Correlations Between Mandibular Third Molars to Inferior Alveolar Nerve Locations in Vietnamese Population

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ABSTRACT

One of the probable complications in mandibular third molar extraction is the damage to the inferior alveolar nerve (IAN). Calculating the distance between IAN and third mandibular can decrease the complication risk. In this study, cone beam computed tomography (CBCT) scans were used to evaluate several factors related to the positional relationship between mandibular third molar and IAN in the Vietnamese population. One-hundred-seventy-eight CBCT scans were collected from dental clinics at Ho Chi Minh City, from 1st January 2018 to 28th February 2021. Only 100 scans were included in this study, 55 scans of female and 45 scans of male patients. The age of the patients ranged from 19 to 59 years old. From this study, the most common location of IAN relative to the roots of the mandibular third molar was on the apical side (60.5%), followed by the buccal side (21.5%), the lingual side (16%), and the least common located between the roots (2%). Overall, the mean distance between mandibular third molar roots to IAN was 3.19 ±1.85mm. There was a significant correlation between the left and right sides of the IAN location, indicating symmetry. Moreover, there is no association was found between gender and the location of IAN.

1. Introduction

The extraction of the mandibular third molar is the most frequent intervention in oral surgery. A cohort study evaluated those general dentists recommend extraction of third molars in 59% of patients, mainly to prevent future problems or because a third molar had an unfavorable orientation or was unlikely to erupt. Unfortunately, a common problem after oral and maxillofacial surgery and even sometimes during routine dental treatment is the inferior alveolar nerve damage. Inferior alveolar nerve damage can lead to numbness in the region supplied by the inferior alveolar nerve, which may be temporary or even permanent. Anatomic varieties identified with the position and course of IAN could impact distinctive treatment modalities in the mandibular area. Understanding the location of the inferior alveolar nerve have great advantages on surgical treatment planning which helps to avoid damage to this nerve and resulting sensory disturbances.

The inferior alveolar nerve (IAN) or inferior dental nerve is a mixed sensory and motor branch of the posterior division of the mandibular division of the trigeminal nerve. The location of IAN is in the pterygomandibular space of the masticator space. The inferior alveolar nerve located anteriorly within the mandibular canal and provide sensory nerve supply to the mandibular teeth, alveolar process, and periosteum.

There is a great difference in the location of IAN during its course in the mandible. Besides that, the exact location of the inferior alveolar nerve significantly different within a specific population. In recent years, there are very few studies on the anatomic structure of
the Vietnamese population even though it a helpful data for doctors and dentists to apply in daily practice. To be more specific, there here has been no study regarding the positional relationship between IAN and mandibular third molar in the Vietnamese population until now. In consequence, this research was conducted to analyze the positional relationship between mandibular third molars and the IAN and factor-related by CBCT

The correlational between mandibular third molar and IAN positions, and other factors affecting the relationships in the Vietnamese population are still being questioned until today. The research aims to investigate the prevalence of the IAN position relative to the roots of the mandibular third molar, based on the Cartesian Coordinate System Concept, measure the distance between the IAN to the root of the mandibular third molar, and analyze the symmetrical and gender correlation between the two landmarks in the Vietnamese population. Other factors are also being observed.

2. Method

This research design is a cross-sectional study, conducted from February to April 2021 at Ho Chi Minh City. The sampling method is purposive sampling.

Population and sample

The population observed was the Ho Chi Minh City commuter, who had taken CBCT radiographic scans for various treatments at Dental Clinics from 1st January 2018 to 28th February 2021. The CBCT radiographic images were taken from the same machine (Newtom GIANO HR), at the same settings. CBCT files were collected in DICOM format. Images were processed using NNT 3D Imaging software. Apart from CBCT scan images, medical records were used to confirm the patient’s gender.

The inclusion criteria of the sample are Vietnamese origin, age between 19 to 59 years old, presence of mandibular third molars on both, left and right, side, and fully-formed permanent mandibular third molars roots on both left and right side.

Mixed dentition and patients with a history of trauma or pathology of the mandible, syndrome conditions, congenital or developmental disorders, and surgical intervention of the mandible were excluded in this study.

Data collection method

From one-hundred-and-seventy-eight CBCT scans collected in the clinic. Only one hundred were selected in this study, based on the inclusion and exclusion criteria. Fifty-five (55) patients were female, and forty-five (45) patients were male. The CBCT images were analyzed twice by two observers, one dental student and one experience radiologist, to classify the three-dimensional relationship of the mandibular third molar and the IAN.

Data analysis method

The selected data were categorized for the position of the mandibular canal relative to the roots of the mandibular third molar, based on the 4 classes of the Cartesian Coordinate System Concept. Afterward, the distance between the IAN to the root of the mandibular third molar was also being measured in millimeters. If the mandibular has only one root, the distance is taken from the distance between the root to the closest point of the IAN. For the mandibular with more than one root, the closest root to the IAN will be chosen as the reference point.

The data collected in this study were analyzed statistically using the SPSS software version 24.0 (IBM Corporation, USA) program.

3. Result

The prevalence of each classification and contact relation of the ian position relative to the roots of the mandibular third molar, based on the cartesian coordinate system concept in the vietnamese population.

This study revealed that IAN is commonly located on the apical side of the mandibular third molar (60.5%), followed by the buccal side (21.5%), the lingual side
(16%), and between the roots (2%). In terms of contact relationship, 94.5% of the IAN does not have any contact relation with mandibular third molar roots (Table 1).

### The distance between the IAN to the root of the mandibular third molar was also being measured in millimeters in the Vietnamese population.

The distance from the root of the third mandibular molar root and IAN is measured in mm. Table 2 summarized all data in a detailed manner. From the table, data illustrated that the mean distance in each class I, class II and class III cases is 3.47mm, 2.81mm, and 3.08mm, respectively. Overall, the mean distance is 3.19 ±1.85mm However, the distance between IAN and mandibular third molar is 0 in all class IV cases. This means that the IAN is in contact relation with mandibular third molar when the IAN is between the roots of mandibular third molars (Table 2).

The normality of data distribution was being analysed. Since the p-value is greater than 0.05, we can conclude that the distance is normally distributed in all the samples.

### The symmetrical correlations between left and right mandibular third molar related to IAN position in the Vietnamese population.

The symmetrical relationships between the left and right side of the mandibular third molar to IAN were evaluated using the Pearson correlation coefficient test (Table 3). The statistical analysis showed that the location of IAN between the right side and left side is .607, which is significant (p < .001 for a two-tailed test), based on 100 complete observations. There were also statistically significant correlations of the location of IAN between the left and right sides, indicating symmetry.

### The gender factor related to IAN and mandibular third molar position in the Vietnamese population.

The distribution of IAN classification was similar between two gender groups (female and male) as shown in Table 4. In both groups, the location of IAN was found more common in the apical position of the mandibular third molar, approximately 60% of total cases. While Class II and III classifications were seen in 1 out of 5 cases (approximately 20%). Class IV classification was rarely found in both groups.

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**Table 1. Prevalence of each classification and contact relation of the ian position relative to the roots of mandibular third molar (cartesian coordinate system concept)**

|       | Contact (+) | Contact (-) | Total  |
|-------|-------------|-------------|--------|
| Class I (Apical) | 4 (2.0%) | 117 (58.5%) | 121 (60.5%) |
| Class II (Buccal) | 2 (1.0%) | 41 (20.5%) | 43 (21.5%) |
| Class III (Lingual) | 1 (0.5%) | 31 (15.5%) | 32 (16.0%) |
| Class IV (Between Roots) | 4 (2.0%) | 0 (0.0%) | 4 (2.0%) |
| **Total** | **11 (5.5%)** | **189 (94.5%)** | **200 (100%)** |
Table 2. The distance (mm) between the ian to mandibular third molar’s root

| IAN Classification | N  | Mean ± Std. Deviation |
|--------------------|----|-----------------------|
| Class I            | 121| 3.47 ± 1.77           |
| Class II           | 43 | 2.81 ± 1.75           |
| Class III          | 32 | 3.08 ± 1.92           |
| Class IV           | 4  | 0 ± .00               |
| Total              | 200| 3.19 ± 1.85           |

Table 3. The Symmetrical Correlations between the left and right mandibular third molar related to IAN position

|                  | Left side | Right side |
|------------------|-----------|------------|
| Left side        | Pearson Correlation 1 | .607** |
| Sig. (2-tailed)  | .000      |            |
| N                | 100       | 100        |
| Right side       | Pearson Correlation 0.607** | 1 |
| Sig. (2-tailed)  | .000      |            |

Table 4. The Correlation between Gender to the IAN classification

| IAN Classification | Gender       | Total |
|--------------------|--------------|-------|
|                    | Female       | Male  |       |
| Class I (Apical)   | 71 (64.5%)   | 50 (55.5%) | 121 |
| Class II (Buccal)  | 22 (20.0%)   | 21 (23.5%) | 43  |
| Class III (Lingual)| 15 (13.5%)  | 17 (18.8%) | 32  |
| Class IV (Between Roots) | 2 (2.0%)   | 2 (2.2%) | 4   |
| Total              | **110 (100%)** | **90 (100%)** | **200** |

4. Discussion

Surgical removal of third molars is often associated with complications. Common postoperative complications associated with third molar extraction included alveolitis, infection, postoperative bleeding, transient dysfunction of the inferior alveolar nerve, and permanent dysfunction of the inferior alveolar nerve. In another study, it is stated that the risk of inferior alveolar nerve (IAN) injury following the extraction of impacted lower third molars accounted for up to 7%. According to preoperative CBCT, when the IAN is adjacent to the enlarged part of the root, the risk of postoperative IAN injury is higher. Injury of the IAN is a serious intraoperative complication that may occur during routine surgical procedures, such as dental implant placement or extraction of impacted teeth.

Pathology associated with the third molar is more often observed in CBCT than in panoramic findings.
Consequently, more third molars would be removed if pathological findings are based on CBCT\textsuperscript{11}. CBCT can help surgeons in surgical planning and reduce operation risk\textsuperscript{12}. A total of 100 CBCT were selected for the study. From data collected, the most common location of IAN to third mandibular molar is on the apical side (60\%) and inter-radicular position was the rarest among the population (2\%). No-contact relations make up a majority in all of the classes.

However, if the IAN is close to the impacted third molar, coronectomy can be chosen as a surgical protocol to reduce the risk of neurologic lesions to the IAN. A prospective cohort study found that no cases of neurologic lesions, no cases of late infection of the retained roots at 5 years, and a low rate of immediate postoperative complications after 116 coronectomies\textsuperscript{13}.

From the data collected, direct contact makes up for 100\% when the IAN is located between the root of the mandibular third molar. Interestingly, IAN damage does not generally happen, even when the IAN is in contact relation with the third molar. A study illustrated that there is no association between nerve injury and direct IAN-M3 contact or canal decorticalization\textsuperscript{14}. Nonetheless, in direct contact cases, surgical caution should be taken before any surgical procedure.

To avoid IAN injury during impacted mandibular third molar removal, a recent study had proposed a novel orthodontic extraction method. A removable appliance was first applied to move the root tips away from the IAN, and the tooth was subsequently removed. This could be a good alternative treatment option to avoid IAN injury in high-risk cases\textsuperscript{15}.

This is a study of the Vietnamese population. From data collected, apical position and no-contact relation of IAN to mandibular third molar are the most occurring in the whole population. The rarest case among the whole population is an inter-radicular location and direct-contact relation. This result is similar to some other research in other ethnicities. A study in the Chinese population illustrated up to 88.1\% of apical relation and 92.7\% no-contact relation between the mandibular canal and third molars\textsuperscript{16}. In this study, they also stated that only 0.5\% of the mandibular canal was found located between the root. Another study in Pakistan showed that most of the patients (54.28\%) were seen with inferior alveolar variations of Type I, followed by 21.42\% Type II, 14.28\% type III, and 10\% with Type IV\textsuperscript{17}. From this information, we may conclude that the apical position and no-contact relationship is the most commonly happened in most of the population. However, more research may need to be conducted with a larger sample size.

Besides, Wang et al (2019) indicated that more than 3mm is the shortest distance between the mandible canal and the lower third molar for most non-contact cases\textsuperscript{15}. In this research, for non-contact cases, the result is quite similar because the mean distance in non-contact cases is 3.26 ± 1.80mm.

Symmetrical of IAN between the left and right side is also a factor affecting treatment decision. In this study, there were statistically significant correlations of the location of IAN between the left and right sides, indicating symmetry. The symmetrical relationship between both sides of the mandible is being analysed in many pieces of research. Research in the Malaysian population has concluded that there are strong positive correlations on both sides of the mandible that indicate the presence of symmetry\textsuperscript{6}.

Moreover, there is no association was found between gender and the location of IAN. In a study of 954 patients, Chen et al illustrated that there was no significant difference based on gender\textsuperscript{12}. Besides, in another research, it is stated that there was statistically no significant variance in the appearance of inferior alveolar nerve according to age and gender\textsuperscript{17}.

To sum up, the result from this research is similar to some of the studies on inferior alveolar nerve location in different ethnicities. Further investigation is required for stronger accuracy.

5. Conclusion

This research is conducted to analyse the positional relationship between IAN to mandibular third molar. Besides, a various factor is evaluated. From the statistical analysis, we concluded that the most common location of IAN relative to the roots of the
mandibular third molar was on the apical side (60%), followed by the buccal side (22%), the lingual side (16%), and then between the roots (2%). No-contact relations make up a majority in all of the classes. Direct contact makes up for 100% when the IAN is located between the root of the mandibular third molar. There were also statistically significant correlations of the location of IAN between the left and right sides, indicating symmetry. Moreover, there was no association found between gender and the location of IAN.

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