

Review Article



## COMPARISON OF DIAGNOSTIC CAPABILITIES OF ORTHOPANTOMOGRAPHY AND CONE BEAM COMPUTED TOMOGRAPHY IN DETERMINING THE TOPOGRAPHIC RELATIONSHIP BETWEEN IMPACTED MANDIBULAR THIRD MOLARS AND MANDIBULAR CHANNEL

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### SUMMARY

Impacted teeth are a common pathology in dental practice. With the greatest frequency is third molars impaction of the upper and lower jaw. Essential for the proper treatment plan has an accurate assessment of the situation of these teeth in the jaw, as well as their relationship with surrounding structures. Of great importance is to determine the position of impacted third molars of the lower jaw to the mandibular channel, in order to prevent complications related to vascular-nerve bundle in this channel. This review article presents a significant X-ray feature published by several authors in the literature. Compare the diagnostic capabilities between two-dimensional method – Orthopantomography (OPG) and three-dimensional Cone-beam computed tomography (CBCT).

**Keywords:** impacted third molars, mandibular channel, Orthopantomography, Cone Beam Computed Tomography,

### INTRODUCTION

In the literature, there are many definitions for impacted teeth. Impacted teeth are those who are arrested in the jaw after the time of their normal eruption period [1]. Another definition for impaction is when the process of root development is completed but has not reached the occlusal plane. In practice, it is important to determine the type of impaction-position in the jaw, the relationship of impacted teeth and surrounding bone structures, adjacent teeth, mandibular channel, maxillary sinuses, nasal cavity.

The location of impacted third molars of the lower jaw to the vascular-nerve bundle is one of the main problems in treatment planning.

Imaging diagnostic methods that have good in-

formative value in determining the exact position of impacted teeth to the mandibular channel are Orthopantomography (OPG) and 3D Cone - Beam Computed Tomography (CBCT). They have a different data value.

OPG is used in practice as the primary X-ray examination. The method provides an overview of impacted teeth and determines the position of the teeth and their relationship to the surrounding structures [1, 2, 3, 4].

CBCT is a relatively new method in dental practice which raises a more precise diagnosis and correct treatment plan. The image of the impacted tooth and surrounding structures are with good quality and informatively. CBCT is with a higher dose of ionising radiation compared with OPG, but often for accurate diagnosis is necessary to make several conventional radiographs, which makes permissible radiation exposure.

### REVIEW OF METHODS

#### Orthopantomography (OPG)

According to Bell G. W. The sensitivity and specificity of OPG for the intimate relation between the root of the mandibular third molar tooth and the inferior alveolar neurovascular bundles between 66 and 74%. The author uses the following X-ray features: 1. The root of tooth more than 1mm distant from the neurovascular bundle. 2. The root of the tooth just touching the upper outline of the neurovascular bundle. 3. The root of tooth superimposed on the neurovascular bundle. With OPG are examined 219 patients with a total of 300 impacted third molars. The most common radiographic appearance of a relation between the mandibular third molar tooth and the inferior alveolar nerve is superimposition, in 110 teeth (37%). This includes any disruption of the radio-opaque outline of the neurovascular bundle. The next most com-

monly observed radiographic signs that the root apex just touched the upper border of the outline of the neurovascular bundle (96 teeth, 32%). In 55 teeth (18%), there is a separation of more than 1mm between the root and the neurovascular bundle. Most significant radiographic sign of the intimate correlation between the tooth and mandibular channel is a superimposition of teeth on the dark shadow of the channel [5].

More detailed radiographic signs are described by many authors: 1. Darkening of the roots (Howe, Neves) [6, 7]; 2. Deflection of the roots (Neves, Stockdale, Waggener) [7, 8, 9]; 3. Narrowing of the roots (Neves, Seward) [7, 10]; 4. The dark and bifid apex of the roots (Seward, Neves) [7, 11]; 5. Interruption of white lines of the channel (McGregor, Neves) [7, 11]; 6. Diversion of the inferior alveolar channel (Seward, McGregor, Neves) [7, 10, 11]; 7. Narrowing of the inferior alveolar channel (Seward, McGregor, Neves) [7, 10, 11].

Significant according to the authors above are X-ray findings: Interruption of white lines of the channel; darkening of the roots; diversion of the mandibular channel.

Rood et al. examined 1560 impacted teeth on OPG. They analyse the next radiographic signs: deflection of the roots, darkening roots, interruption of white lines of the channel and deviation of the channel. The authors associated the higher proportion of intimate relations between the tooth and the nerve than other radiological observations, with the exception of narrowing of the channel. The second most reliable sign indicative of the danger of damage the inferior alveolar nerve is darkening of the root. Third most reliable sign indicative of nerve injury interruption of the radio-opaque outline of the inferior alveolar channel as it crossed the tooth [12].

Many authors concluded that in most cases there is a combination of these signs [12, 13, 14].

A major disadvantage of conventional methods (particularly OPG) is that the image is two-dimensional and has a limited informative value. The buccolingual position of impacted teeth in the lower jaw, as well as their attitude towards the mandibular channel in this plane, are not displayed. For a panoramic radiograph position of the structure of interest, it is crucial to note that structures that are outside the centre of rotation of the radiologic source and detector are not displayed sharply and are distorted over-proportionally. Impacted or ectopic third molars are frequently outside of this centre of rotation and the reform can be visualised incorrectly, making diagnosis difficult.

The diagnostic information from both methods (OPG and 3D CBCT) Neugebauer et al. rated from 1 to 5 (1-excellent; 2-good; 3 sufficient; 4-fair; and 5-poor) for the horizontal and vertical information. These authors define the position of the root apex of impacted teeth in the vertical (craniocaudal) and horizontal (buccolingual) direction. The position of the root tip relative to the mandibular channel is determined vertically with: superior, at the level, and inferior. Horizontally with: lingual, vestibular, at level. The authors examined by OPG and CBCT 30 patients with impacted third molars. In 2D methods-28.5%

were superior, 50.7% at level, and 19.8% inferior. Similar values are at 3D images-28.1% are above, 43.8% of the level 27.1% below the mandibular channel. The diagnostic information for the vertical dimension shown a significant difference between the 2 methods. The informative value of panoramic radiographs according to this criteria, the authors define as good. The difference between the diagnostic information for the horizontal dimension was highly significant, with an advantage for the CBCT. The diagnostic value of OPG according to this criteria is fair [15].

Carmichael Fa, et al. and Gerlicher D, et al. determined the risk of inferior alveolar nerve injury after extraction of impacted third molars on a scale of 5 degrees: 1-no risk; 2-low risk; 3-medium risk; 4-high risk; 5-very high risk. In cases where OPG root apex positioned slightly above the bottom wall of the mandibular channel, the risk is high to very high. This requires defining the buccolingual position of an impacted tooth to the channel, which is an indication of three-dimensional X-ray methods [16, 17].

### **3D Cone Beam Computed Tomography or Cone Beam Volumetric Tomography**

Many authors concluded that the visualisation of impacted teeth and the Ir surrounding structures with three-dimensional images are more precise [15, 16, 17]. A significant difference between 2D and 3D methods is the ability to determine the buccolingual relationship between impacted teeth of the lower jaw and vascular-nerve bundle. CBCT has been reported to be a reliable imaging modality in the assessment of the buccolingual position of the mandibular channel in relation to the third molar [1, 14, 18 - 23].

According to Ghaemina H, et al. the position of the mandibular channel with respect to the third molar is classified as: 1. lingual, 2. buccal, 3. inter-radicular, 4. inferior. The images were evaluated in a cross-sectional slice. These projections are a buccolingual reconstruction of the jaw. The study sample consisted of 53 impacted third molars from 40 patients (20 women and 20 men). As determined on CBCT images, the mandibular channel is positioned lingual to the third molar in 49% of cases, 17% were buccal, 19% inferior and 15% inter-radicular [1] Tantanapornkul et al. at 142 teeth determined 25% buccal location of vascular nerve bundle, 26%-lingual, 4%-between the roots, 45%-below [14]. De Melo Albert et al. out of 29 cases establish, 45%-buccal available to vascular nerve bundle; 48%-lingual, between roots-absent; 7% channel under the roots [18].

If the radiological marker on the panoramic radiograph indicates there is a close relationship between the third molar and the mandibular channel, additional investigation using CBCT. Ghaemina G, et al. using MPR to establish of the cortical layer of the mandibular channel between the third molar and mandibular channel is intact [1].

Neves et al. classify the relationship between the roots of impacted third molars as follows: 1. The absence of relationship: tooth roots is clearly separated from the

mandibular channel. 2. Proximity relationships: the lamina dura of the root and the mandibular cortex are indistinct, without restricting mandibular channel space. 3. At-risk relationship: the tooth roots invade and restrict the mandibular canal space [7].

Lubbers et al. using the following criteria [24]:

1. The spatial relationship between tooth and mandibular channel: the buccal position of the mandibular channel; lingual position mandibular channel; between apically open roots (inter-root mandibular channel course); inside apically closed roots (intra-root mandibular channel course).

2. Distance between impacted teeth of mandibular channel: without perforation of cortical plate; with perforation of cortical plate;

3. The diameter of the mandibular channel: constant diameter versus obvious reduction of diameter.

4. Maturation: fully formed roots, versus immature roots.

5. Type of retention: Vertical; Mesial; Horizontal; Distal; Transversal.

Based on these criteria, the authors examined 404 patients with 707 impacted mandibular third molars. Women in the study are 255 (54%) with 392 (55, 4%) impacted teeth and 217 men (46.1%) with 315 (44.6%) impacted third molars. With the greater frequency are cases with vestibular position of the channel- 373 teeth (52.8%); 264 (37.3%) are lingual; in 58 (8.2%)-mandibular nerve localized between the roots of teeth that are not related

apically; 12 teeth (1.7%) have apically closed roots and the mandibular channel runs between them. The authors found that in 11.7% there is a perforation of the mandibular channel. Complete development of the root is present in 610 (86.3%) of the teeth. The frequency of teeth with two roots is 562 (80.9%), 83 (11.7%) are teeth with three roots, 44 (6.2%)-with one root and only 11 teeth (1,6 %) are found with four roots. Medial and vertical impaction is most frequent according to the authors [24].

## CONCLUSION

Variations in the location of the mandibular channel, the number of the roots of the impacted teeth and the type of impaction give rise to many authors recommend 3DCBCT in treatment planning [19, 20, 21, 22]. It is important to assess the position, and establish the relationship, of the third molar with the mandibular channel preoperatively to minimise the risk of nerve injury. Panoramic radiography is the standard diagnostic tool for this purpose. Clinicians use various radiographic markers to indicate a close relationship between the third molar and the mandibular channel. If the radiological marker on the panoramic radiograph indicates there is a close relationship between the third molar and the mandibular channel, additional investigation using CBCT. Cross-sectional and multiplanar reconstruction are with great informational value in determining the relationship of vascular - nerve bundle and roots [18, 24, 25, 26].

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