



Anatomical Variation of the Buccal Nerve in the Retromolar Area: Incidence in Harvesting Ramus Bone Graft

Bruno E^{1,2*} and Cyril S¹

¹Department of Oral Medicine & Oral Surgery, University Hospital Center of Bordeaux, France

²Laboratory of Anatomy, Bordeaux University, France

Abstract

The Retromolar Foramen (RMF) and the Retromolar Canal (RMC) have generally been studied or reviewed in the dental literature. However, these anatomical variations draw special attention in the recent years in oral surgery and clinical dental practice. The RMF is an inconstant foramen situated in the retromolar fossa, and it is often linked to the RMC. It presents morphologic and morphometrical variability.

The introduction of advanced dental surgical procedures in this area, such as bone graft techniques, in which a surgeon often chooses the mandibular ramus as the donor site, has increased the probability of damaging the buccal nerve and other complications such as sensory deficits. To date, despite an exhaustive review of the literature, few links have been established between RMC or RMF and Buccal Nerve (BN) and bone harvesting techniques in this area. The purpose is to present a clinical case that shows a retromolar foramen contains a nervous branch originating from the buccal nerve instead of the infra-alveolar nerve and its surgical incidence in oral surgery.

Introduction

Bone augmentation is required when the alveolar area has insufficient volume [1] and the mandibular retromolar area is recommended to be a donor site to provide a good cortical graft [2]. A decreased sensitivity can occur after of ramus graft harvested with an incidence of 8% to 20% [3,4].

The foramen and the canal of the retromolar region have generally been rarely reviewed in the literature of oral implantology [5]. However, these anatomical variations on the retromolar trigone draw special attention these last years in oral and maxillofacial surgery. This foramen is inconstant and located in the mandibular trigone area. As described [6-8] this foramen situated behind the third mandibular molar is the end of an accessory canal coming from the mandibular canal, and follows a recurrent path to end in this area, and it can present morphologic variability [8]. The introduction of bone graft techniques in dental surgical procedures such as a ramus bone block has increased the rate of damage to the buccal nerve [9] and other complications such as sensory deficits, due to the ignorance of these anatomical variations [4]. The buccal nerve supplies sensory innervation to the buccal gingiva of the mandibular molar region. Therefore, the anesthesia of the soft tissues in this area is done via this nerve.

To date, despite an exhaustive review of the literature, few links have been established between retromolar canal or retromolar foramen and buccal nerve in bone harvesting techniques in this area. The purpose in this clinical case is to show an anatomical variation which the retromolar foramen contains a nervous branch which from the buccal nerve.

Patient and Method

A 47-year-old patient came to consult to the Oral Surgery Unit at Bordeaux University Hospital for a prosthetic rehabilitation of a maxillary edentulous area. The patient's clinical examination did not report any general health problems. No history of trauma or sensitivity, no allergies to local anesthetics, no apparent abnormality in the jaws to contraindicate surgery. He was informed to the informed consent according to the Helsinki Declaration. A treatment was offered to him to place two dental implants in the toothless sector. Before implant placement, tomographic examination

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*Correspondence:

Bruno E, Department of Oral Medicine & Oral Surgery, Laboratory of Anatomy, University Hospital Center of Bordeaux, 146 rue Léo Saignat, 33076 Bordeaux Cedex, France, Tel: +33557576193; E-mail: bruno.ella@u-bordeaux.fr

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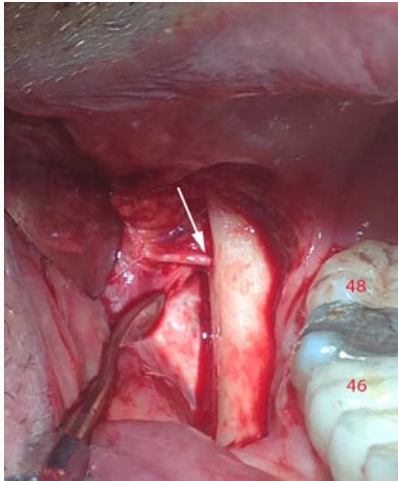


Figure 1: Surgical view showing the emergence of branch nervous from lateral wall of the mandibular ramus, and his distribution mainly in buccinator muscle and in the cheek.

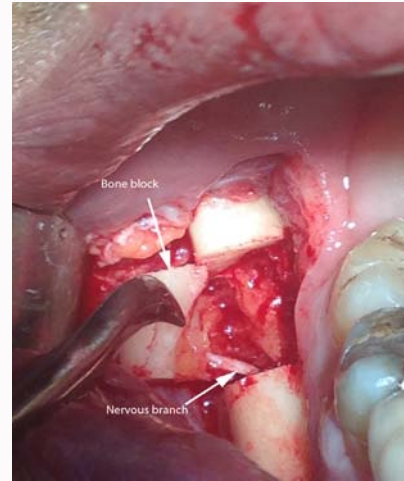


Figure 2: Surgical view showing the dislocation of bone block that allowed to see the path of the nervous branch and the fact that it was not connected to the IAN.

(NewTom VGi, 2009, NewTom Inc., Verona, Italy) was carried out. An onlay bone graft was indicated before implants placement. The ramus region was the donor site.

Prior to the surgical step, local anesthesia in both sites, anterior mamillar and retromolar regions was performed (1.7 mL 2% Articaine with 1:200,000 adrenaline). After muco-periosteal flap to prepare the receiving site, the toothless sector, the same full-thickness flap was performed on the donor site, the retromolar mandibular area. But during the deep resection of the full-thickness flap, the patient suddenly experienced acute pain on the same side along the masseter up to the cheek and a discharge at the adjacent molar. We immediately stopped the resection of the flap, to assess the situation and reassuring him about the nature of this pain. Then we tested the sensitivity of the vestibular mucosa and the retromolar region, the patient did not feel any pain. A cold sensitivity test (Topical cryo-anesthetic, Septodont, France) was performed on the third and second mandibular molars, which all responded positively to the cold test.

We tried to resume the deep resection of the full flap, but it caused the same pain, and we stopped again. We decided to perform anesthesia of the inferior-alveolar nerve according to the conventional technique.

Ten minutes after the nerve block, we assessed the lower lip numbness. After that, a cold sensitivity test was repeated during 2 min to determine pulpal anesthesia of the mandibular molars. Without repeating the anesthesia of the buccal region, the retromolar and vestibular mucosa was still insensible. Curiously the third and second molars responded again positively to the cold test, nevertheless we decided to continue the deep resection of the full flap, unfortunately the same pain occurred again by touching a specific point like a trigger zone on the vestibule. We dissected meticulously the soft tissue around this point. And we discovered a nervous branch that came out of a lateral accessory foramen (or penetrated into this foramen). This nervous branch was about 2 mm wide (Figure 1) without associated with a vascular component. We have therefore added anesthesia in the immediate vicinity of the nerve to continue the surgery. After this anesthesia near the nerve, in order to understand the discharge that occurred at the molar teeth, five minutes later we repeated the cold sensitivity test on the molars, these teeth no longer responded to the

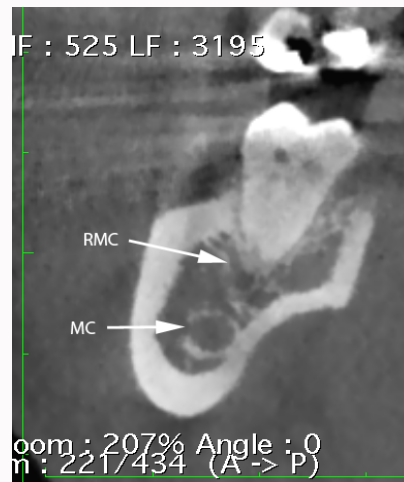


Figure 3: Axial CBCT cut shows the retromolar canal with its cortical bone lining in the retromolar area.

test. We were able to continue the surgery.

At the end of deep full flap, the osteotomy for autologous bone grafts was performed. One of the vertical osteotomies (distal) adjoined the accessory foramen. The dislocation of the bone graft allowed us to see the path of the nervous branch and the fact that it was not connected to the infra alveolar nerve (Figure 2). Secondary the bone block was fixed on the anterior maxilla, and flaps were sutured. The intervention was completed. One week after the surgery, the patient reported having some tingling and numbness around the operated area. One month later, the patient no longer reported any symptoms related to surgery on this area.

Discussion

The interest of this case is characterized by its anatomical variation in the retromolar area. The day after surgery, the analysis of CBCT showed no anatomical variation because of sectional image limited to 10 mm behind the 3rd molar. From the primary acquisitions the radiologist extended the scanning sections across the ramus in order to obtain a full view of the mandibular ramus. The new scope of the

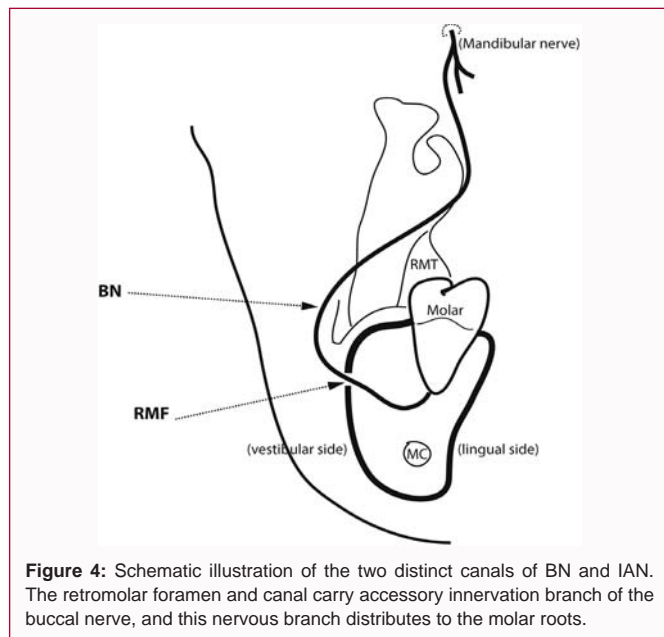


Figure 4: Schematic illustration of the two distinct canals of BN and IAN. The retromolar foramen and canal carry accessory innervation branch of the buccal nerve, and this nervous branch distributes to the molar roots.

CBCT, wider than the first, allowed us to distinguish the retromolar canal, and appreciate its path and diameter (Figure 3). It is necessary to use cross-sectional images in order to highlight possible anatomical variations in this area, as described by Von Arx et al. [10].

To better understand and explain our clinical cases, we performed a literature review. Electronic databases were performed *via* Medline, PubMed and Google Scholar, about variations of the retromolar foramen. Though this variation has been observed, its incidence in the harvesting ramus graft has never been described. According to several authors, these anatomical variations are located in the posterior mandible [11] in the mandibular trigone. Their contain provide accessory innervation to the mandibular molars and buccal area. Several authors have explained local anesthetic failures to these anatomical variations [10,12,13] and hypoesthesia of this region in the medium or long term. Some authors have proposed a classification of the variations of the canal in this posterior region [14-17], while others claim to find this anatomical variation on the lower half of the crest. In this clinical case the retromolar foramen is located in the vestibular side of the ramus more than 10 mm below the external oblique line [18]. The lack of vigilance or the ignorance of these anatomical variations can cause these complications and unpleasantly surprise the practitioner. In the present clinical case, we did not observe a vascular component (Figure 2). However, the innervation of the mandibular molars in this area by the observed accessory nerve branch could effectively cause the anesthetic failure of these molars [19]. We first thought that this nervous branch derived from the inferior alveolar nerve and emerged from this foramen to continue in soft tissues. But a careful examination of the CBCT (Figure 3) did not show a bifid mandibular canal, or a link with the infra-alveolar nerve. On the other hand, the position of the retromolar foramen from which this nervous branch emerged is located outside the retromolar triangle (below the external oblique line). Otherwise, due to its large diameter (2 mm), this anatomical variation joins what Narayana et al. [20,8] described in their studies about a foramen due to its diameter and its position outside the retromolar trigone [21]. Kawai et al. [22], Ossenberg et al. [23] hypothesized that the retromolar canal from double mandibular foramen would lead the long buccal nerve according to the variation [24]. Although this

clinical case did not present a double mandibular canal, we supposed that this nervous branch came from the buccal nerve. To illustrate his path, we have shown on fresh cadaver a buccal nerve along the temporalis crest (Figure 4).

It would be therefore possible that, the foramen reported here was not a retromolar foramen classically described behind the 3rd mandibular molar [20], as well as the structure/s passing through it.

In this clinical case the nervous branch from the retromolar foramen is distributed mainly in the jugal mucosa and in the lower molar teeth, at its distal portion (Figure 2).

As described by Lew et al. [25], normally an insensitivity of the lip, chin and teeth on the same side indicates the effectiveness of anesthesia of the infra-alveolar nerve. However, if the insensitivity concerns only the lip and the chin on the same side, without the teeth, one should consider a possible anatomical variation. This is what happened in our clinical case after the infra-alveolar nerve block, with the persistence of cold sensitivity of the mandibular molars. Thus, as suggested by Eliades et al. [19], and described by Bilecenoglu et al. [12], Lew et al. [25], we assumed in this clinical case that the long buccal nerve innervates mandibular teeth. The symptoms reported by the patient in this case were found in a case during extraction of a mandibular third molar. The nerve crossing an unusual foramen located in the retromolar fossa had been injured [14]. Also, according to Hun-Mu Yang et al. [9], it is possible that buccal nerve injury caused by an inappropriate surgical procedure could produce similar symptoms. In addition, in his study Hun-Mu Yang et al. [9] warn that the buccal nerve may be injured by an incision during surgery in this area, subsequently resulting in persistent numbness of the cheek. The description of previous authors almost concurs with that of the present clinical case. So, in accordance with this knowledge, in this clinical case we hypothesize that it is the buccal nerve that penetrates through this accessory foramen runs through the retromolar canal to ensure the innervation of these mandibular molars. These anatomical variations and supplementary nervous branch could explain certain failures of classical anesthesia of the inferior alveolar nerve as shown in this clinical case. Thus, if the CBCT highlights or makes suspect an anatomical variation of the mandibular canal in this area, or if the patient reports difficulties in anesthesia, it is necessary to use other complementary techniques of anesthesia [25,26]. Contrary to what several authors [27,28,17] described, in this clinical case the mandibular canal was not bifid. Indeed, his link with the retromolar canal is not systematic as stated by Capote et al.

To sum up, even if Kawai et al. [17] suggested that the retromolar canal and foramen are not a rare anatomical structure, the knowledge of their variations and their relationship with the mandibular molars are not well reported [19].

Complications due to these anatomical variations are not uncommon. A case of facial pain refractory to analgesics showed, via a CBCT, an implant crossing an accessory inferior alveolar nerve [29]. This is why the donor site (ramus) would require a CBCT to prevent these anatomical variations, unpleasant complications and limit nerve damage during surgery as in this clinical case. Knowledge of the sensory territory of the buccal nerve is useful to prevent injury during surgery, also to avoid inducing certain pain similar to unexplained trigeminal neuralgia [30].

Conclusion

The objective of the present case was to show the interest of

knowing the anatomical variations by the practitioners in order to avoid complications related to bone harvesting technique and incidentally failures associated with local anesthesia in this area. So, it is useful to remember that the preoperative radiographic evaluation of anatomical variations in this region is essential to avoid complications as described above. Therefore, computed tomography is appropriate for the three-dimensional bone view in this area as shown in the clinical case. The anatomical knowledge of the location of retromolar canal should be considered for optimizing surgery in this region.

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