolar nerve in just two instances when postoperative neurologic deficits were present. One of the neural pathways identified was classified as inter radicular, while the other was categorised as caudal. The likelihood of a neurological deficiency increases by a factor of 14.9 when the inferior alveolar nerve bundle is exposed during the surgery [16]. The surgical technique employed significantly influences the potential for exposure of the inferior alveolar nerve bundle. When conducting a search for potential correlations with problems, it is imperative to provide explicit details on the surgical method. In addition, the surgeon plays a significant role in affecting the result of a research. Every conceivable statistic is influenced by factors such as an individual's experience, skill level, as well as their physical and mental condition. This study involved the participation of six oral surgeons with diverse levels of ability and experience, who conducted the surgical procedures.

Objective assessment of postoperative edema and pain perception poses significant challenges. This investigation necessitated the exclusive reliance on patient documentation. In order to obtain a more precise and unbiased understanding of postoperative swelling and pain, it is imperative to conduct prospective research employing pre-established standardised questionnaires and medical records.

Numerous writers in the past have highlighted the limited accuracy associated with relying solely on an OPT for preoperative diagnosis [15, 17]. Before the availability of CBCT diagnostics, radiological signals observed in two-dimensional diagnostic imaging were used as an indicator for the need of a CT scan. The advent of smaller and more cost-effective CBCT machines in the early 2000s provided dentists and maxillofacial surgeons with the opportunity to utilise three-dimensional diagnostic capabilities at a reduced cost, while also minimising radiation exposure for both patients and medical personnel [18, 19].

CBCT remains the preferred imaging modality for dentoalveolar diagnosis. In our investigation, the use of preoperative CBCT was found to have no significant impact in mitigating the occurrence of postoperative neurological impairment. However, the comprehensive data obtained via the use of CBCT allows the surgeon to make informed decisions on the most suitable surgical approach. This ultimately results in a modified and thus less invasive procedure, accompanied by reduced operation duration. Consequently, CBCT should not be regarded as a routine diagnostic tool, but rather reserved for cases when the OPT reveals indications of potential inferior alveolar nerve (IAN) injury [17].

Based on our data analysis, it has been observed that the presence of a horizontally rotated lower third molar (winter classification) in close proximity to the inferior alveolar nerve does not exhibit a statistically significant link with the occurrence of postoperative sensitivity impairment. Based on the presence of a contraindication for coronectomy resulting from horizontal rotation, it is advisable to prioritise full extraction as the preferred treatment. The CBCT is also of considerable importance in assessing the rationale for removal of asymptomatic mandibular third molars. If the CBCT) reveals the presence of a caudal touching or inter radicular pathway, it is advisable to reassess the reason for surgery.

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