Int. J. Morphol.,
42(3):549-553, 2024.

Unusually Pronounced and Expansive Mandibular Foramen. A Incidental Radiological Finding

Foramen Mandibular Inusualmente Pronunciado y Expansivo: Un Hallazgo Radiológico Incidental

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SANJAY C. J.; PATIL, K.; JAISHANKAR, H. P. & CHRISTOPHER, V. S. Unusually pronounced and expansive mandibular foramen. A incidental radiological finding. *Int. J. Morphol., 42(3)*:549-553, 2024.

SUMMARY: The mandibular foramen and its canal are one of the most important structures in the skull, as they solely supply the mandible through their associated nerves and vessels. Many anatomical variations have been reported in the literature until now, and this case report represents a clear-cut appearance of its shape in a panoramic radiograph, which is not mostly seen in normal panoramic radiographs. These factors are of utmost importance when it comes to performing various surgeries and preventing complications due to their varied anatomy, which will allow dentists to create a better treatment plan and provide better treatments without any complications.

KEY WORDS: Mandibular foramen; Panoramic Radiography; Cone Beam Computed Tomography; Incidental Finding; Anatomic Variation.

INTRODUCTION

The midline is innervated by the mandibular nerve, a branch of the third division of the trigeminal nerve, which also innervates the labiomental region, buccal gingiva, and premolar mucosa. It exits the mandible anteroinferiorly through the mental foramen after passing through the mandibular canal and the mandibular foramen on the medial aspect of the ramus (Somayaji *et al*., 2012).

The mandibular foramen (MF) is an irregular foramen located a little above the centre of the medial surface of the mandibular ramus. The inferior alveolar nerve and vessels pass through the MF, traverse the mandibular canal, divide into mental and incisive branches to supply the mandibular teeth, and participate in the formation of the anterior loop (Bikfalvi, 2018). An inferior alveolar nerve block is a common local anesthetic technique used in dental practice. But the failure rate of this technique is reported to be as high as 20 %–25 % (Shah *et al*., 2013). The commonest cause of inferior alveolar nerve block failure is inaccurate localization of MF (Oguz & Bozkir, 2002). The main complications during this technique are hemorrhage, injury to the neurovascular bundle, fractures, and necrosis of the mandibular ramus (Daw Jr. *et al*., 1999). Hence, thorough knowledge of the mandibular ramus is very essential.

In normal panoramic radiographs, the normal shape of the mandibular canal is not usually this pronounced. This article showcases its widened appearance and its funnel shape clearly in a panoramic radiograph.

CASE REPORT

A 37-year-old male arrived at our outpatient facility with multiple bony, hard swellings in the upper front tooth region. The patient has no other associated comorbidities. No relevant familial history was given by the patient of anyone having the same type of jaw lesions. Initial physical examination results were normal for that time period. His intraoral examination revealed multiple bony, hard nodules in the upper and lower alveolar mucosa, which were painless and covered with normal mucosa. The patient did not mention any dimensional changes, which had remained the same size since he first spotted them about two months ago. Other intraoral findings include

- Missing 16 and 36
- Initial dental caries in 24, 25, 26, and 27
- Cervical abrasion in relation to 44, and
- Restoration in relation to 37

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Received: 2023-06-28 Accepted: 2023-11-27

A panoramic radiograph was advised for the patient to rule out any other bone deformities. The radiograph revealed a peculiar funnel-shaped, widened mandibular canal apart from the dental findings (Fig. 1). A Cone Beam Computed Tomography (CBCT) examination along with nerve tracing revealed the same, along with a thin ramus, and confirmed the clear anatomy of the mandibular foramen and its canal (Figs. 2 to 7).

Fig. 1. Panoramic radiograph showing the bilateral presence of a funnel-shaped mandibular canal.

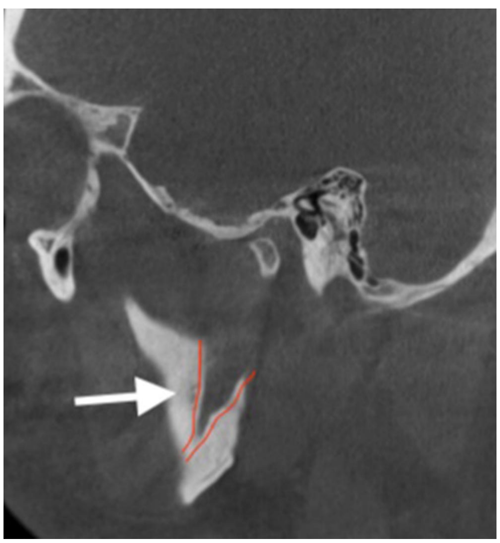

Fig. 2. Sagittal view of CBCT imaging showing the outline of the funnel-shaped mandibular canal.

Fig. 3. 3D Rendered image of CBCT showing the thinning of the ramus and the outline of the mandibular canal.

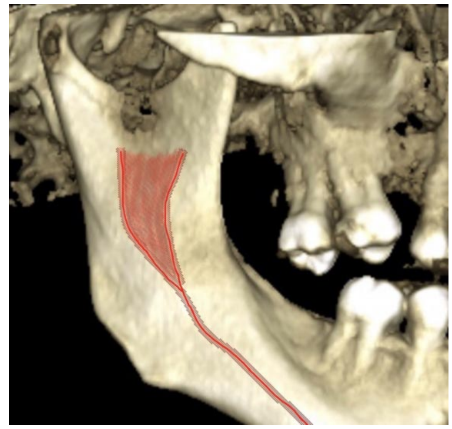

Fig. 4. Depiction of the right widened funnel-shaped mandibular canal with nerve tracing.

Fig. 5. Depiction of the left widened funnel-shaped mandibular canal with nerve tracing

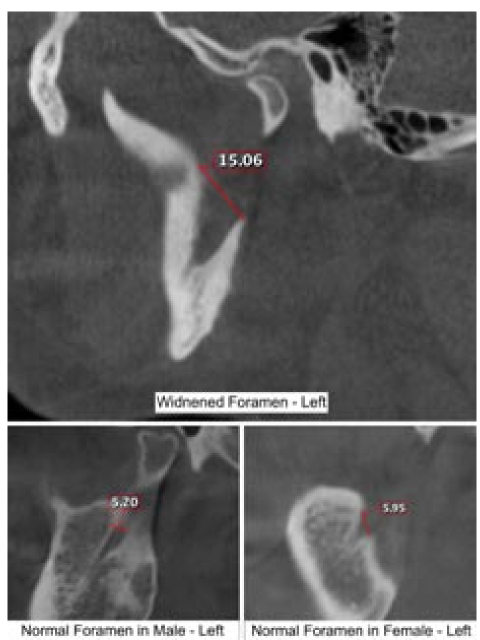

Fig. 6. Comparison between the widened foramen and the normal foramen- Left

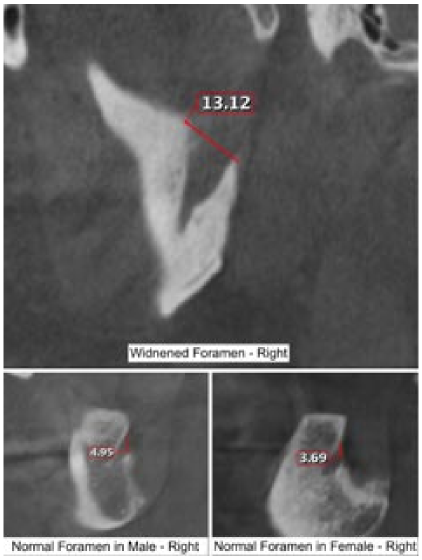

Fig. 7. Comparison between the widened foramen and the normal foramen- right.

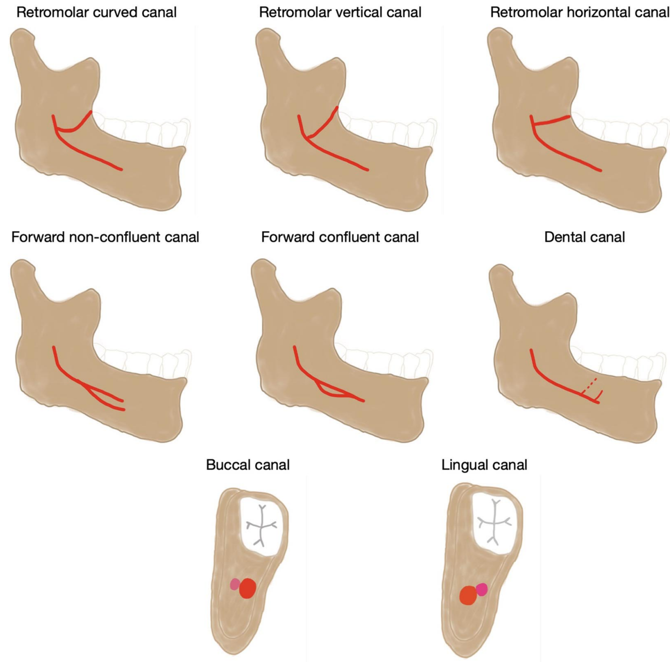

Fig. 8. Classification of bifid mandibular canals.

DISCUSSION

The beginning of the human mandibular canal is located on the medial surface of the ascending mandibular ramus, which extends horizontally forward in the mandible's body, which usually in a dry skull is in the shape of a funnel, and then obliquely runs downward and forward in the mandibular ramus, until coming to a halt where the mental foramen opens. The inferior alveolar neurovascular bundle extends forward within the mandibular canal and is composed of the inferior alveolar nerve, inferior alveolar artery, vein, and lymphatic vessels. The apices of the first and second premolars are where the mental and incisive canals of the mandibular canal diverge. The mandibular canal is an element of the mandible, or lower jaw. It contains the inferior alveolar nerve, which gives the lower lip, chin, and teeth sensation (Ahmed *et al*., 2021).

The mandible forms during embryogenesis from the first pharyngeal arch, which is made up of neural crest cells. When the mandible is developing, these neural crest cells move to the area and undergo differentiation into numerous cell types, including osteoblasts, which build the bone. Intramembranous ossification, which is how the mandibular canal is initially formed, happens. The mandible's bony walls are created by the mineralization of bone matrix, which is secreted by osteoblasts in the neural crest-derived mesenchyme. The mandibular canal is a groove-like depression that develops in the interior of the growing jaw as the bone grows and changes (Lipski *et al*., 2013).

As development proceeds, the inferior alveolar nerve, a branch of the trigeminal nerve, enters the mandible through the mandibular foramen, which is located on the medial aspect of the mandibular ramus (Ghandourah *et al*., 2023). The lower teeth and related structures receive innervation from the nerve as it travels through the mandibular canal. The inferior alveolar artery is one of the blood vessels that travel alongside the nerve in the canal. Individuals might have different mandibular canal sizes and shapes. The size of the canal is influenced by skeletal growth in general, age, and heredity. The mandibular canal occasionally exhibits anatomical changes like auxiliary canals or branches (Asghar *et al*., 2023).

Dental and maxillofacial surgery require a thorough understanding of the mandibular canal's anatomy and development. During treatments like wisdom tooth extraction, or orthognathic surgery, it helps prevent nerve damage. The jaw contains arteries and nerves; therefore, understanding its topography and morphology is important for performing surgeries on the mandible. Using panoramic radiography, Computed Tomography (CT) imaging, and CBCT imaging, mandibular canal variations have been identified. Cone beam computed tomography (CBCT), an advanced imaging technology, allows for precise vision and assessment of the mandibular canal, improving surgery planning and reducing complications (Urban *et al*., 2023).

In most panoramic radiographs, the funnel shaped entrance of the mandibular canal is not usually pronounced. In this case report, we can see that the funnel-shaped entrance of the canal was not only pronounced but also revealed unusual widening due to the thinning of the ramus, and the base of the funnel measured around 15.37 mm in the right and 12.50 mm in the left (Figs. 7 and 8), whereas in a normal variant it is only around 6–8 mm (Shalini *et al*., 2016).

The location of the mandibular foramen is essential for mandibular surgeries like vertical ramus osteotomies, inverted L osteotomies, and aesthetic surgeries for dentofacial deformities. The inferior alveolar nerve is at greater risk during these surgical procedures. Daw Jr. *et al*. (1999) have reported great variability in the position of the mandibular foramen in Non-Asian hemimandibles. They have also emphasized that knowledge of the location of the mandibular foramen would assist in performing a proper sagittal split of the mandibular ramus.

During the pterygomandibular technique of inferior alveolar nerve blockage, needles of size 33 mm and short needles of size 21.5 mm are used. If a long needle is used on a patient with a small mandible, there is a risk of perforating the parotid gland capsule and injuring the branches of the facial nerve. If a short needle is used in a patient with a large mandible, there may be a fracture of the needle when it is completely introduced into the oral tissues (Ennes & Medeiros, 2009).

The structure of the mandibular canal can vary, despite the fact that its path generally follows regular patterns. These are some noteworthy variations:

Bifid Mandibular Canal (BMC): The bifid mandibular canal is one of the most common types of the mandibular canal, despite the fact that in clinical practice it is occasionally disregarded. However, following the earliest instance's publication (Nortjé *et al*., 1977), scientists have started to focus more on the existence of BMCs. Several methods, instruments, and procedures, including panoramic radiography, histology, CT, and CBCT, are used to assess the presence and shape of BMCs (von Arx & Bornstein, 2021). Bifid mandibular canals have been classified in a number of different ways by various authors (Nortjé *et al*., 1977; Langlais *et al*., 1985; Naitoh *et al*., 2009) and are depicted in Figure 8. In order to categorize BMC into four groups, namely retromolar, dental, forward, and buccolingual types, Naitoh *et al*. (2009) used CBCT imaging. Although panoramic radiography cannot be used to classify the buccal or lingual types of BMC, they can only be classified in accordance with Naitoh's categorization. The most common form is the forward canal of the BMC (27.9 %), whereas the least prevalent is the buccolingual canal (0.8 %), according to research by Naitoh *et al*. (2009). The forward canal was identified as the most prevalent kind (17.8 %) by Eren *et al*. (2016) in a Turkish population, while the dental canal was identified as the least prevalent (4.3 %). The retromolar canal was shown to be the most prevalent kind in studies on a Korean population by Kang *et al*. (2014) and Rashsuren *et al*. (2014).

Accessory Canals: From the main mandibular canal, these smaller side canals branch out. They may reach the soft tissues close to the jaw, the teeth, the surrounding bone, or both. Accessory canals may present difficulties during dental treatments like implant implantation or nerve block injections because of their variety in location, number, and size. While accessory canals were not seen in 5.4 % of the CBCT scans, Aps (2014) has detected them in 94.6 % of scans. Comparably, a researcher from Italy discovered supplementary canals in 90.35 percent of CBCT images and no canals in 9.65 percent (Scaravilli *et al*., 2010). Both 159 lateral and 236 median lingual canals were discovered when Kilic *et al*. (2014) evaluated 200 CT scans. In the lateral and midline regions, there were varying numbers of lingual canals. A Belgian study found that the prevalence of single, double, and triple canals varies significantly by gender. In the mandibular midline region, the authors found that multiple canals were more common in men than single canals were in women. (Oettlé *et al*., 2015).

Anomalous Course or Position: The mandibular canal may not follow its usual path in some people. It may take on a different position within the mandible than typical, such as one that is more superior or inferior. To prevent potential harm to the inferior alveolar nerve during surgical treatments, these anatomical variations should be taken into account. According to Gowgiel (1992), the mandibular canal's position and course changed slightly in the area of the molars on the lingual cortical palate side. The mandibular canal's path, according to Rajchel *et al*. (1986), flowed laterally on the buccal side by 1 %. According to Littner *et al*. (1986) in nearly half of all cases, the mandibular canal was typically located buccal to the second molar's apex and lingual to the first tooth. These investigations showed that the presence of teeth in the mandibular molar region had an impact on the buccal and lingual directions of the mandibular canal. Age-related alveolar bone resorption impacts where the mandibular canal is located (Couso-Queiruga *et al*., 2022).

CONCLUSION

This study presents a unique anatomical arrangement of the mandibular foramen and its canal. The precise localization of the mandibular foramen is very important to achieve a successful inferior alveolar nerve block, prior to dental surgeries in the lower jaw like osteotomies and orthognathic reconstruction surgeries of the mandible, as well as to avoid injury to the neurovascular contents passing through it.

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RESUMEN: El foramen mandibular y su canal son algunas de las estructuras más importantes del cráneo y cara, ya que a través de ellos la mandíbula es inervada por nervios e irrigada por vasos. Hasta ahora, en la literatura consultada, se han informado de numerosas variaciones anatómicas. En este trabajo reportamos la forma y trayecto del foramen y canal mandibular, obtenidos en una radiografía panorámica, que no es observada normalmente en este tipo de radiografía. Los factores anatómicos son de importancia a la hora de realizar las cirugías para prevenir complicaciones debido a su variada anatomía, permitiendo a los odontólogos crear un mejor plan de tratamiento sin ningún tipo de complicaciones.

P**ALABRAS CLAVE: Foramen mandibular; Radiografía panorámica; Tomografía computarizada de haz cónico; Hallazgo incidental; Variación anatómica.**

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