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CASE REPORT

Mandibular canal variant: a case report

P. Wadhwani, R. M. Mathur, M. Kohli, R. Sahu

Saraswati Dental College, Lucknow, Uttar Pradesh, India

The mandibular canal transmits the inferior alveolar artery, vein and the inferior alveolar nerve. From an embryological perspective, there might be three inferior dental nerves innervating three groups of mandibular teeth. During rapid prenatal growth and remodeling in the ramus region there is spread of intramembranous ossification that eventually forms the mandibular canal. Occurrence of bifid/trifid mandibular canals in some patients is secondary to incomplete fusion of these three nerves. Various types of bifid mandibular canals have been classified according to anatomical location and configuration. This case report highlights an unusual variant of the mandibular canal.
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Introduction

The mandibular canal transmits the inferior alveolar artery, vein, and the inferior alveolar nerve, a branch of the third division of the trigeminal nerve, from the mandibular foramen to the mental incisival region. Dental and incisive branches leave the inferior alveolar nerve within the canal to supply the teeth and adjacent structures. A terminal branch leaves the canal at the mental foramen to become the mental nerve (1). A secondary collateral of the inferior artery vascularizes the sheath and the inferior alveolar nerve as well as the bony tissue around the canal.

From an embryological perspective, the presence of mandibular canal variants can be explained by the facts put forth by Chavez et al., who suggested that during embryonic development there might be three inferior dental nerves innervating three groups of mandibular teeth. The canal to the incisors appeared first followed by the canal to the primary molars and subsequently canal to the permanent molars. These canals are directed from the lingual surface of mandibular ramus towards different tooth groups. During rapid prenatal growth and remodeling in the ramus region, there is spread of intramembranous ossification that commences where the inferior alveolar nerve divides into mental and incisive branches around 7 weeks in utero. The extension of ossification posteriorly along the lateral border of Meckel's cartilage produces a gutter around the inferior alveolar nerve that eventually forms the mandibular canal (2). This theory also explains the occurrence of bifid/trifid mandibular canals in some patients secondary to incomplete fusion of these three nerves.

The course of the inferior alveolar nerve within the mandible is very variable, contrary to common thought. Carter and Keen (3) found that in only 49 of the 80 (61%) radiographs that they examined did the inferior alveolar nerve and its neurovascular bundle appear to stay completely within the mandibular canal.

The term bifid is derived from the Latin word meaning a cleft into two parts or branches. Bifid mandibular canals originate at the mandibular foramen and might each contain a neurovascular bundle.

Various types of bifid mandibular canals have been classified based on: anatomical location and configuration (3, 4); patterns of duplication (5). While it is interesting to assume that the presence of bifid mandibular canals is synonymous with bifid inferior alveolar nerves, it is possible that these canals may only surround blood vessels instead of both blood vessels and nerves (5). Possible support for this suggestion comes from the findings of a study by Grover and Lorton (6) in which four patients, who seemed to have bifid inferior alveolar nerves based on examination of their panoramic radiographs, did not report having any previous difficulty with mandibular anesthesia. In contrast, Sanchis et al. (7) have reported that the presence of bifid mandibular canals is associated with increased difficulty in obtaining mandibular anesthesia with the conventional inferior alveolar nerve block.

A case report

A 42-year-old male patient, who was receiving routine general dental care including the extraction of mandibular tooth, was seen in 2006 by the first author at

Correspondence: Dr Puneet Wadhwani, 3/233 Vishal Khand – III, Gomtinagar, Lucknow 226010, Uttar Pradesh, India. Tel: +91 522 2392571, Fax: +91 522 2815392, E-mail: drpuneetwadhwani@hotmail.com
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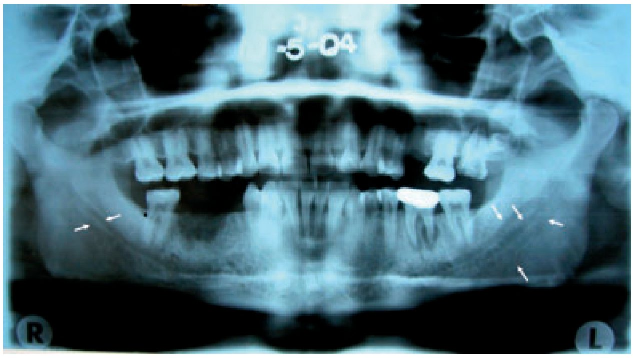

Figure 1 OPG illustrating the bifid mandibular canal on the right side and trifurcation on the left side.

Saraswati Dental College, Lucknow. On the first visit, an inferior alveolar nerve block, including deposition of anesthetic solution to block the lingual nerve and long buccal nerve block was given on the left side, before the treatment commenced. A total of 2.2 ml of 2% lignocaine HCl with 1:100 000 adrenaline was injected. The main intra-oral landmarks, including the pterygomandibular fold, pterygotemporal depression and coronoid notch could all be located without difficulty. Although some soft tissue anesthesia of the left side of the mandible was obtained after 5 min, including the lip and tongue, the periodontal tissues surrounding the 36 was still sensitive. Sensitivity of the gingivae and alveolar mucosa around the 36 was assessed by the use of the tip of a dental probe.

A panoramic radiograph (Fig. 1) indicated the presence of bifurcation of the mandibular canal on the right side and trifurcation of the mandibular canal on the left side of the mandible. The right side showed distinct radiographic images of the canals with separate origins that appeared to join anteriorly to form a single canal in the area below where the 47 would be located. The two canals appeared to be distinct, originating from two separate foramina. It would seem most likely that the more postero-inferiorly located canal also had the characteristic 'funnel'-shaped radiolucency that is normally visible at the most superior portion of the mandibular canal and which correlates with a depression on the medial surface of the ramus above the mandibular foramen.

The left side of the mandible also displayed an apparent trifurcation of the mandibular canal. The two canals appeared to be distinct, originating from two separate foramina similar to that observed on the right side.

Discussion

A review of the available literature revealed that the occurrence of bifid canals is unusual but is not thought of as being rare. Results of previous anatomical and radiological studies demonstrate a significant variation in the course of the mandibular canal. Oliver (8) found the inferior alveolar nerve in a single canal in 60%. In the other specimens, the canal was less well defined and the nerves and vessels were spread out to occupy a space within the bone rather than a tunnel. Grover and Lorton (6) were only able to find 0.08% of radiographs suggestive of bifurcation of the inferior alveolar nerve. Nortje et al. (9) found an occurrence of bifid inferior mandibular canals of 0.9% (Type I variation 0.72%, Type II variation 0.14%, and Type III variation 0.06%). Langlais et al. (4) found 0.95% cases of bifid inferior mandibular canals (Type I variation 0.367%, Type II variation 0.517%, and Types III and IV were 0.0333% each). In both of the latter studies, there was no statistically significant difference in the prevalence of bifid mandibular canals between male and female patients.

The clinical relevance of this issue is to remind clinicians of the variable anatomy of the mandibular canal. Bifid mandibular canals may have some important clinical implications. Inadequate anesthesia may be possible with any bifurcation type, but especially when there are two mandibular foramina. The most conclusive way to determine the contents of accessory inferior alveolar nerve canals would be histological analysis after dissection. As there are many possible reasons for failure to obtain profound mandibular anesthesia, we need to be able to differentially diagnose these causes and manage them accordingly. Conventionally, the presence of profound soft tissue anesthesia of the ipsilateral lip, chin, and teeth is indicative of an effective inferior alveolar nerve block. If a patient experiences only soft tissue anesthesia around the injection site, but not of the ipsilateral lip or chin, then a problem with local anesthesia technique is likely to be the cause of the failure. However, if there is soft tissue anesthesia of the lips and chin but not the teeth, one should consider anatomical variation.

If the problem is considered to be due to a problem with local anesthesia technique, a repeat inferior alveolar nerve block should prove effective provided the operator is able to correct his or her technique. If the problem is thought to involve anatomical variation, other types of local anesthesia techniques are indicated, as repeating the same procedure is likely to be ineffective and may result in increased postoperative pain and even trismus (10).

When third molar surgery has to be carried out, extreme care must be taken when there are bifid canals to the molar area. The tooth may infringe on or be within the canal itself. As a second neurovascular bundle may be contained within the bifid canals, complications such as traumatic neuroma, paresthesia, and bleeding could arise because of failure to recognize the presence of this anomaly and its implications. In other surgical procedures, such as mandibular osteotomy, the complexity of the surgery increases with the addition of a second neurovascular bundle. Furthermore, in cases of trauma, all mandibular fractures should be handled with care to ensure that the neurovascular bundle is lined up exactly to avoid impingement when the fracture is reduced. The alignment becomes much more difficult with a second neurovascular bundle located in a different plane. As alveolar bone resorbs to the proximity of the mental foramen, patients with mandibular prostheses may experience discomfort because of the pressure placed on the neurovascular bundle. This may also be a problem in the third molar and retromolar pad areas in the cases where the mandibular canal duplicates to the molar region. The study of this anomaly is obviously important in surgical procedures involving the lower jaw.

The main purpose of this article is to pay attention to an apparently harmful anomaly, which can induce complications when surgery has to be performed.

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