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Case Report

Anatomy Section

Rare Anatomical Variation of the Inferior Alveolar Nerve: A Case Report

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ABSTRACT

A profound understanding about the neurovascular anatomy and its variations in the infratemporal region are highly pertinent in clinical practice. Inferior Alveolar Nerve (IAN) is a branch from the posterior division of mandibular nerve, supplies sensory innervation to the roots of mandibular teeth, skin over chin region and motor supply to mylohyoid, anterior belly of digastric muscles. Hereby, authors are reporting a variation in the formation of IAN and its relation with 2nd part of the maxillary artery during cadaveric dissection. The IAN took origin as a superficial and a deep root, encircling the second part of maxillary artery, then nerve to mylohyoid was noted before IAN entered mandibular foramen along with the inferior alveolar vessels. Variations of this kind are considered to have clinical implications like arterial compression, neuropathic pain, ischaemic nerve injury, ineffective dental anaesthesia, and surgical intervention.

Keywords: Infratemporal fossa, Dental anaesthesia, Neuropathic pain, Neurovascular anatomy

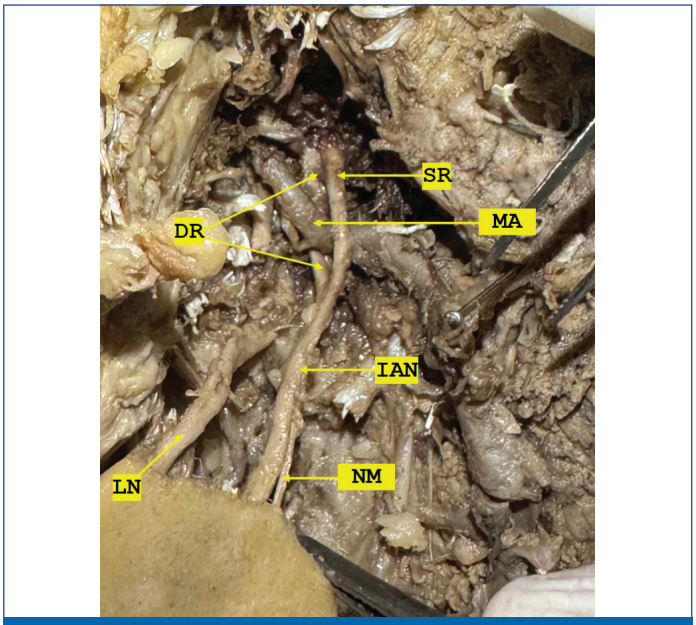
CASE REPORT

The variation in the formation of IAN was encountered during the dissection of the embalmed 65-year-old male cadaver, for undergraduate learning, in March 2025.

The left-side Infratemporal Fossa (ITF) was exposed after removing zygomatic arch and cutting the coronoid process and lifting temporalis muscle above. Then the lateral pterygoid muscle was exposed and structures deep to the muscle were dissected and cleaned. Maxillary artery and branches of mandibular nerve were traced. Posterior division of mandibular nerve gave auriculotemporal nerve as usual, subsequently divided into Lingual Nerve (LN) and IAN. A variation in the formation of IAN and relation with maxillary artery was observed [Table/Fig-1].

[Table/Fig-1]: Specimen of an embalmed male cadaver showing the dissected left Infratemporal Fossa (ITF), exposing the variation in the formation of Inferior Alveolar Nerve (IAN).

The superficial root (anterior to MA) measured 23.07 mm and deep root (posterior to MA) measured 31.88 mm in length before these roots converged. It was then noted that the IAN was accompanied by its associated vessels to enter the mandibular foramen as expected. The nerve to mylohyoid was seen arising 12.56 mm below the point of formation of IAN. The length of MA in the infratemporal region was 50.55 mm [Table/Fig-2]. The findings on right-side were normal.



[Table/Fig-2]: Cadaveric specimen showing the variations observed in the left infratemporal region revealing the maxillary artery located between the superficial and deep roots of IAN.
IAN: Inferior alveolar nerve; SR: Superficial root; DR: Deep root; LN: Lingual nerve (cut); MA: Maxillary artery; NM: Nerve to mylohyoid

DISCUSSION

The IAN of the left ITF originated as a superficial and a deep root, which encircled the 2nd part of the Maxillary artery and converged to form IAN proper. The course hereafter was normal.

Normal anatomy: The ITF is the potential space beneath the base of the skull, with foramen spinosum and ovale piercing the roof, lateral surface of lateral pterygoid plate of sphenoid forming the medial wall, ramus of mandible forming the lateral wall, and the floor remains open.

The mandibular nerve a branch of the Trigeminal (5th) the largest cranial nerve, traverses through foramen ovale, to become most important neural structure of the infratemporal region. Mandibular nerve lies between the tensor veli palatini and lateral pterygoid muscles. The nerve divides into anterior and posterior division after giving nerve to medial pterygoid passes near/via the Otic ganglion without synapsing; tensor tympani and tensor veli palatini are supplied

by branches passing through (not synapsing in) the Otic ganglion. The anterior division gives motor fibres to masseter, temporalis and lateral pterygoid muscles (derivatives of 1st pharyngeal arch) and one sensory branch to buccal mucosa. The posterior trunk of mandibular nerve, mainly sensory, gives rise to auriculotemporal, LN and IAN. IAN normally takes origin as a single branch and descends deep to the lateral pterygoid muscle, and lies between the sphenomandibular ligament and ramus of mandible. IAN runs vertically downwards along with associated vessels. It gives off nerve to mylohyoid that provides motor supply to mylohyoid and anterior belly of digastric muscles. IAN supplies sensory to the roots of mandibular teeth via incisive branches and skin over chin region along with the mucous membrane of the lower lip via mental nerve. Most importantly, the second part of the maxillary artery runs anterior to the IAN [1].

Tumours in the ITF, such as haemangiomas and those arising from peripheral nerve sheaths, are common. Schwannomas and neurofibromas are generally noted between the medial and lateral pterygoid muscles, as the lingual and IANs are located in this region. IAN contributes to around 20% of nerve complications caused due to ITF tumours [2]. IAN block is extensively practiced in dental anaesthesia, and multiple techniques are employed to achieve complete block [3]. Tic douloureux, also called as Trigeminal Neuralgia (TN), involving the 5th cranial nerve, is a kind of chronic neuropathic pain disorder that presents with clinical features like frequent attacks of intolerable facial pain. Nearly, 85% of the patients affected by TN have shown vascular contact with the nerve and its branches [4]. Sometimes, tumours in ITF are the cause for secondary TN [5].

Dental anaesthesia: A failure rate of 15-20% is noted in the IAN block techniques associated with multiple complications, including haematoma [3]. Gow-Gates technique, which targets the neck of the mandibular condyle and blocks the mandibular nerve at foramen ovale, and anaesthetises all divisions, has an efficacy of 84% in patients with irreversible pulpitis, whereas the IAN block technique has 69% efficacy [6]. In the present case, the IAN was formed by two roots, with the maxillary artery positioned between nerve loop, there are high chances of, unexplained haematoma formation during administration of local anaesthesia.

Neurovascular compression: According to the literature, the primary cause for TN is due to compression of the trigeminal nerve at pons level by branches of posterior cerebral arteries [5]. But it is important to consider that the pulsation of the artery entrapped in ITF between the nerve roots can lead to complications of neurovascular compression such as numbness, regional pain and headaches. In the present case, compression of maxillary artery by either the deep or superficial root may result in Tic Douloureux. Vascular rupture of the pseudoaneurysms involving maxillary artery may cause facial pain due to involvement of IAN [7].

Embryological aspect: Fifth cranial develops from the first pharyngeal arch and IAN develops during 46-51 days of gestation [8]. The angiogenesis of maxillary artery occurs earlier to IAN formation. During the formation of the nerve, the neural crest cells migrate towards the target organ. As the maxillary artery is already formed, the migratory neural crest cells pass around the maxillary artery. A hypothesis can be built, that abnormal migration and abnormal number of neural crest cells during embryogenesis, could be the reason for such variation. The sensory and motor components of IAN might be separately carried by the deep and the superficial roots. The motor component of IAN is carried by nerve to mylohyoid [9,10].

Comparison of similar variations reported by other authors from cadaver dissection are shown in [Table/Fig-3]. There is similarity in formation of two roots of IAN around maxillary artery observed more frequently on the left side in reported cases, though no statistical inference can be drawn except study reported by Wolf KT et al., and Azerado R et al., reported bilateral variation [11,12]. There are reports of communication between LN and IAN by Jha S et al., Wolf KT et al., and Sandoval MC et al., [10,11,13].

Sl no.	Author and year	Gender and age	Laterality	Observations
1	Sandoval MC et al., [13] 2009	Male 54 y	---	A communication between the IAN and LN through a connecting root. Maxillary artery passing in the juncture formed between IAN and LN.
2	Wolf KT et al., [11] 2016	Female 87 y	Bilateral	IAN formed by two roots around the maxillary artery. A nerve connecting the LN and IAN was observed.
		Male 92 y	Left	A nerve communicating with the LN and IAN was observed on left-side.
3	Azeredo RA et al., [12] 2016	Not reported	Bilateral	The variant branch of IAN was a recurrent branch towards superior, posterior and medial entering in the Lateral Pterygoid Muscle before the nerve to mylohyoid muscle.
4	Babu PB et al., [9] 2011	Male	Left	IAN was noted to arise as two distinct long roots, and the nerve to mylohyoid originated from the deep root, and later the two roots merged
5	Jha S et al., [10] 2017	Male	Left	IAN formed by union of the deep and superficial roots from the post division of Mandibular nerve in relation with the second part of the maxillary artery. LN was communicating with the deep root of IAN.
6	Maekawa S et al., [14] 2020	Male 74 y	Left	Three minor branches arising from the mandibular nerve, passing lateral to the maxillary artery (MA), and joining the IAN.
7	Nayak U et al., [15] 2020	Female 70 y	Right	Superficial root (14 mm) and deep root (20 mm) in relation to second part of the maxillary artery were from the posterior division of Mandibular nerve. Later nerve to mylohyoid arises below 10 mm after convergence. Length of MA 69 mm
8	Present case, 2026	Male 65 y	Left	IAN was formed by superficial (23.07 mm) and deep (31.88 mm) roots from the posterior division of mandibular nerve, encircling the second part of MA (50.55 mm) nerve to mylohyoid arises 12.56 mm below convergence

[Table/Fig-3]: Comparison with studies reported by other authors [9-15].

Radiologists, dentists and maxillofacial surgeons should have a profound understanding about the anatomical variations of the neurovascular structures in infratemporal region to avoid errors in diagnosis and complications during management.

CONCLUSION(S)

The entrapment of the maxillary artery within the roots of the IAN, as observed in the present case, is a rare anatomical variation with imperative implications for avoiding surgical complications to achieve successful pain control and the dental researchers will be able to study the effectiveness of the nerve block and complications following regional anaesthesia. The knowledge of the variations is also essential for radiologists, dentists, and oncologists to perform procedures in this region. Also, it can be taken into consideration in relieving approach during idiopathic neuralgia.

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