

Original Research Article

## Decortication of Inferior Alveolar Canal in Elderly Population: A Cone Beam Computed Tomography Study

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### ABSTRACT

**Purpose:** This study assessed the levels of cortication of the inferior alveolar canal (IAC) in different age groups on Cone Beam Computed Tomography (CBCT) scans.

**Materials and Methods:** Retrospective study of 100 mandibular CBCT scans having second premolar, first molar and second molar, were assessed by 3 experienced oral radiologists. Fifty male and 50 female scans were divided into 3 age groups. Levels of decortication was studied in the region of second premolar, first molar and second molar. The cortication was scored as grades 1 for 0% to 25% cortication, 2 for 26% to 50% cortication, 3 for 51% to 75% cortication, and 4 for 76% to 100% cortication according to the extent of visibility of IAC. At the end of the session all observers arrived at a mutual consensus score which was then used for analysis.

Results were analysed using chi-square and kappa test.

**Results:** With increasing age especially after 50 years of age, the IAC gradually shifts from good cortication (scores 1 and 2) to poor cortication (scores 3 and 4). Gender analysis showed no statistical significance, however elderly females show more decortication compared to elderly males. Inter-observer reliability (Kappa: 0.72), indicated substantial agreement.

**Conclusion:** Absence of cortication could lead to error in selecting the length of the implant or planning other surgeries in this region, subsequently injuring the mandibular nerve and affecting quality of life. Clinicians should therefore be judicious when planning surgeries in the mandibular second premolar to second molar region to avoid injuring the IAC contents.

**Key words:** Mandible; Cone Beam Computed Tomography; Nerve injuries; Decortication; Inferior alveolar canal.

### INTRODUCTION

Inferior alveolar canal (IAC) is an anatomical structure that extends bilaterally from the mandibular foramen present on the inner aspect of the ramus, to the mental foramen. The IAC carries inferior alveolar nerves, arteries and veins. These structures are well protected till the time the canal is corticated.

Panoramic radiograph is widely used to study various structures and pathologies in the cranio-facial region, IAC is seen in a two dimensional view in a panoramic radiograph where it appears as a linear structure extending from the mandibular foramen till the mental foramen, and only the superior and inferior cortical borders of the canal are visible.

Cone beam computed tomography (CBCT) systems provide a more detailed image quality in three dimensions, along with lower radiation dose compared to conventional CT scan. [1] CBCT is superior to conventional panoramic radiographs in displaying the normal and anatomic variations, and cortication in three dimensions of the IAC. This is essential in predicting osteoporosis, and while performing various surgical procedures, thereby avoiding potential sensory disturbances, hemorrhagic complications, and anesthetic failures. [2]

Inferior alveolar nerve (IAN) is the most commonly injured nerve (64.4%) during implant treatment. [3] Before planning any surgery, accurate assessment of crest of alveolar bone and IAC (especially the superior border) is important, else there is a high probability of injury to inferior alveolar neuro-vascular bundle. Osteoporosis affects elderly population especially females, and is seen as decreased skeletal bone mineral density which leads to loss of mandibular alveolar bone mass. Considering the fact that with increasing age, there is gradual loss of bone density, [4] it was hypothesized that IAC also shows progressive loss of cortication with increasing age and could be a radiographic predictor of osteoporosis. Cortication of the IAC in different age groups and gender has never been studied previously. This study was to assess the levels of cortication of the IAC in different age groups on CBCT scans.

## **MATERIALS AND METHODS**

After clearance for the study was obtained from the ethical committee, CBCT scans of mandibular body region were retrieved from the database of department of Oral Medicine and Radiology from June 2014 to June 2015. Mandibular CBCT scans with presence of 2<sup>nd</sup> premolar, 1<sup>st</sup> molar and 2<sup>nd</sup> molar of the same side were included. Scans with periapical pathologies, fractures, anatomic deformity, artefacts, mental foramen apical to or posterior to 2<sup>nd</sup> premolar, and scans not involving the above

mentioned teeth were excluded. Applying these criteria 50 scans of male patients and female patients each were selected, accounting to total of 100 scans. The scans were divided into 3 age groups as 11 years to 30 years, 31 years to 50 years, and 51 years to 70 years. The first age group included 15 male scans and 17 female scans, second age group included 17 male scans and 17 female scans, and third age group included 18 male scans and 16 female scans.

All the CBCT scans were taken using Kodak 9000 C 3D machine (made in Paris, France, for Care stream Health Incorporation, Rochester NY, USA). The parameters of the scan included 76.5  $\mu$ m voxel size 10 mA, 50-70 kVP, 10 seconds scan time, and a field of view of 5 x 3.7 cm., All scans were assessed using software Care Stream 3D.

The scans were assessed by three experienced Oral and Maxillofacial Radiologists on HP Pavilion note book PC of screen resolution 1366 x 768 dpi, 15.6 inches LED screen in a dimly lit silent room. Distance from the observers to the monitor was adjusted at 20 - 30 cm and no time limitation was set for the observation of individual scans. The observers were allowed to change the magnification and brightness of the images according to their convenience. Scans were blinded to all personal details of the patient and not more than 4 scans per day to avoid fatigue to the eye.

The three observers assessed the scans in sagittal, coronal and axial section for decortications. Cortication was defined as radiopaque border along the lining of the IAC. Score 1 was denoted when up to one fourths (0% to 25%), score 2: more than one fourths to half (26% to 50%), score 3: more than half to three fourths (51% to 75%) and score 4: more than three fourths of the canal lining was corticated (76% to 100%) as represented in figure 1 A, B; 2 A, B; 3 A, B; 4 A, B. Score 1 and 2 were considered poor cortication, and score 3 and 4 were considered good cortication.

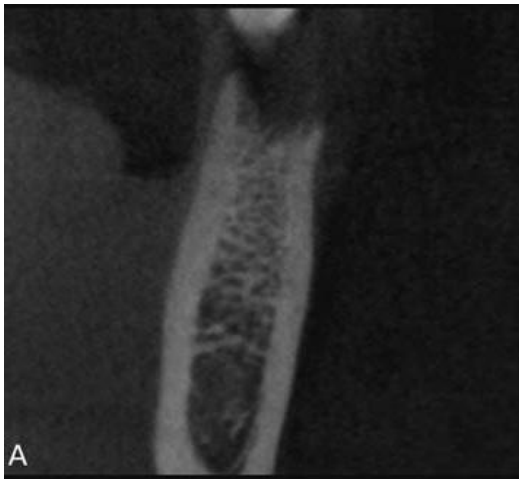


Figure 1A: shows 0% to 25% cortication of inferior alveolar canal (score 1)

Figure 1B shows no evidence of cortical boundaries of inferior alveolar canal (yellow circular ring)

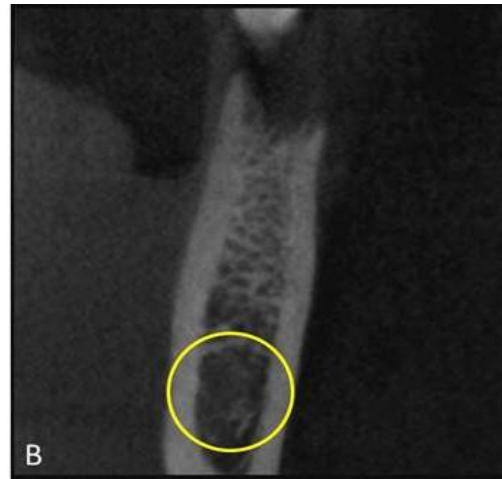


Figure 2B shows highlighted cortical boundaries of inferior alveolar canal (yellow semicircle)

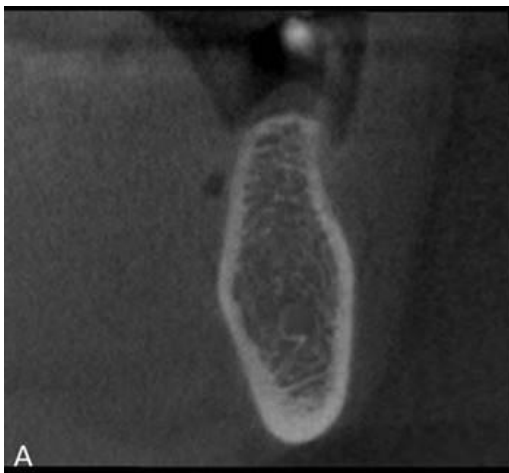


Figure 2A: shows 26% to 50% cortication of inferior alveolar canal (score 2)

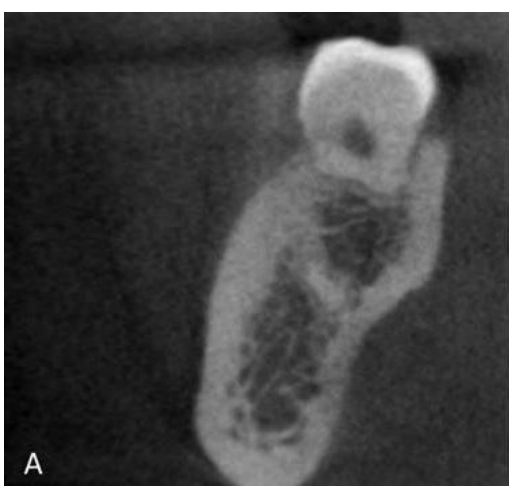
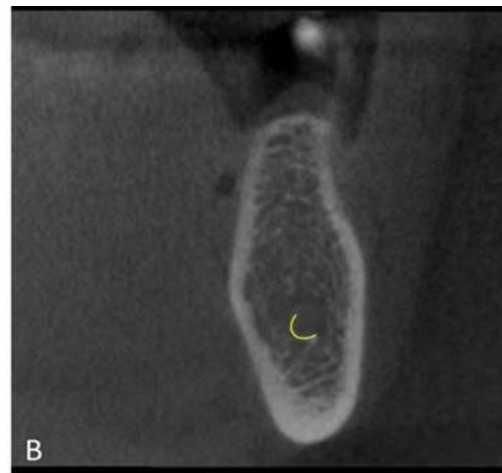


Figure 3A: shows 51% to 75% cortication of inferior alveolar canal (score 3)

Figure 3B shows highlighted cortical boundaries of inferior alveolar canal (3/4<sup>th</sup> of a yellow circle)

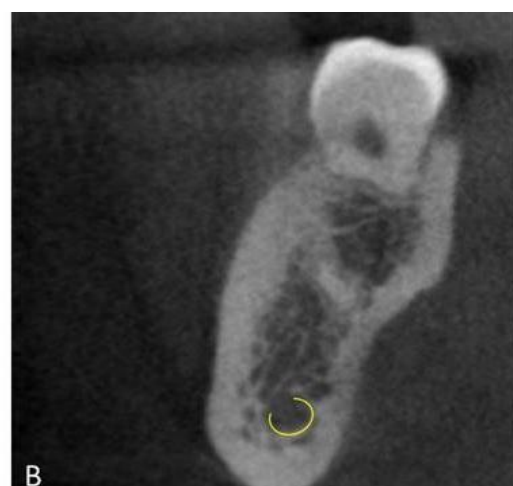


Figure 4B shows highlighted cortical boundaries of inferior alveolar canal (yellow circle)

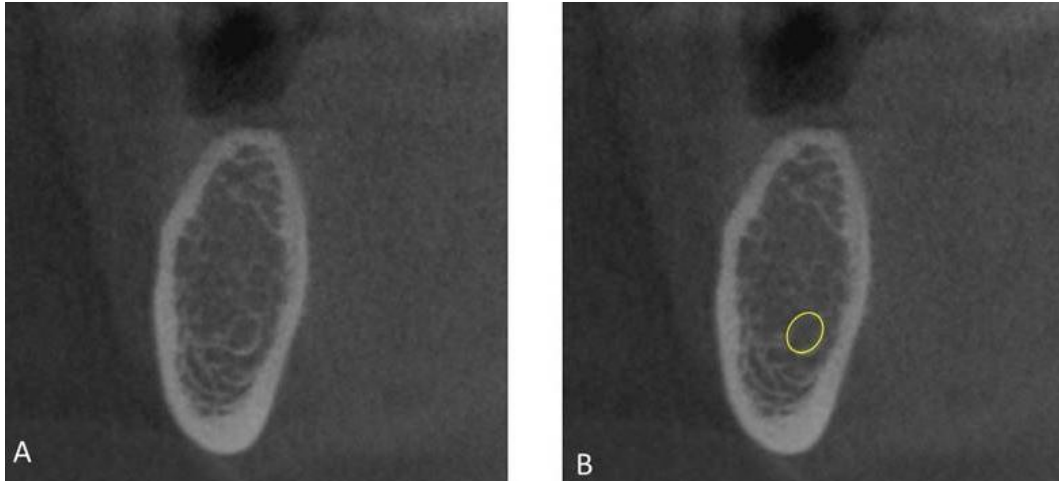


Figure 4A: shows 76% to 100% cortication of inferior alveolar canal (score 4)

A visual estimate of cortication of borders of IAC corresponding to second premolar, first molar and second molar was assessed by examining multi-planar formatted images and were scored separately for each teeth. At the end of the session all observers arrived at a mutual consensus score which was then used for analysis.

Descriptive and inferential statistical analyses were carried out in the present study. Results on categorical measurements were presented in Number (%). Level of significance was fixed at  $p=0.05$  and any value less than or equal to 0.05 was considered to be statistically significant. Chi square analysis was used to find the significance of study parameters on categorical scale. The Statistical software IBM SPSS statistics 20.0 (IBM Corporation, Armonk, NY, USA) was used for the analyses of the data and Microsoft word and

Excel were used to generate tables. Kleiss kappa was calculated to measure inter-observer reliability.

## RESULTS

The p value was found to be highly significant ( $p<0.001$ ) for the scores of decortication in the region of second premolar and first molar, and significant ( $p<0.05$ ) in the region of second molar.

The distribution of scores with respect to all the above mentioned regions showed that with increasing age especially after 50 years of age, the IAC gradually shifts from good cortication (score 1 and score 2) to poor cortication (score 3 and score 4) as represented in the table 1.

Gender predilection for decortication shows no statistical significance, however the data in the table 2 shows more decortication in elderly females compared to elderly males.

Table 1: Distribution of percentages of cortication among different age groups

Age group (Years)	Teeth	Score 1 0% to 25% N (%)	Score 2 26% to 50% N (%)	Score 3 51 % to75% N (%)	Score 4 76% to 100 % N (%)	Total N (%)
11-30 years	2 <sup>nd</sup> premolar	0 (0)	2 (6.2)	2 (6.2)	28 (87.5)	32 (100)
	1 <sup>st</sup> molar	0 (0)	3 (9.4)	2 (6.2)	27 (84.4)	32 (100)
	2 <sup>nd</sup> molar	1 (3.1)	2 (6.2)	6 (18.8)	23 (71.9)	32 (100)
31-50 years	2 <sup>nd</sup> premolar	0 (0)	2 (5.9)	8 (23.5)	24 (70.6)	34 (100)
	1 <sup>st</sup> molar	0 (0)	2 (5.9)	11 (32.4)	21 (61.8)	34 (100)
	2 <sup>nd</sup> molar	0 (0)	4 (11.8)	7 (20.6)	23 (67.6)	34 (100)
51-70 years	2 <sup>nd</sup> premolar	4 (11.8)	10 (29.4)	3 (8.8)	17 (50)	34 (100)
	1 <sup>st</sup> molar	4 (11.8)	11 (32.4)	6 (17.6)	13 (38.2)	34 (100)
	2 <sup>nd</sup> molar	4 (11.8)	9 (26.5)	5 (14.7)	16 (47.1)	34 (100)

**Table 2: Distribution of percentages of cortication among genders**

Gender	Teeth	Score 1 0% to 25% N (%)	Score 2 26% to 50% N (%)	Score 3 51 % to75% N (%)	Score 4 76% to 100 % N (%)	Total N (%)
<b>Male</b>	2 <sup>nd</sup> premolar	1 (2)	8 (16)	5 (10)	36 (72)	50 (100)
	1 <sup>st</sup> molar	1 (2)	8 (16)	9 (18)	32 (64)	50 (100)
	2 <sup>nd</sup> molar	2 (4)	7 (14)	8 (16)	33 (66)	50 (100)
<b>Female</b>	2 <sup>nd</sup> premolar	3 (6)	6 (12)	8 (16)	33 (66)	50 (100)
	1 <sup>st</sup> molar	3 (6)	8 (16)	10 (20)	29 (58)	50 (100)
	2 <sup>nd</sup> molar	3 (6)	8 (16)	10 (20)	29 (58)	50 (100)

Inter-observer reliability calculated by Fleiss kappa shows a score of 0.72, indicating substantial agreement.

## DISCUSSION

This study was conducted to check variations in the levels of cortication of IAC in various age groups. CBCT scans were used for the study because it gives a three dimensional representation of the structures compared to two dimensional radiography, and is most commonly used to assess bone level and other anatomic structures before planning for implants or other surgeries. Body of the mandible including second premolar, first molar and second molar was studied as this is the most common site for implant placements, surgeries and pathologies. Injury to IAN most likely occurs during dental implant placement in the mandible, root canal treatment where tooth roots are close to the nerve canal in the mandible, deep dental local anesthetic injections or orthognathic surgery. Accurate visualization of borders of IAC is vital for proper planning of various surgeries and implant placements. The superior border of IAC is specifically important to be precisely located radiographically. Absence of cortication could lead to error in selecting the length of the implant which subsequently might injure the mandibular nerve. Trauma and mandibular body and angle fractures are also often related to inferior alveolar nerve injuries. [5] Mandibular sensory nerve injuries are associated with numbness, pain, altered sensation and usually a combination of them. [6] This can result in a significant reduction in quality of life of the patient

with functional difficulties and psychological impact. [7]

Table 1 implies that there is significant increase in decortication above 50 years. Clinicians should therefore be judicious when planning any surgery in the mandibular second premolar to second molar region to avoid injuring the IAN bundle.

Osteoporosis is a silent, progressive, complex, chronic, and symptomless disease affecting bones of adults regardless of gender. Post-menopausal women are more affected and it is estimated that 33.33% of women and 12.5% of men over 50 years old are affected. Osteoporosis causes reduced bone mineral density due to extensive loss of bone calcium which in turn is due to progressive deterioration of specific bone protein considered as calcium carrier. Osteoporosis may affect the structure of the alveolar bone interfering with therapy in every sub-specialty especially tooth implantology, and results in higher rates of implant loss. [8] Since decortication of inferior border of mandible is a radiographic sign of osteoporosis, it was our hypothesis that decortication of IAC could be significantly higher in elderly females. The lack of significant difference between males and females rejects our initial hypothesis that IAC decortication could be used as a radiographic sign of osteoporosis.

This study based on descriptive parameters could be a limitation, however objective analysis was not possible because literature is devoid of decortication scale and no such studies have been done previously. The smaller sample size is another limitation for the study. Further



studies with larger sample size could assess IAC decortication.

With increasing age, especially after 50 years, the IAC shows decreased cortication. Care should be taken when elderly patients are planned for surgical procedures involving the body of mandible.

## **CONCLUSION**

Absence of cortication could lead to error in selecting the length of the implant or planning other surgeries in this region, subsequently injuring the mandibular nerve and affecting quality of life. Clinicians should therefore be judicious when planning surgeries in the mandibular second premolar to second molar region to avoid injuring the IAC contents.

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