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Relative changes in Position of Mandibular Foramen in 3-13 year olds in Realtion to Inferior Alveolar Nerve Block

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Abstract

Aim: To assess pattern of changes n the position of mandibular foramen in growing children between 3 and 13 years of dental age.
Design: Panoramic radiographs were obtained from patients requiring pre-operative radiographs for routine dental treatment. The radiographs were traced from which the relative position of the mandibular foramen was assessed and compared in different age groups to determine the growth pattern of the mandible and changes in the location of the mandibular foramen.
Results: There was overall increase in both the horizontal and vertical dimensions. Horizontally the distance between the mandibular foramen and the anterior border of the ramus was always greater than the distance between the mandibular foramen and the posterior border of the ramus. Comparatively the vertical dimension showed more increase than that of horizontal dimensions.
Conclusion: There was no great difference in the relative position of the mandibular foramen and lied somewhere between half to two-thirds of the entire width of the ramus posteriorly and roughly around the occlusal plane.

Keywords: Inferior alveolar nerve block, local anesthesia, mandibular foramen

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Introduction

One of the most important aspects of pediatric dentistry is pain control. Local anaesthesia is still the main technique for pain control in any dental procedure procedure. In case of dental procedure involving the mandible, the inferior alveolar block is still the most important technique for mandibular anaesthesia. IANB is effective when the needle is inserted in close proximity to the mandibular foramen in order to deposit a solution of the anaesthetic agent near the nerve. Despite the technique being commonly used in daily routine dental procedure, the failure rate is as high as 5 to 15 %[1]. There are basically two factors associated with the failures of the mandibular anaesthesia. First is the accessory innervations of the mandibular dentition from the mylohyoid, buccal, lingual and transverse cervical cutaneous nerves. The second and by far the most common, is the improper placement of the needle because of improper evaluation of the anatomic landmark[2]. Different authors have reported various anatomic structures relevant to successful mandibular anaesthesia, but failures in this technique still persist. Olsen reported that the mandibular foramen is situated at a level lower than the occlusal plane of the primary teeth in pediatric patients[3]. Whereas Benham reported that the foramen is at or slightly above the occlusal plane during the period of primary dentition[4]. As the position of the mandibular foramen changes during growth, it is very important to understand the developmental changes in its anatomic position.

Orthopantomography is a panoramic radiographic technique of the oral region which produces a single image of the facial structures that includes both the maxillary and mandibular arches alongwith the temperomandibular joints and their supporting structures. It is a very popular and widely used diagnostic technique for routine examination especially for children. The advantage of panoramic radiography is its simple procedure and low dose of radiation. A greater area of hard and soft tissue coverage and continuity of the visualized area can be achieved[5]. It also provides qualitative and quantitative information as well as comparison between right and left homologous structures. This ability to view the entire mandible can allow estimating the position of the mandibular foramen in both vertical and horizontal dimensions[6].

Therefore this study was undertaken to assess pattern of changes in the position of mandibular foramen in growing children between 3 and 13 years of age.

Materials and methods

This in-vitro study was undertaken in the Department of Pedodontics & Preventive dentistry and Department of Pharmacology, I.T.S Dental College and Hospital, Muradnagar, Uttar Pradesh. Institutional Ethical committee clearance was obtained prior to start of this study. An informed consent was taken from patients who participated in this study.

The study was performed on 90 children in the age group from 3 to 13 years who had come for treatment to ITS CDSR. These children were divided into 6 groups based on the Hellman's dental developmental stages, with 15 children in each group: (1) IIA; (2) IIC; (3) IIIA; (4) IIIB; (5) IIIC; (6) IVA [Table 1].

GROUP	DENTAL AGE	HELLMAN'S STAGES	CHARACTERISTICS	SAMPLE SIZE
1	3-4 yrs	II A	Completion of primary occlusion	15
2	5-7 yrs	II C	Eruptive phase of permanent first molar or incisors	15
3	7-9 yrs	III A	Eruption of permanent first molar or incisors completed	15
4	9-12 yrs	III B	Exchange phase of lateral teeth	15
5	11-12 yrs	III C	Eruptive phase of permanent second molar	15
6	12-13 yrs	IV A	Eruption of permanent second molar completed	15

Table 1: Hellman's Dental Developmental Stages7

Children with previous orofacial trauma, surgery, temporomandibular joint and craniocervical disorders and those falling under Hellman's stages of IA, IC, IVC and VA were excluded as they did not fit into the age group selected. The standardized radiographic procedure was fully explained to the parents/children. The left side of the outline of the mandible on each radiograph was traced on the matte acetate paper using a radiographic viewer and reference points and planes were identified. Various landmarks were mentioned as reference points and were connected to form different planes. Four planes were drawn of which 2 were horizontal and 2 were vertical. This was achieved by joining the various points on the tracings. Eight linear measurements were made of which 2 were horizontal and 6 were vertical [Figure 1 and 2]. This was accomplished with the help of a digimatic calliper with 0.01 mm precision. All the obtained data was then summarised in the form of tables for each stage.

The mean values and the standard deviations of linear measurements in each of the Hellman's stage were calculated. The relative position of the MF was then arrived at by comparing the dimensions of each of the linear measurement which showed the varied growth of the mandible as a whole and the ramus particularly.

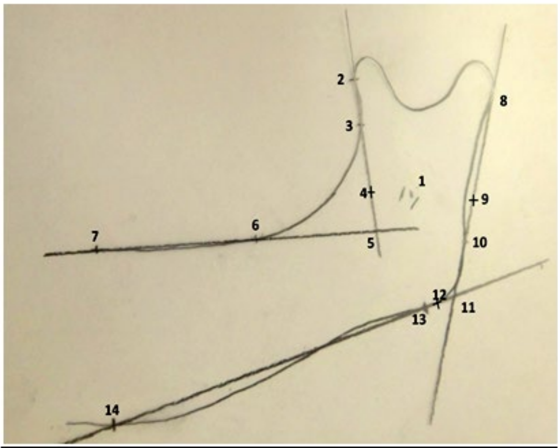

Figure 1: Reference points.

Point -1: Center of the MF.
Point -2: Most prominent point on the anterior border of the ramus.
Point -3: Deepest point on the anterior border of the ramus.
Point -4: Intersecting point of the perpendicular line from the MF to P1.
Point -5: Intersecting point of P1 and P3.
Point -6: The distal alveolar crest of the most distal molar.
Point -7: Mesial alveolar crest of the canine.
Point -8: Most prominent posterior point of the condyle.
Point -9: Intersecting point of the perpendicular line from the MF to P2.
Point-10: Most prominent posterior point at the angle of mandible.
Point-11: Intersecting point of P2 and P4.
Point -12: Intersecting point of the perpendicular line from the MF to P4.
Point -13: Most prominent inferior point at the angle of mandible.
Point -14: Most prominent inferior point at the canine area.

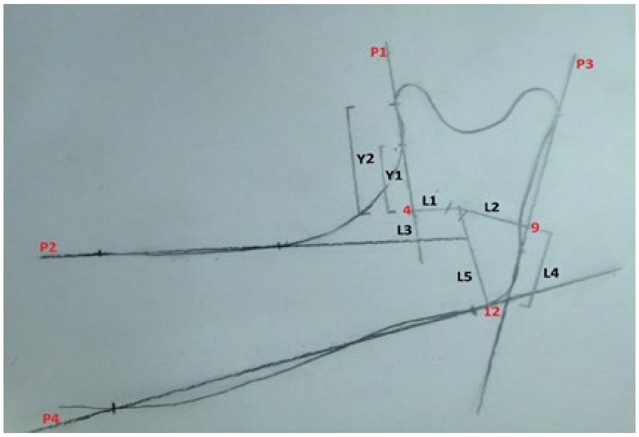

Figure 2: Linear measurements between reference points and planes.

L1: Distance between reference points 1 and 4 (Linear horizontal measurement).
L2: Distance between reference points 1 and 9 (Linear horizontal measurement).
L3: Distance between reference points 4 and 5 (Linear vertical measurement).
L4: Distance between reference points 9 and 11 (Linear vertical measurement).
L5: Distance between reference points 5 and 11 (Linear vertical measurement).
L6: Distance between reference points 1 and 12 (Linear vertical measurement).
Y1: Distance between reference points 3 and 4 (Linear vertical measurement).
Y2: Distance between reference points 2 and 4 (Linear vertical measurement).
Plane 1 - (P1): Plane connecting reference points 2 and 3 (ramus anterior plane).
Plane 2 - (P2): Plane connecting reference points 8 and 10 (ramus posterior plane).
Plane 3 - (P3): Plane connecting reference points 6 and 7 (alveolar crest plane).
Plane 4 - (P4): Plane connecting reference points 13 and 14 (mandibular plane).

Results

The linear measurements showed a consistent increase in values through the stages that were studied, except the mean values of L3, which varied a lot between each of the stage and was inconsistent.

Normality of the data was tested using Shapiro-Wilk test and was found to be normally distributed.

On statistical evaluation we found that the intra group comparison between the mean values of the linear horizontal measurements (L1 and L2) among any two consecutive stages showed no significant difference. However, other groups (L3, L4, L6, Y1 and Y2) showed significant differences through the six stages except for group L5 where no significant difference between the steps was found. [Table 2]

Measurements Stages	N	L1 Mean SD	L2 Mean SD	L3 Mean SD	L4 Mean SD	L5 Mean SD	L6 Mean SD	Y1 Mean SD	Y2 Mean SD
IIA	15	15.81333 2.67	13.08000 1.61	6.253333 1.41	16.30000 2.14	24.79333 4.21	19.32667 1.83	7.113333 1.57	19.46000 2.22
IIC	15	15.90000 2.74	13.13333 1.45	4.406667 1.81	16.54667 1.54	27.54667 2.80	21.15333 1.91	9.113333 2.54	20.23333 3.16
IIIA	15	16.06667 1.68	13.30000 1.81	4.853333 1.75	16.95333 3.69	28.31333 2.85	22.81333 2.56	10.24000 2.11	21.60000 5.14
IIIB	15	16.29333 2.77	13.46000 2.41	6.488000 1.90	17.33267 2.90	27.92667 4.33	23.86667 3.85	11.64000 3.00	24.54667 1.88
IIIC	15	16.60000 0.87	13.52000 1.51	3.393333 0.89	18.66667 3.68	27.33333 2.25	23.71333 2.55	13.46667 3.52	25.75333 4.96
IVA	15	17.06000 2.12	14.18667 1.96	6.340000 1.47	19.96000 1.99	27.72667 4.03	25.16000 1.59	15.57333 1.33	25.19333 3.45

$P<0.05$ = Statistically significant

Table 2: Mean values and standard deviations of linear measurements in each stage

Karl Pearson's correlation coefficient test showed overall positive correlations which were significant. A strong positive correlation between L1 and L2 was found which was significant. L3 showed positive correlation with all the groups which was not significant except with L5 which showed negative correlation although it was also not significant. A positive correlation was found between the groups L4, L5 and L6 which was significant. The correlation between the vertical measurements Y1 and Y2 was positive and significant. [Table 3]

Measurements Stages	N	L1 Mean SD	L2 Mean SD	L3 Mean SD	L4 Mean SD	L5 Mean SD	L6 Mean SD	Y1 Mean SD	Y2 Mean SD
IIA	15	15.81333 2.67	13.08000 1.61	6.253333 1.41	16.30000 2.14	24.79333 4.21	19.3266 7 1.83	7.11333 3 1.57	19.4600 0 2.22
IIC	15	15.90000 2.74	13.13333 1.45	4.406667 1.81	16.54667 1.54	27.54667 2.80	21.1533 3 1.91	9.11333 3 2.54	20.2333 3 3.16
IIIA	15	16.06667 1.68	13.30000 1.81	4.853333 1.75	16.95333 3.69	28.31333 2.85	22.8133 3 2.56	10.2400 0 2.11	21.6000 0 5.14
IIIB	15	16.29333 2.77	13.46000 2.41	6.488000 1.90	17.33267 2.90	27.92667 4.33	23.8666 7 3.85	11.6400 0 3.00	24.5466 7 1.88
IIIC	15	16.60000 0.87	13.52000 1.51	3.393333 0.89	18.66667 3.68	27.33333 2.25	23.7133 3 2.55	13.4666 7 3.52	25.7533 3 4.96
IVA	15	17.06000 2.12	14.18667 1.96	6.340000 1.47	19.96000 1.99	27.72667 4.03	25.1600 0 1.59	15.5733 3 1.33	25.1933 3 3.45

$P<0.05$ = Statistically significant

Table 3: Karl Pearson's correlation coefficient test

Discussion

The mandible is always in constant phase of growth. As a child grows there is remodelling of the mandible mostly on the anterior border of the ramus and the alveolar crest. It shows a differential pattern of growth. This pattern of growth influences the Inferior Alveolar Nerve Block procedure as the position of the mandibular foramen differs from individual to individual in different ages. Inferior Alveolar Nerve Block is a very important procedure in any general dental procedure for a pain free procedure which is a great benefit for both the operator and the patient. This is possible when we achieve a successful local anaesthesia. Thus the knowledge of the relative position of the mandibular foramen is very crucial for this outcome especially in children.

A panoramic radiograph is generally used by all the dental specialities. An OPG is of great help in locating the mandibular foramen. Studies have shown that panoramic radiographs are as good as cephalometric radiographs for analyzing the position of the mandibular foramen[8] and show negligible distortion of the ramus length[9, 10]. Also there is no difference between male and female11 or right and left side of the ramus in the location of the mandibular foramen[12, 13]. In this study both boys and girls were involved and only left side of the ramus were traced on matte paper.

The position of the mandibular foramen has been depicted by various studies as being located just posterior to the middle of the ramus14, in the third quadrant[12, 15], at the midpoint[16, 17], or approximately at the posterior third of the ramus, in both the vertical and horizontal directions9 and no age-related difference in the anteroposterior position of the mandibular foramen[4]. In the vertical aspect the mandibular foramen position has been found to be at the occlusal plane in children4, inferior to the occlusal plane[18], midway and slightly inferior to the line connecting the deepest concavity on the internal oblique ridge and posterior border of the ramus[19] as reported by various authors.

The present study showed that the distance between the mandibular foramen and the anterior border of the ramus (L1) was greater than that between the mandibular foramen and the posterior border of the ramus (L2) through all the stages (Fig.3).

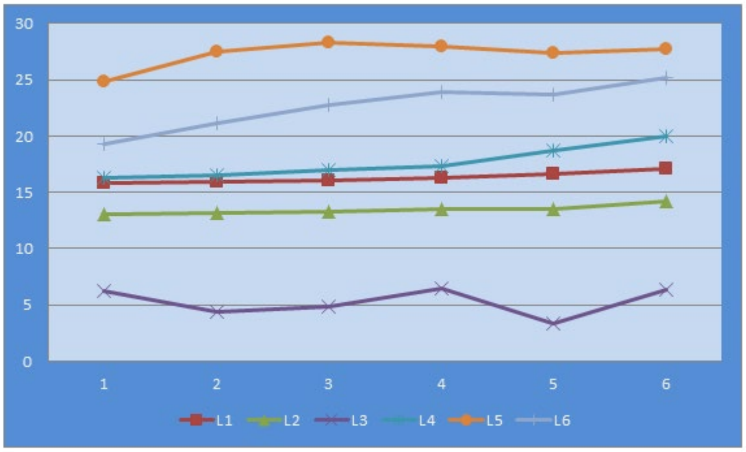

Figure 3: Line diagram representation of linear measurements L1, L2, L3, L4, L5, and L6 in through various stages [1= IIA, 2=IIC, 3=IIIA, 4=IIIB, 5=IIIC, 6=IVA]

he antero-posterior position of the mandibular foramen ranged from half to two-thirds of the width of the ramus from its anterior border. It was observed that the growth of the anterior border of the ramus was constant (Fig. 5); however when the posterior border was considered, it showed an increased growth after stage IIIC. The mean amount of increase in L2 was greatest after stage IIIC (Fig. 6). This spurt of growth may be due to growth of the condyle and apposition of the bone in the posterior border of the mandibular ramus during the eruptive phase of permanent second molar as stated by a previous study done by Tsai HH[20].

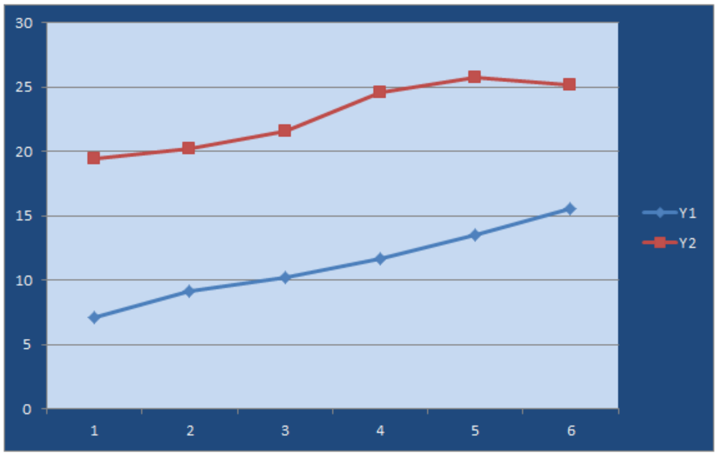

Figure 4: Line diagram representation of linear measurements Y1 and Y2 in through various stages [1= IIA, 2=IIC, 3=IIIA, 4=IIIB,5=IIIC, 6=IVA]

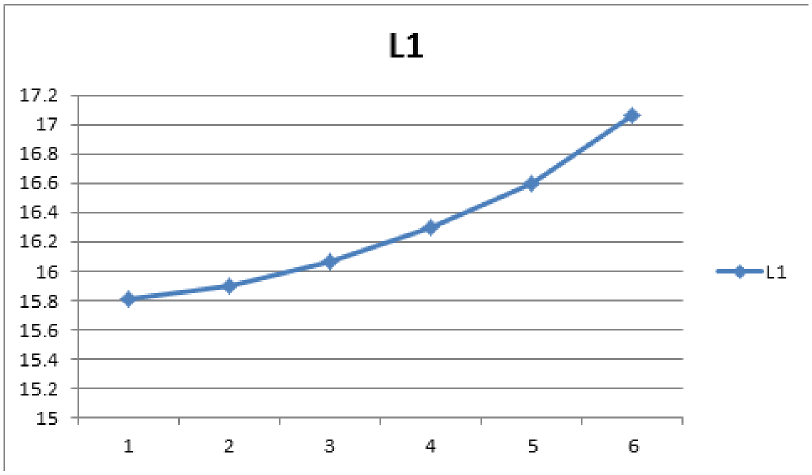

Figure 5: Line diagram representation of linear measurements L1 through various stages [1= IIA, 2=IIC, 3=IIIA, 4=IIIB, 5=IIIC,6=VA]

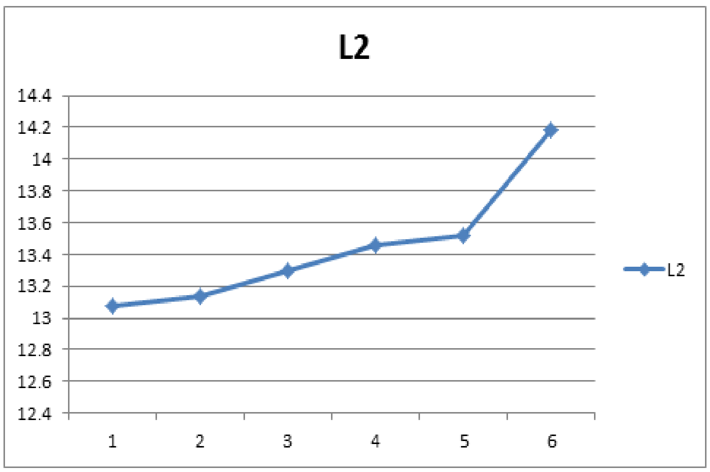

Figure 6: Line diagram representation of linear measurements L2 through various stages [1= IIA, 2=IIC, 3=IIIA, 4=IIIB, 5=IIIC6=IVA]

In the vertical direction from the level of mandibular foramen to the alveolar crestal plane, the distance (L3) showed a slight change from stage IIA to IVA. In between the stages it showed considerable variation with both increase and decrease in values. The reason for this variation maybe due to active eruption and shedding phases or due to influence of remodelling process at the anterior border of the ramus. Also the value of L3 from stage IIA to IVA showed that the vertical position of the mandibular foramen from the alveolar crestal plane remained relatively constant. Thus, considering the crown height of the teeth we can roughly say that the position of the mandibular foramen was near the occlusal plane in all the stages studied here. This findings was in accordance with a previous study done by Poonacha KS[21] et al where similar variation was seen in the vertical dimensions from the mandibular foramen to the alveolar crest.

The distance of the mandibular foramen from the lower border of the mandible (L4) showed an increase of about 3.5mm from stage IIA to IVA. This indicated a growth of the mandible at its lower border which may be influenced by the growth of the ramus itself and the apposition of the bone in the lower mandibular border.

In the anterior border of the ramus the distance from the coronoid notch to the level of the mandibular foramen showed an increase through the stages IIA to IVA. The overall height of the anterior border of the ramus also showed an increase through the stages IIA to IVA. But in comparison to overall height of the anterior border of the ramus (Y2), the lower half of the anterior border of the ramus (Y1) showed greater rate of growth in this study (Fig.4). This may suggest that the overall growth of the anterior border of the ramus maybe influenced more by the lower half. The coronid notch is an important landmark which is considered while giving an inferior alveolar nerve block. In this study it was seen that the distance from the level of the mandibular foramen to the coronoid notch increased through the stages that were studied.

Conclusion

In the present study it was seen that there was no great change in the relative position of the mandibular foramen in the antero-posterior direction with the foramen lying somewhere between half to two-thirds of the entire width of the ramus posteriorly. In the vertical direction the mandibular foramen was found to lie roughly around the occlusal plane through the age groups that was considered in this study. Therefore, this study suggests that during the Inferior Alveolar Nerve Block technique the needle should be placed at the occlusal level below the coronoid notch in all age group studied and the point of insertion for the needle should be at or posterior to the midpoint of the ramus of the mandible.

References

1. Wong MK, Jacobsen PL. Reasons for local anesthesia failures. J Am Dent Assoc. 1992; 123(1):69-73.

2. Hetson G, Share J, Frommer J, Kronman JH. Statistical evaluation of the position of the mandibular foramen. Oral Surg Oral Med Oral Pathol 1988; 65:32-4.

3. Olsen, N.H., 1956. Anesthesia for the child patient. J. Am. Dent. Assoc., 53: 548-555.

4. Benham, N. R., 1976. The cephalometric position of the mandibular foramen with age. ASDC J. Dent. Child. , 43: 233-237.

5. Phillips JL, Weller RN, Kulild JC. The mental foramen; radiographic position in relation to the mandibular second premolar. JEndod 1992; 18: 271-4.

6. Tsai HH. Panoramic radiographic findings of the mandibular growth from deciduous dentition to early permanent dentition. J Clin Pediatr Dent 26: 279-84, 2002

7. Nakata M, Wei SH. Development of dental arch and occlusion. Occlusal guidance in pediatric dentistry. 1st ed. St. Louis, Tokyo: Ishiyaka EuroAmerica, Inc.; 1986. p. 10.

8. Afsar A. Haas DA. Rossouw PE. Wood RE. Radiographic localisation of mandibular anesthesia landmarks. Oral Surg Oral Med Oral Pathol Oral Oral Radiol Endod 86: 234-41, 1998.

9. Da Fontoura RA, Vasconcellos HA, Campos AE. Morphologic basis for the intraoral vertical ramus osteotomy: Anatomic and radiographic localization of the mandibular foramen. J Oral Maxillofac Surg 2002; 60:660-5.

10. Amir C, Asja C, Melita VP, Adnan C, Vjekoslav J, Muretic I. Evaluation of the precision of dimensional measurements of the mandible on panoramic radiographs. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998; 86:242-8.

11. Tsai HH. Panoramic radiographic findings of the mandibular growth from deciduous dentition to early permanent dentition. J Clin Pediatr Dent 2002; 26:279-84.

12. Hayward J, Richardson ER, Malhotra SK. The mandibular foramen: Its anteroposterior position. Oral Surg Oral Med Oral Pathol 1977; 44:837-43.

13. Larheim TA, Svanaes DB, Johannessen S. Reproducibility of radiographs with the orthopantomograph 5: Tooth-length assessment. Oral Surg Oral Med Oral Pathol 1984; 58:736-41.

14. Hetson G. Share J. Frommer J. Kronman JH. Statistical evaluation of the position of mandibular foramen. Oral Surg Oral Med Oral Pathol 65: 32-4, 1988.

15. Bremmer G. Measurements of special significance in connection with anesthesia of the inferior alveolar nerve. Oral Surg Oral Med Oral Pathol 5: 966-88, 1952.

16. Sweet APS. Canals and foramen of the maxilla and mandible. Dent Radiogr Photogr 16: 13-6, 1943.

17. Weiss KM. On the systemic bias in skeletal sexing. Am J Phys Anthropol 37: 239-49, 1972.

18. Malamed SF. Handbook of local anesthesia. 5 th ed. India: Elsevier publishers; 2004.

19. Trebus DL, Singh G, Meyer RD. Anatomical basis for inferior alveolar nerve block. Gen Dent 1998; 46:632-6.

20. Tsai HH. Panoramic radiographic findings of the mandibular foramen from deciduous to early permanent dentition. J Clin Pediatr Dent 2004; 28:215-20.

21. Poonacha KS, Shigli AL, Indushekar KR. Relative position of the mandibular foramen in different age groups of children: A radiographic study. J Indian Soc Pedod Prev Dent 2010; 28:173-178.

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