

## The Relationship of the Inferior Dental Canal to the Roots of Impacted Mandibular Third Molars in Jordanian Population

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### Abstract

**Objective:** The aim of this study was to evaluate the topographic relationship between the inferior dental canals (IDCs) and the roots of impacted mandibular third molars.

**Methods:** Preoperative orthopantomograms (OPGs) were examined and the proximity of the IDC to the roots of impacted mandibular third molars was categorized into the following: groups: superimposition, adjacent, perforation, grooving, notching, or none. The categories notching, grooving, and perforation were regrouped together and called the true relationship between the IDC and the root apices. The type of impaction, age, and sex of the patient were also noted.

**Results:** The positional category of 96.1% of the radiographs with bilateral impactions was identical on both sides of the mandible. Out of 2526 impacted mandibular third molars examined, 1146 (45.3%) belonged to the superimposition category, 663 (26.2%) were adjacent, 312 (12.3%) showed grooving, 78 (3.08%) showed notching, and 9 (0.35%) were actually perforating the IDC. The results showed 15.7% of the total cases were in true relationship with the IDC. There was a significant association ( $p = 0.000$ ) between patient's age and true relationship.

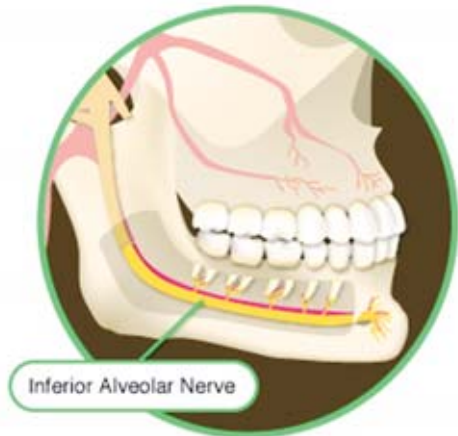
**Conclusions:** Identical positional relationship of the bilateral impacted third molars to the IDC was noted in 96.1% of the radiographs. The position of the IDC in relation to the roots of impacted third molars varied according to the patient's age.

**Keywords:** Impacted third molar, inferior dental canal, IDC, Jordanian population, orthopantomogram

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## Introduction

The removal of impacted mandibular third molars is one of the most common surgical procedures performed and can be complicated by inferior alveolar nerve damage.<sup>1</sup> Injury to the inferior alveolar nerve has been related to deeply impacted teeth<sup>2</sup> and to roots in close approximation to the inferior dental canal (IDC).<sup>3</sup>



Thus, accurate assessment of the position of the inferior alveolar nerve in relation to the impacted third molar might reduce injuries to this nerve. Anatomically, the nerve lies in the IDC which is enclosed within a tube of dense bone. The tube is seen on radiographs as two parallel radiopaque lines; one representing the roof of the canal and the other the canal floor. Oliver<sup>4</sup> studied 50 dry specimens of mandibles and found in 60% of them a distinct IDC contained the whole of the inferior alveolar neurovascular bundle, while in the remaining 40% the vessels and branches of this bundle were spread out of the canal so a well-defined canal was not present. Carter and Keen<sup>5</sup> radiographically examined 80 dried mandible specimens and found 61% of them showed a single bony canal with unbroken margins near the roots of molar teeth, while a bony canal with a broken upper wall was seen close to the molar roots in 14% of radiographs. The remaining 25% of the mandibles showed bony patterns lacking definite mandibular canals. Based on radiographic examination of a 100 edentulous human mandibles, Schroll<sup>6</sup> concluded the position of the IDC was variable. This finding has been confirmed by Nortje et al.<sup>7,8</sup> who reviewed 3612 panoramic radiographs and found the position of the IDC was either touching or within 2 mm of the apices of molar teeth in 46.7% of the

subjects. In 48.9% the IDC was touching or within 2 mm of the cortical plate of the lower border of the mandible and intermediately positioned between tooth apices and the lower border in 3.3% of the subjects.

A literature search revealed a lack of studies on the location of the IDC in relation to the impacted mandibular third molar by using conventional or computed tomography (CT) on Arabic populations. Therefore, the aim of this study was to determine the radiographic relationship of the IDC to the roots of impacted mandibular third molars in a Jordanian population group.



## Methods and Materials

The subjects included in this study were those referred to the Oral and Maxillofacial Surgery Unit, Faculty of Dentistry, Jordan University of Science and Technology for surgical removal of symptomatic impacted mandibular third molars during a three-year period from 1995 to 1998. The records of all subjects were retrieved and preoperative orthopantomograms (OPGs) were reviewed. OPGs were included if there was no evidence of jaw fracture or other pathological conditions affecting the IDC.

Prior to the investigation, calibration of the examiner (AMH) was undertaken by means of a pilot study involving 30 OPGs examined during a

period of two weeks until complete intra-examiner reliability and reproducibility was achieved. OPGs were examined under ideal conditions including the use of subdued lights, film masking, magnifying lenses, and a conventional viewing box (Exal-Type F.I.D-1, serial No. J2834, voltage 230-250; electronic and X-ray applications Ltd., Basingstone, England) with a variable light intensity and a 2X magnifying lens (X-viewer, X-Prostus, Malmo, Sweden). Impacted mandibular third molars were classified according to Winter's classification as vertical, horizontal, mesioangular, and distoangular impaction. Teeth outside of these categories were classified as aberrant.

The radiographic relationship of the root apex of mandibular third molars and the IDC was assessed and categorized according to the following criteria:

1. **Adjacent:** The superior border of the canal was either touching the roots apices or within 2 mm below them.
2. **Superimposed:** The canal was superimposed over part of the roots which appeared less radiopaque than the remaining radiological image of the roots.
3. **Notching:** Radiolucent band at the apex of the roots, a break in the continuity of the upper radio dense border, and narrowing at the expense of the top of the canal.
4. **Grooving:** Radiolucent band across the root above the apex, interruption of both superior and inferior borders of the canal, and narrowing of the canal space.
5. **Perforation:** Radiolucent band crossing the root above the apex, loss of both superior and inferior borders of the canal

at the area where they cross the roots, and constriction of the canal maximal in the middle of the root.

6. **None:** A relationship between the canal and the root apices could not be decisively assessed.

The data obtained were analyzed using the Statistical Package for the Social Sciences (SPSS). Possible correlation between the detected variations and each factor was tested using the chi-square test ( $\chi^2$ ). A statistically significant difference was considered to be present when P values were 0.05.

### Results

The radiographs examined were retrieved from the dental records of 1359 patients with 2526 impacted mandibular third molars. The study subjects consisted of 789 (58%) males and 570 (42%) females with ages ranging from 14 to 67 years, with the majority being within the 20 to 25 year-old age group (Table 1).

Bilateral impaction was detected in 1167 (85.9%) radiographs, whereas unilateral impaction was found in 78 (5.7%) and 114 (8.4%) radiographs for right and left sides, respectively.

The frequency of each impaction type in relation to age and sex of the patients is detailed in Table 2. The greater number of impacted third molars was of vertical position and accounted for 1686 (66.7%) of the total sample. Only 6 (0.2%) third molars were classified as aberrant. Patients in the age group 20-25 years had the greatest number of impacted teeth, and most of impactions were of the vertical type.

**Table 1. The distribution of the mandibular third molars according to the age and sex of patients.**

Sex	Age (Years)					Total	%
	14 -19	20-25	26-30	31-36	≥37		
Male	57	288	129	99	216	789	58.1
Female	69	52	96	48	105	570	41.9
Total	126	540	225	147	321	1359	
%	9.3	39.7	16.6	10.8	23.6	100	100

Table 2. The distribution of the type of impaction according to the sex and age group of the patients.

Type of impaction	Sex		Total (%)	Age (Years)					Total (%)
	Male	Female		14-19	20-25	26-30	31-36	≥37	
Vertical	984	702	1686 (66.74)	126	681	285	171	423	1686 (66.74)
Horizontal	123	60	182 (7.24)	21	33	24	66	39	182 (7.24)
Mesioangular	288	210	498 (19.72)	66	246	93	33	60	498 (19.72)
Distoangular	75	78	153 (6.06)	21	84	18	12	18	153 (6.06)
Aberrant	6	0	6 (0.24)	0	0	6	0	0	6 (0.24)
Total (%)	1476 (58.43)	1050 (58.43)	2526 (100)	234 (9.2)	1044 (41.3)	426 (16.8)	282 (11.1)	540 (21.6)	2526 (100)

Table 3. The number of impacted mandibular third molars in each category according to the age and sex of the patients.

Inferior dental canal	Sex		Total (%)	Age (Years)					Total (%)
	Male	Female		14-19	20-25	26-30	31-36	≥37	
Superimposition	642	504	1146 (45.5)	108	438	224	108	258	1146 (45.5)
Notching	51	27	78 (3.0)	0	18	24	18	18	78 (3.0)
Grooving	162	150	312 (12.35)	24	156	48	57	27	312 (12.35)
Adjacent	423	240	663 (26.2)	69	279	96	72	147	663 (26.2)
Perforation	9	0	9 (0.35)	0	6	0	0	3	9 (0.35)
None	189	129	318 (12.6)	33	147	24	27	87	318 (12.6)
Total (%)	1476 (58.43)	1050 (41.57)	2526 (100)	234 (9.26)	1044 (41.35)	426 (16.86)	282 (11.16)	540 (21.37)	2526 (100)

The positional category of the IDC on the right side of the mandible was identical to the left side in 1122 (96.1%) of radiographs with bilateral impaction. The position of the IDC was decisively demonstrated and, thereby, categorized according to its relationship to the roots in 2208 (87.4%) of impacted mandibular third molars. Accordingly, 1146 (45.3%) teeth were of superimposition, 663 (26.2%) of adjacent, 312 (12.3%) of grooving, 78 (3.08%) of notching, and 9 (0.35%) of perforating

categories in relation to the IDC. The remaining 312 (12.6%) could not be placed under any of these categories and, therefore, were placed in the category *none*.

The number of impacted mandibular third molars in each category according to the age and sex of the patients is described in Table 3. The prevalence of the impacted third molar was more common in the 20 to 25 year-old age group



Table 4. Relationship between the inferior dental canals and angular position of the mandibular third molars.

Type of Impaction	Inferior dental canal						Total	%
	Superimposition	Notching	Grooving	Adjacent	Perforation	None		
Vertical	783	33	165	567	0	138	1686	66.74
Horizontal	75	12	33	33	3	45	183	7.24
Mesioangular	240	27	90	60	3	57	153	19.72
Distoangular	42	6	24	21	3	57	153	6.06
Aberrant	6	0	0	0	0	0	6	0.24
Total	1146	78	312	663	9	318	2526	
(%)	45.5	3.0	12.35	26.0	0.35	12.6	100	100

Table 5. The distribution of the true relationship according to the sex and age group of the patients.

Relationship	Sex		Total (%)	Age (Years)					Total (%)
	Male	Female		14-19	20-25	26-30	31-36	≥37	
True relationship	117	93	210 (15.5%)	12	93	36	39	30	210 (15.5%)
Other relationship	672	477	1149 (84.5%)	114	447	189	108	291	1149 (84.5%)
Total	789	570	1359 (100%)	126	540	225	147	321	1359 (100%)

compared with other age groups, accounting for 41.3% of impacted mandibular third molars.

Similarly, the relationship between the IDC and angular position of the mandibular third molars was found to be more common in vertical impactions (61.2%) than any other type of impaction (Table 4). Six impacted molars were in aberrant impaction, and these fell into the superimposition category.

The categories notching, grooving, and perforation were regrouped together and called a true relationship between IDC and root apices. The results showed 15.7% of the total impactions fell into this group. However, when this relationship was expressed per patient rather than per teeth, it was found 210 (15.5%) of the total patients had such a relationship. Furthermore, a statistically significant association was found between the patient's age and true relationship ( $p=0.000$ ); 26.5% of those belonged to the 31-36 age group. No association was found between the patient's

sex and true relationship ( $p=0.4$ ), however, 16.3% of female patients demonstrated such a relationship compared to 14.8% of male patients. The frequency of a true relationship in association with the age and sex of the patients is detailed in Table 5.

### Discussion

One of the complications that may occur following the extraction of mandibular third molars is injury to the inferior alveolar nerve.<sup>2,3,12-17</sup> Prior knowledge of the proximity of the roots of the mandibular third molars to the IDC may minimize such complications.<sup>1,18-19</sup>

Various preoperative radiographic techniques to evaluate the relationship between the mandibular third molar and the IDC have been used. These include intra-oral radiographs, OPGs, cross-sectional tomographs, scanographs, and CTs.<sup>20-30</sup> However, the OPG has been recommended as the primary radiographic investigation of choice in the preoperative assessment of mandibular third



molar teeth and their surrounding structures.<sup>30-33</sup> For portrayal of subtle object structures, such as the IDC wall, it is well known two-dimensional imaging techniques provide limited information in terms of the buccolingual relationship between the mandibular canal and the roots of mandibular third molar. However, several authors have evaluated the reliability of OPG against CT images in the preoperative assessment of the relationship between mandibular third molars and IDC, and they all concluded the OPG remains an invaluable tool in the assessment and posed the potential for identifying the need for further computed diagnostic procedures.<sup>19,34-35,40</sup> Furthermore, the relatively high radiation exposure, high cost, and inferior image resolution are drawbacks of CTs.<sup>28,36,38</sup> Therefore, it can be concluded OPG remains the most common radiograph used for the assessment of impacted mandibular third molars and appears to have the best cost-information ratio.<sup>39</sup>

Our study showed all categories occurred more in males than females, but the difference was only statistically significant on the right side ( $p=0.006$ ). The radiographic assessment of the relationship between the roots of impacted mandibular third molars and the IDC was not discernible in 318 (12.6%) cases. This was either because of other causes of radiolucency which affected the apical 2 mm of the third molar roots, such as developing teeth or because of the pharyngeal air space which made the exact radiographic interpretation difficult.

This study showed only a small minority (3.9%) of mandibles with bilateral impactions demonstrated

a degree of asymmetrical configuration. This finding suggests a category of a canal in relation to the roots of any given type of impaction at one side of the mandible enables the clinician to predict the configuration of the canal on the other side.

The results of this study have shown 26.2% of the assessed IDCs were classified as adjacent. These findings are consistent with the report of Kipp et al.<sup>17</sup> but in contradiction with those of Bell<sup>41</sup> who found such a category in 50% of his sample. This discrepancy may be due to different criteria of assessment.

The results of the present investigation revealed 15.7% of the cases were within the true relationship of IDC to the root apices; a finding in accordance with those reported by both Howe and Poyton<sup>18</sup> (13.7%) and Bell<sup>41</sup> (13%). Furthermore, the results of this study displayed no specific pattern in IDC categories with regards to true relationship. This is inconsistent with the report of Howe and Poyton<sup>18</sup>, which indicated true relationship was in direct correlation with the age of the subjects. This finding may be related to the racial morphological variation between the population groups studied. The vertical impacted molars were mainly found to be in true relationship with the IDC. There were 399 impacted third molars associated with the categories true relationship, notching, grooving, and perforation. Of these, 49.6% were vertically impacted followed by those with mesioangular impaction (30.1%), horizontal impaction (12%), and distoangular impaction (8.29%). This finding suggests surgeons should be careful when interpreting the radiographs of vertical impactions and when operating on vertically impacted teeth.

### Conclusion

The mandibular canals are mostly bilaterally symmetrical, and the position of the IDC varies with respect to the apices of the roots of the impacted mandibular third molars with the majority being in superimposed or adjacent positions. However, a true relationship was noticed in 15.7% of the total cases. This variation should be appreciated, particularly by the oral surgeon, when undertaking surgical removal of the impacted mandibular third molars.

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