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ORIGINAL RESEARCH ARTICLE

RADIOGRAPHIC ASSESSMENT OF MANDIBULAR CANAL IN NEPALESE POPULATION: A STUDY BASED ON CONE BEAM COMPUTED TOMOGRAPHY IMAGES

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ABSTRACT

Background: Mandibular canal runs in the body and ramus of mandible and provides passage for inferior alveolar nerve. Knowledge on spatial relationship of canal with adjacent structures prevent damage to nerve during surgical procedures. This study aims to find three-dimensional relationship of canal as well as its relation with third molar.

Methods: This was a cross sectional and retrospective study conducted on Cone Beam Computed Tomography images. The relation and position of canal with third molar and position of canal in vertical and horizontal dimensions were analyzed.

Results: Mandibular canal was found to be progressively descended in 43% of the canals. The canal was located apical to third molar in 61.9% cases and regarding contact relation, 121(56%) of the third molars had no contact with the canal. Buccal cortical plate was maximum at the level of distal root of second molar and minimum at the level of mesial root of first molar and was reverse for lingual cortical plate. The highest distance between upper border of canal and inferior border of mandible was at mental foramen 13.55±2.27 mm and lowest at mesial root of second molar, 8.72±2.59 mm. Minimum distance between superior border of canal and alveolar crest was distal to second molar (13.78±3.54 mm) and maximum between first molar and second premolar (17.91±3.08 mm).

Conclusions: It was observed that canal was interradicularly placed and was by penetrated by third molar in some cases. Thickness of cortical plates varied in various locations buccally and lingually.

INTRODUCTION

The mandibular foramen is present on medial surface of mandible that leads to mandibular canal. Mandibular nerve enters the canal and exits as mental nerve through the mental foramen on anterolateral surface of mandible.[1] The canal moves in lingual and labial direction forming a S-shaped pattern.[2]

Variation in mandibular canal with regard to sex and race have been previously reported.[3,4] Precise knowledge on mandibular canal is inevitable to prevent any iatrogenic damage to the nerve during invasive surgical procedures.[5]

This study aimed to evaluate any variations in the shape and position of the canal and its relation with the mandibular third molars. Being a tertiary hospital, patient from different parts of Nepal come to visit Dhulikhel hospital for various treatments. The data obtained from patient from different part of Nepal may be a representative of the Nepalese population.

METHODS

This was a retrospective study conducted in Department of Anatomy and Department of Oral Medicine and Radiology, Dhulikhel Hospital/Kathmandu University School of Medical Sciences (KUSMS) during the period of October 2018 to April 2019. Ethical approval was taken from the Institutional Review Committee KUSMS (IRC No. 41/19). The study was done on Cone beam computed tomography (CBCT) of the patient taken for various diagnostic and treatment procedures collected within the period of six months from the Department of Oral Medicine and Radiology, Dhulikhel Hospital.

The study was performed on 150 CBCT images of the patient above 18 years with all teeth present in posterior mandibular region. Patient with fracture of mandible or pathological conditions and poor-quality images were excluded from the study.

Patients were scanned by Rainbow™ CT using standard protocols (80kVp, 7.0 mA, Scan Time 17 secs). CBCT images was viewed and analyzed in Rainbow™ Image Viewer Version 1.0.0.0. Data were analyzed in SPSS v 23 and the results of all these measurements were presented in detail with descriptive statistics.

The shape of the canal was observed as (Figure 1):[3]

a) Straight projection: Last part of mandibular canal was almost at the same level with mental foramen

b) Catenary-like configuration: Mandibular canal curled as hanging between two points

c) Progressive descent: Descent of mandibular canal from posterior to anterior

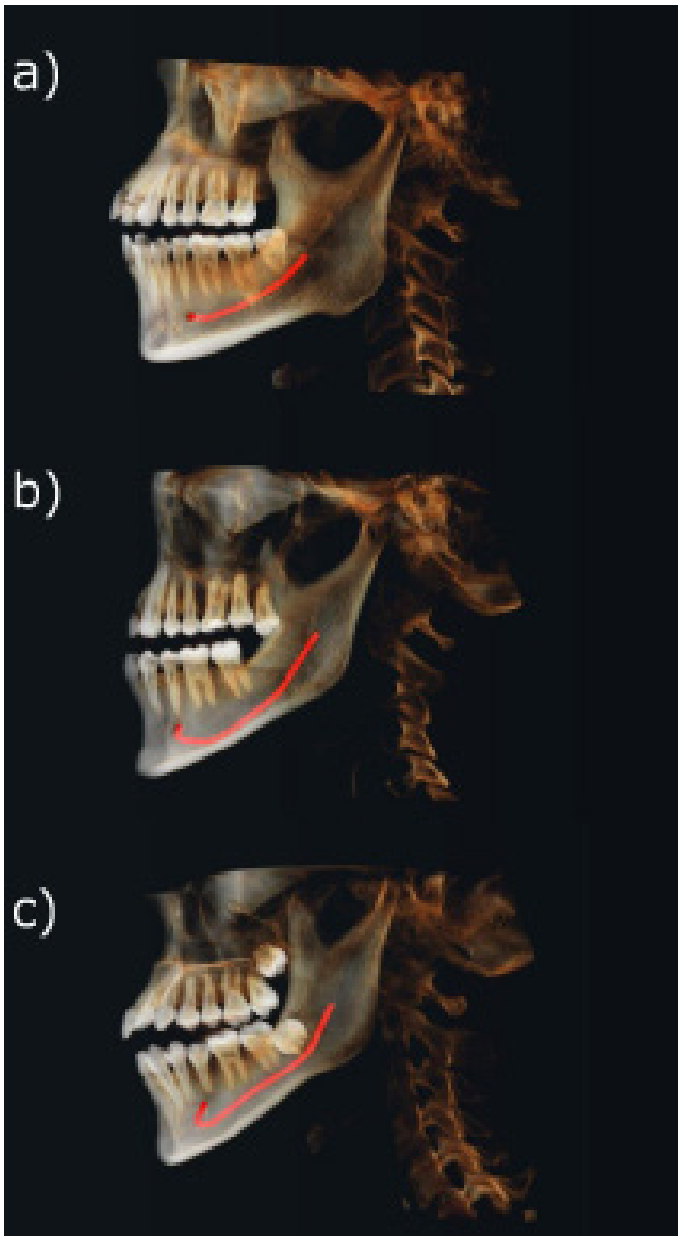

Figure 1: Shape of mandibular canal: a) Straight projection b) Catenary-like configuration c) Progressive descent from posterior to anterior

Position of the mandibular canal relative to the roots of the mandibular third molar was analyzed as: [6]

Class I: the mandibular canal locates on the apical side (apical position).

Class II: the mandibular canal locates on the buccal side (buccal position).

Class III: the mandibular canal locates on the lingual side (lingual position).

Class IV: the mandibular canal locates between the roots (interradicular position).

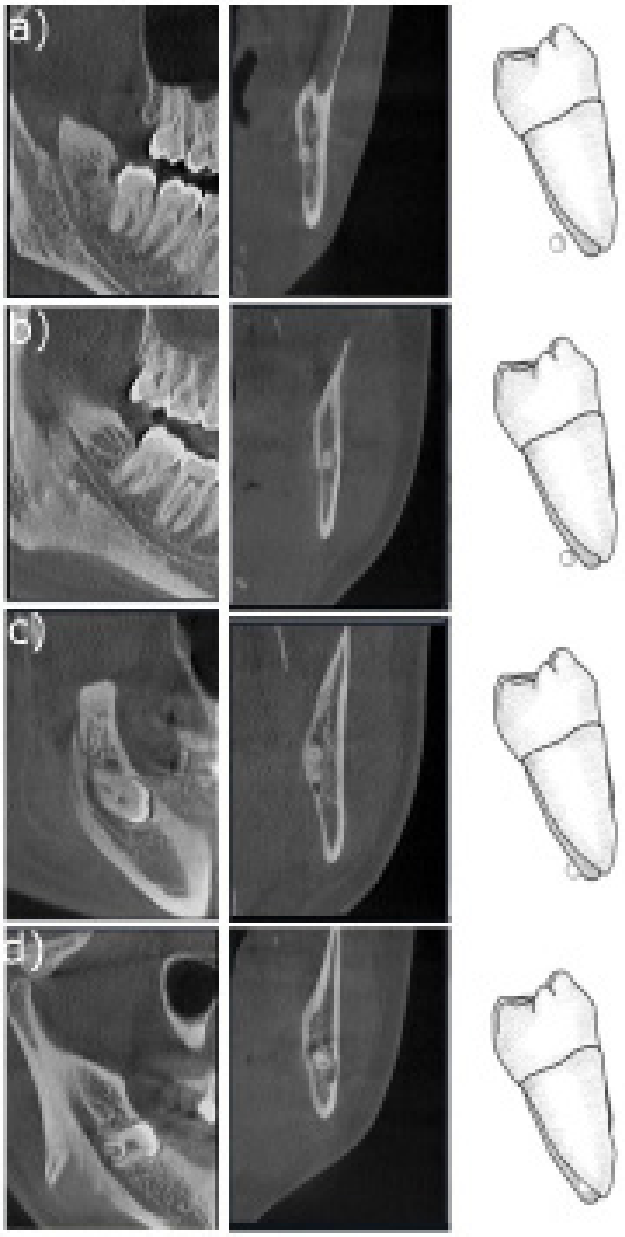

Figure 2: Contact relation of the mandibular third molar and the mandibular canal: a) The mandibular third molar has no contact with the mandibular canal. b) The mandibular third molar contacts with the mandibular canal with a complete white line. c) The mandibular third molar contacts with the mandibular canal with a defective white line. d)The mandibular third molar penetrates the mandibular canal

Contact relation of the mandibular third molar and the mandibular canal in each class was classified into four conditions (Figure 2).[6]

Position of mandibular canal in horizontal dimension was evaluated as: [3]

a) Thickness of buccal cortical plate at the level of mesial root of first molar

b) Thickness of buccal cortical plate at the level of distal root of first molar

c) Thickness of buccal cortical plate at the level of mesial root of second molar

d) Thickness of buccal cortical plate at the level of distal root of second molar

e) Thickness of lingual cortical plate at the level of mesial root of first molar

f) Thickness of lingual cortical plate at the level of distal root of first molar

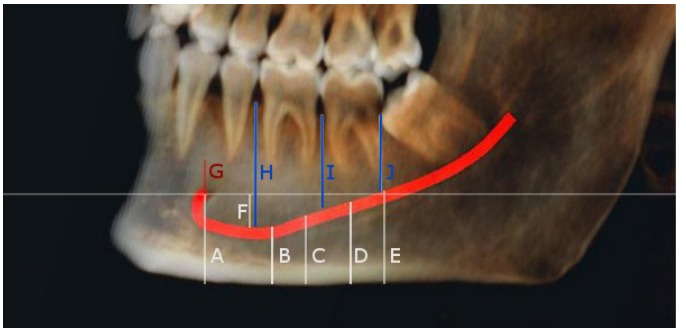

Figure 3: Position of the mandibular canal in vertical dimension. A) Upper border of mental foramen to inferior alveolar border of mandible. B) Upper border of mandibular canal to inferior border of mandible at the level of mesial root of first molar. C) Upper border of mandibular canal to inferior border of mandible at the level of distal root of first molar. D)Upper border of mandibular canal to inferior border of mandible at the level of mesial root of second molar. E) Upper border of mandibular canal to inferior border of mandible at the level of distal root of second molar. F) Upper border of mental foramen to upper border of mandibular canal at the lowest point in mandible. G) Root tips of premolar to mental foramen. H) From superior border of canal to alveolar crest between the first molar and second premolar. I) From the superior border of canal to alveolar crest between the first and second molar. J) From the superior border of canal to alveolar crest distal to second molar

RESULTS

The most common shape of mandibular canal progressive descent in 129 (43%) followed by straight projection in 87 (29%) and catenary like in 84 (28%) (Table 1).

The analysis was done on 215 mandibular third molars due to missing third molars in some patient which were excluded for recordings. Anatomic position of mandibular canal to the molar showed 133(61.9%) were Class I (apical position), 35 (16.3%) were Class II (buccal position), 33(15.3%) were Class III (lingual position) and 14(6.5%) were Class IV (interradicular position).

Table 1: Shape of mandibular canal

Shape of mandibular canal	Right n (%)	Left n (%)	Total n (%)
Straight projection	44	43	87 (29)
Catenary like	36	48	84 (28)
Progressive Descent	70	59	129 (43)

With respect to the contact of mandibular canal with the third molar, 121(56%) of the molars had no contact with the canal. Out of contact of third molar with the canal, 51(23.6%) contacts with the complete white line, 30 (13.9%) contacts with the defective white line and 14 (6.5%) of the molar penetrates the canal.

The minimum distance between upper border of mandibular canal and inferior border of mandible was at mesial root of second molar, 8.72±2.59 mm and maximum distance was at the mental foramen 13.55±2.27 mm. The minimum distance between superior border of mandibular canal and alveolar crest was distal to second molar 13.78±3.54 mm and maximum distance was at region between first molar and second premolar 17.91±3.08 mm (Table 2).

Table 2: Vertical Position of the mandibular canal

Vertical distance	Range	Mean±SD
Upper border of mental foramen to inferior alveolar border of mandible	7.80-22.80	13.55±2.27
Upper border of mandibular canal to inferior border of mandible at the level of mesial root of first molar	4.76-15.79	8.94±2.12
Upper border of mandibular canal to inferior border of mandible at the level of distal root of first molar	4.39-16.17	8.73±2.22
Upper border of mandibular canal to inferior border of mandible at the level of mesial root of second molar	3.47-19.83	8.72±2.59
Upper border of mandibular canal to inferior border of mandible at the level of distal root of second molar	3.14-20.82	8.93±2.80
Upper border of mental foramen to upper border of mandibular canal at the lowest point in mandible	0.0-8.58	3.23±1.81
Root tips of premolar to mental foramen	-5.45-9.54	1.41±2.31
Superior border of mandibular canal to alveolar crest between the first molar and second premolar	7.17-26.68	17.91±3.08
Superior border of mandibular canal to alveolar crest between the first and second molar	6.85-28.25	16.81±3.29
Superior border of mandibular canal to alveolar crest distal to second molar	2.55-24.98	13.78±3.54

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Thickness of buccal cortical plate was highest at distal root of second molar 8.23±1.66 mm and least at mesial root of first molar 5.15±1.26 mm. Thickness of lingual cortical plate was highest at mesial root of first molar and least at distal root of second molar 3.77±1.74 mm (Table 3).

Table 3: Horizontal position of mandibular canal

Position	Range	Mean
Thickness of buccal cortical plate at the level of mesial root of first molar	1.23-9.08	5.15±1.26
Thickness of buccal cortical plate at the level of distal root of first molar	2.21-10.08	5.88±1.38
Thickness of buccal cortical plate at the level of mesial root of second molar	2.45-13.01	8.04±1.59
Thickness of buccal cortical plate at the level of distal root of second molar	2.40-12.60	8.23±1.66
Thickness of lingual cortical plate at the level of mesial root of first molar	1.23-10.13	6.17±1.78
Thickness of lingual cortical plate at the level of distal root of first molar	0.49-10.61	5.78±1.99
Thickness of lingual cortical plate at the level of mesial root of second molar	0.49-9.92	4.12±1.81
Thickness of lingual cortical plate at the level of distal root of second molar	0.59-8.95	3.77±1.74

DISCUSSION

The present study illustrates the three-dimensional relation of the mandibular canal. It also attributes the relation of canal with the third molar. The spatial relationship of the mandibular canal to adjacent anatomic structures are to be considered before any surgical procedures to prevent any iatrogenic damage to inferior alveolar nerve.[8] Cone beam computed tomography (CBCT) besides providing low radiation dose and high-resolution images provides three-dimensional configuration of canal.[5]

The most common shape of canal was progressive descent in 129 (43%) followed by straight projection in 87 (29%) and catenary like in 84 (28%). However, the study by Mirbeigi done to analyze the mandibular canal of Iranian population from CBCT showed the equal distribution of all three shape of mandibular canal.[9] Catenary provides more space for dental implant placement, especially in the first molar region compared with the premolar region. Straight is less favourable for implant placement posterior to premolars.[3]

The most common anatomic location of mandibular canal was apical to the mandibular third molar, second most common position was buccal to molar, then lingual to molar and then in between the root of the third mandibular molar. Similar finding was observed in the study by Gu et al, who studied among Chinese population.[6]

The study illustrated 56% of the third molar had no contact with the mandibular canal and 6.5% of the molar penetrate into the canal. Similar result was found in the study by Jun et al done among South Korean population where 68.9% had no contact and 10.3% penetrated into the canal.[10]The risk of injury to inferior alveolar nerve leading to various postoperative complication occur in patient where mandibular third molar are in contact with the mandibular canal than those of non-contact cases.[11]

For bone height from superior border of mandibular canal to alveolar crest, there was greater height between second premolar and first molar area than the height distal to second molar area. Similar results were obtained in the study by Braut et al where there was steady decrease of height of alveolar process from mandibular premolar to molar region.[12] Vazquez et al reported a safety margin of at least 2 mm above the mandibular canal was desirable prior to the insertion of posterior mandibular implants.[13] Thus, this knowledge is inevitable to avoid damage to neurovascular structures during dental implants.

The shortest distance between mandibular canal and inferior border of mandible was at the level of mesial root of second molar which is similar to study of Nemati and longest distance was at the level of mental foramen.[7]

The thickness of the buccal cortical plate was maximum, at the level of distal root of second molar and minimum, at the level of mesial root of first molar. Similar to the present study Kovisito in his study found out thickest buccal cortical plate at the level of mesial root of second molar and thinnest at the level of second premolar.[14] The measurement of thickness of buccal cortical plate is obligatory before monocortical plating to prevent damage to inferior alveolar nerve.[4]

The lingual cortical plate was thickest at the level of mesial root of first molar, 6.17±1.78 mm and thinnest at the level of distal root of second molar 3.77±1.74 mm. Whereas the study by Koivisto demonstrated maximum thickness of lingual cortical plate at the level of second premolars and minimum thickness at the distal root of first molar.[14]

However, the study fails to include larger sample size of different geographical regions of Nepal. This study recommends further research on correlation of clinical and radiological findings in the coming days.

CONCLUSION

Variation in the shape of the mandibular canal was observed among the studied population. The mandibular canal was located apically and with no contact with the third molar in most of the cases. The buccal cortical plate was found to be greatest in posterior region and was least in the anterior and the findings were reverse in case of the lingual cortical plate. These findings may be useful during any surgical procedures in

close proximity to the canal and prevent any iatrogenic damage to nerve.

CONFLICT OF INTEREST

None

FINANCIAL DISCLOSURE

None

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