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Review Article

Morphological assessment of mandible: Way to effective anaesthesia

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ABSTRACT

The biggest bone in the human skull, the mandible shapes the inferior third of the face and forms the lower jawline. The inferior alveolar nerve and vessels enter the mandibular canal through the mandibular foramen, which punctures the internal surface of the ramus. It is located at the level of the occlusal surfaces of the lower teeth, midway between the anterior and posterior borders of the ramus, and ends at the mental foramen. Most people have a single mandibular canal, while there are some variations in shape (oval, round, or pear-shaped) and whether an accessory canal can be distinguished (canal bifurcation). Failure of inferior alveolar nerve block (IANB) anesthesia can be attributed to these anatomical variables as well as operator technique. The anesthetic solution is administered as near to the mandibular foramen as feasible by adhering to the landmarks. Repeated injections of the local anesthetic solution in children due to IANB failure can be a tiresome task since they may cause the kid to behave negatively and there is a chance that the solution will be administered in excess of the safe suggested dosage. Data regarding the shifting position of the mandibular foramen from childhood to puberty is lacking in the literature. In light of this, this research was carried out to evaluate, using radiographic techniques, how the mandibular foramen's locations change as a kid grows and develops from childhood to adolescent.

1. Introduction

Mandible is the largest bone in human skull that shapes the inferior third of the face and forms the lower jaw line. The coronoid process marks the upper termination of the ramus's anterior boundary, whereas the condyle or head of the mandible marks the posterior border. The two are separated by the smooth concave mandibular notch. The inferior alveolar vessels and nerve goes into the mandibular canal via the mandibular foramen, which punctures the internal surface of the ramus. It is located at the occlusal level of the mandibular teeth, midway between the anterior and posterior borders of the ramus, and ends at the mental foramen. Because they provide entrance to the mental nerve for a local anesthetic block. The bilateral mental foramina is a significant landmark on the exterior surface of mandible. This landmark, which fluctuates with age, is typically located on the imaginary line that goes between the second and first premolars, midway between the mandibular body's upper and bottom borders.[1]

The mandibular foramen contains the inferior alveolar vein, artery, and nerve as well as blood vessels. The mandible, gums, and tooth sockets are innervated by the

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inferior alveolar nerve. The inferior alveolar nerve gets divided into mental and incisive nerves at mental foramen.[2] Most people have a single mandibular canal, while there are some variations in shape (round, oval, or pear-shaped) and if an accessory canal is distinguished (as bifurcated canals). Most of the dental practitioners are unable to recognize such anatomical changes in radiographic pictures because they are not aware of them.[3]

Inferior alveolar nerve block (IANB) anesthesia failure can be attributed to these anatomical variables as well as operator technique. Numerous researchers have observed that mandibular foramens in children vary in position. Parts of the mandible are made of thicker, solid bone, despite significant anatomical diversity.[4] This makes it hard for externally injected local anesthetic to permeate into the inferior alveolar nerve (IAN), which is located in the mandible.[5] From childhood to adolescence, bone mineral density (BMD) rises till maximum bone mass is achieved. Using sensitive and trustworthy diagnostic methods and instruments is essential for evaluating the health and morphological characteristics of bones in children and adolescents.[6]

Repeated injections of the solution of local anesthetic in children because of failure of IANB is a tiresome task since they may cause the child to behave negatively and there is a chance that the solution will be administered in excess of the safe suggested dosage.[5] Thus keeping this in mind, we planned the present review to assess the changing positions of mandibular foramen and BMD in relation to child's growth and development from childhood to adolescence.

2. Location of Mandibular Foramen

In the literature, it has been mentioned that mandibular foramen position may vary. Mandibular foramen is not always situated in the middle of the ramus of mandible in anteroposterior dimension. In the posterior orientation, the foramen is located approximately 2.75 mm from centre of the ramus of mandible. Additionally, it is recommended that the coronoid notch and mandibular foramen are 19 mm apart; this distance is level below or at the plane of occlusion. Age can affect the location of mandibular foramen in respect to the plane of occlusion. In children, the mandibular foramen is situated at or below the occlusal plane level, however in adults, it is situated below the occlusal plane.[7]

3. Mandibular Canal: Anatomical Variations

The planning of many dental operations, particularly surgical procedures, depends on the mandibular canal's location. Intraosseous channels called mandibular canals are often specific to every hemimandible. These start in the mandibular foramen, which is situated in the lingual surfaces of the mandibular bodies, and extend in the direction of vestibule in the pre-molar area until they goes into the mental foramen. The inferior alveolar neurovascular bundle, the largest mandibular division, is situated inside these canals and is in charge of innervating the posterior teeth, surrounding structure of bone, and tongue coating's mucosa.[8]

Branching of the mandibular canals is a problematic feature that necessitates careful design so as to prevent lesions in the inferior alveolar neurovascular bundle. Additional to the 3D mandibular canal classification, the three-dimensional picture of the mandibular structures offered by computed tomography (CT) tests allows for increased sensitivity for the identification and assessment of mandibular canals.[9]

The mandibular canals were classified by Carter and Keen, 1971 (Figure 1). In Type 1, the inferior alveolar nerve is a large single structure which is located in bony canal that pass close to the tips of roots. In Type 2, the inferior alveolar nerve runs closer to the base of mandible, and the small branches of main nerve penetrate the tips of root. In Type 3, the main nerve branch innervates the posterior area of the mandible, while a lower nerve branch traverses the mandible to the anterior area.[10]

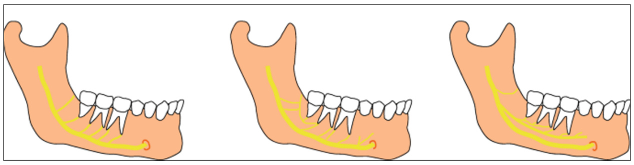

Figure 1: Classification of mandibular canal (Carter and Keen, 1971)[10]

4. Inferior Alveolar Nerve Block

In addition to blocking the lower lip's sensory innervations, the inferior alveolar nerve block temporarily anesthetizes the mandibular teeth in the ipsilateral quadrant, the gingival tissue, and the mucoperiosteum of the mandibular arch. This block can help with a variety of mandibular surgical operations, including root canal therapy, surgical reconstruction, tooth extraction, periodontal therapy, and stabilization in cases of trauma and fracture.[11]

The most known method is the traditional inferior alveolar nerve block technique. Anatomical markers such as the sigmoid notch, anterior and posterior edge of the mandibular ramus, coronoid process, and coronoid notch must be recognized. The pterygomandibular raphe, which is created by the buccinator and superior constrictor muscles, and the coronoid notch are also important markers; the ideal place for needle entrance is in the space between these two structures.[12]

When done properly, the inferior alveolar nerve block offers superior anesthesia for the length required to carry out standard dental treatments, affecting the ipsilateral mandibular teeth, gingiva, mucoperiosteum, and lower lip. Providers must be aware of the necessary anatomic landmarks and procedures, as well as choose the best approach for each situation.[13]

5. Discussion

Based on two-dimensional exams, radiographic studies of the prevalence branching in mandibular canals show variety, ranging from 15.6% to 65% and from 0.08% to 38.75%.[14] This variation is linked to the application of various techniques, such as CT scans and panoramic radiography assessments. The easiest way to identify and find their course, according to the scientists, was to use the cross-sectional cuts of the mandibular bodies, which were made feasible by CT tests. In an effort to develop a more effective technique that can identify the actual frequency and location of these changes, the CT scan has made significant strides and has outperformed the panoramic radiography in terms of the limits they present. Because of this, it is advised as the preferred technique for organizing a variety of dental surgical treatments.[15]

The majority of these clinical procedures are carried out while the IAN is sedated. The radiographic location of the mandibular foramen is evaluated in order to execute appropriate blocking of the IAN. Children's mandibular growth causes significant variation in the position of the mandibular foramen. Since age was closely linked to the location of the mandibular foramen in children, these findings further support additional forensic research based on age estimation approaches, in addition to the surgical management of pediatric patients.[16] Since the number of mandibular foramina correlates with the number of inferior alveolar nerves, the clinician can use radiographic imaging to confirm the presence of multiple mandibular foramina. By using this method, the entire area innervated by the inferior alveolar nerve will be anesthetized by a successful and appropriate nerve block.

According to Pereira PN et al.,[16] there is a statistically significant correlation between particular age ranges and the location of the mandibular foramen. They recommended that while blocking the inferior alveolar nerve in children under the age of eight, the needle should be placed downwards along the occlusal plan. Additionally, the needle should be put upwardly in the occlusal plan in youngsters older than eight. Poonacha KS et al.,[4] found that IANB had a good success rate when the needle was positioned at the occlusal plane level in children aged three to thirteen years.

In a study by Krishnamurthy NH et al.,[17] it was observed that for children aged seven to eight, the mandibular foramen is roughly 2-3 mm above the occlusal plane and 11.6-13.0 mm from the deepest point of the coronoid notch; for children aged 9 to 10, it is 3-4 mm above the occlusal plane and 13.0-13.9 mm from the deepest point of the coronoid notch; and for children aged 11 to 12, it is 5.5-6.5 mm above the occlusal plane and 11.9-12.2 mm from the deepest point of the coronal notch. They found that there was a statistically significant gradual increase in the distance between the mandibular lingula and the occlusal plane in all three groups.

Intraosseous anesthesia (IO) involves injecting the anesthetic fluid straight into the cancellous bone. The anesthetic fluid can momentarily stop the sodium pump when it reaches the periapical region and, consequently, the axonal portion of the nerve. There is virtually little time lag in achieving the anesthetic effect, and minimal anesthesia is required.[18] Determining the bone mineral density of the mandibular cancellous bone is crucial for evaluating the efficacy of IO anesthesia.[6] Clinicians can closely analyze neurovascular routes, bone thickness, and bone density (BD) by using CBCT to assess anatomical landmarks in the mandible. The bone mineral densities are measured using rectangular customized regions of interest (ROI), placed by one clinician. The shape and size of the ROIs are altered to conform to the shape of the bone images of each patient.

Our review indicates that research studies should be conducted utilizing the sophisticated diagnostic tools like CBCT imaging and other cutting-edge technologies that will allow the assessment of the mandibular foramen and mandibular canal position, along with BMD in children of different ages.

6. Conclusion

In dentistry, CBCT has produced an imaging solution that does not suffer from the superimposition issues that come with conventional panoramic imaging or the projection mistakes that come with magnification. Furthermore, CBCT offers a variety of capabilities, including 3D reconstructions in any direction, to enable precise landmark recognition. Our review suggested the use of CBCT for assessing the position of mandibular foramen and mandibular canal, so that effective Inferior alveolar nerve block can be achieved in children and adolescents.

7. Source of Funding

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8. Conflict of Interest

None.

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