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Inferior Alveolar Nerve Paraesthesia Resulting from Orthodontic Treatment: A Case Study

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Introduction

Inferior alveolar nerve paraesthesia has been widely reported in the literature, which mainly focusses on surgical procedures (orthognathic surgery, extractions, etc.), tumor's (compression and removal), neuropathies, endodontic therapy, etc. However, due to the nature of its presentation, only a small number of clinical cases have been directly linked with orthodontic treatment. For this reason and due to the difficulties of differential diagnosis that the clinician may encounter when attempting to verify this assumption, we have conducted a brief review of this phenomenon. The symptoms and signs that accompany this disorder are described and illustrated by means of a case study.

Aetiology and Pathogenesis

According to the international association for the study of pain [1-4], paresthesia is regarded as an abnormal sensation, not experienced as unpleasant, regardless of whether it is spontaneous or provoked. The most frequent form is described as a tingling sensation that appears when a nerve is compressed, associated with numbness of a bodily area. It is not always perceived as painful. The following table gives a list of the various causes that can lead to inferior alveolar nerve paresthesia (Table 1).

Local Factors	Systemic Factors		Others
	Collagen diseases	Benign trigeminal sensory neuropathy infections	Metabolic disorders: Hypothyroidism and Diabetes
Orthognathic surgery	Lupus Erythematosus	Herpes Zoster virus	Hypovitaminosis
Dental extractions (lower third molars and premolars)	Dermatomyositis	Herpes simplex association	Paget's Disease
Iatrogenic post extraction injuries	Progressive Systemic Sclerosis	Tetanus	Demyelinating diseases (Multiple Sclerosis)
Local infections (periapical, periimplantar, osteomieltis) [2,3]	Sjogren's Syndrome	Syphilis	Stroke
Trauma (cranial, mandibular fractures)	Rheumatoid Arthritis	Leprosy	Transient ischemic attack
Nerve block anaesthesia	Mixed connective tissue disease	AIDS	Vertebrobasilar Vascular Diseases
Implantology			Sarcoidosis
Endodontic therapy			Amyloidosis
Pre-prosthetic surgery			Sickle cell anaemia
Impacted teeth			Metastasis (breast cancer, lymphoma)
Orthodontics			Reactions to medication [2-7]
Local tumors (benign, malignant) or cysts			Psychogenic syndromes

Table 1: Causes of inferior alveolar nerve paresthesia.

The mechanisms that causes neural injury may be:

- **Mechanical:** Compression, stretching, total or partial resection and laceration.
- **Chemical:** Resulting from toxic components of sealant materials and of irrigation in endodontics; due to the alcohol group of local anesthetic's, or inflammatory products from tissue damage or bacterial products following a periapical infection.

- **Thermal:** Due to overheating of the bone caused by the surgical hand piece [2,6,7]

In orthodontics, temporary paresthesia of the inferior alveolar nerve (IAN) has been linked with the following isolated situations or combination of several situations:

- Lingualized straightening of premolars [8-13]
- Traction of impacted premolars [7,8]
- Excessive length of roots [3,5,7,8]
- Intrusion of second and/or third molars [5,14-19]
- Anatomical variations in the IAN canal [8,9]
- Lack of bone around the IAN [7,8,17]

Anatomical recap

The inferior alveolar nerve (IAN) is the thickest branch of those making up the posterior trunk of the mandibular nerve (V3 or third branch of the trigeminal nerve). Before entering the mandibular foramen, it branches off into the mylohyoid nerve, which descends stuck to the inside of the jawbone along with the artery of the same name below the mylohyoid muscle. It is accompanied in the dental canal by the inferior alveolar artery up to the mental foramen (up to the first lower premolar), where it divides into its two terminal branches: the mental nerve and the incisive nerve. Finally, it splits up into small nerves forming the inferior dental plexus of premolars and molars. The mental nerve emerges through the mental foramen, outside the quadratus mentalis muscle. It innervates the skin of the chin, gums and lower lip. It may be anastomosed with the facial nerve and the cervical plexus via which it can innervate the lower premolars and the mesial root of the first molar by means of sensory fibers.

The incisive nerve continues the intraosseous path of the inferior alveolar nerve up to the mental symphysis. It innervates the teeth and the periodontium of the lower incisor-canine group. When it becomes independent from its trunk before the mental foramen, it also innervates the premolars.

Knowledge of the morphology and topography of the mandibular canal is important for carrying out any kind of dental intervention [20-24]. Lesions of the mandibular canal can cause bleeding and neurosensory abnormalities, usually occasioning temporary or permanent paresthesia. These lesions may be facilitated by poor planning of dental treatment and in some cases by anatomical variations in the morphology and topography of the mandibular canal. The most accurate radiographic technique used to identify the mandibular canal is cone beam computed tomography (CBCT).

Prevalence

The teeth most involved in the processes of paresthesia are the second premolars and second molars (ratio 4:2) [8,11]. This fact may be related to the confinement of the IAN within the limits of the mandibular cortical plates and its proximity to the apices of the premolars. Along its path from the mandibular foramen to the mental foramen, the neurovascular bundle is in contact with the lingual cortex of the mandible [3,11]. The channel describes an upward curve that allows the mental nerve to exit through the mental foramen. This curve brings the second premolar and second molar closer to the nerve. In the molar area, cortical spacing is relatively wide. The width of the body of the mandible narrows in the premolar region; therefore, the neurovascular bundle occupies the entire area between the buccal and lingual cortices in the vicinity of the mental foramen. Due to the minimal medial and lateral dimension of the mandible at this point, any kind of pathology can affect the nerve due to its proximity to the apices of the premolars [11]. It affects more women than men in a ratio of 4:2 [8]. One of the most prevalent causes (60% to 70%) is paresthesia following orthognathic surgery. It is unusual, however, during conventional orthodontic treatment [3,5,7-9,13,15,17,19,20].

Clinical case study

15-year-old patient with sequelae of unilateral cleft lip and palate, referred by the Nino Jesus Children's Hospital (Madrid) in 2006 for a second phase of orthodontic treatment. The patient presented a Class II skeletal pattern as a result of maxillary hypoplasia and a Class III dental dolichofacial pattern, maxillary compression with a left posterior cross bite, anterior open bite and agenesis of the second upper and lower premolars.

Orthodontic treatment with fixed appliances was prescribed (MBT, 0.022" slot). After six months of treatment, tubes were cemented into the lower second molars, subsequently placing a 0.16 × 0.16″ Nitinol arch wire in position. The patient came for consultation reporting a tingling sensation and numbness in the mandibular area and lower lip on the left side. This sensation had begun the day after the last orthodontic follow-up appointment. Clinical examination revealed decreased sensitivity in the area corresponding to the inferior alveolar nerve (Figure 1).

Figure 1: Clinical examination of inferior alveolar nerve.

All the patient's teeth and gums were normal in appearance. No other dental treatment was performed in the weeks before or after the orthodontic follow-up appointment. The patient's sensitivity too cold and heat as well as pulp vitality tests were normal. Orthopantomography revealed the roots of the second molars to be very long and near the inferior dental canal (Figure 2).

Given the possibility that the root of the lower second molar was compressing the nerve, it was decided to remove the tube and release the molar from any orthodontic stress. Pharmacological therapy with NSAIDs (Ibuprofen 600 mg, 1 tablet every 8 hours for 3 days) and a vitamin B complex group (Hydroxyl B1-B6-B12®, 1 capsule daily for 2 weeks) were prescribed. The CBCT scan revealed the close relationship between the apex of the lower second molar and the alveolar nerve canal located lingual to the roots of the molar (Figure 3).

Figure 2: Orthopantomography of inferior dental canal.

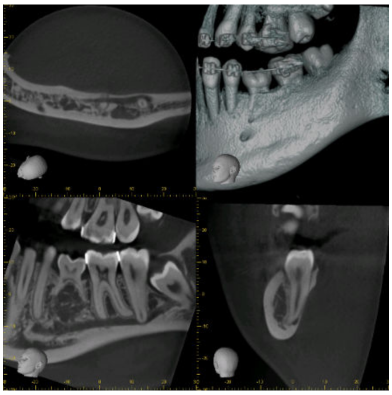

Figure 3: CBCT scan.

In subsequent periodic reviews, recovery of sensitivity was observed with paresthesia disappearing completely after three weeks without leaving any other sequela.

Discussion

As far as we know, ten cases of paresthesia of the lower lip associated with orthodontic treatment have been reported in the literature. Five of these were attributed to the lower second molar, four to the lower second premolar and one case was related to intrusion caused by occlusal stops in the lower third molar. In all cases, the condition was resolved within 48 hours and the arch wire was removed two months later [3,5,7,8]. In almost all cases, the onset of paresthesia coincided with the changing of the arch wire, as in the present case.

Paresthesia of the lower lip as a result of orthodontic treatment seems to be related to the proximity of some tooth roots to the mandibular canal [3,9]. Therefore, the distance between the apices and the mandibular canal is a factor to consider before commencing orthodontic treatment [16]. According to the literature, it is rare for there to be a close relationship between the roots of the first and second molar and the mandibular canal [7], proximity of the nerve root to the lower premolars being more common [7,11].

This is so, seeing as the mandibular canal is usually located more towards the vestibular region at the level of the roots of the molars and a little less so at the level of the premolars. Only in rare cases is the mandibular canal found lingual to the roots [9]. In addition, Farronato [7] states that anatomical variation may appear in ectopic or impacted teeth, in teeth with very long roots, or in the case of mandibular bodies of low height [7,9].

Furthermore, when there is an intimate relationship between the apices and the mandibular canal, the bone bordering the canal is usually more deficient [7]. This could be the cause of "almost immediate" labial paresthesia as a result of treatment with fixed appliances. Some authors [6] report the existence of a direct relationship between the duration and extent of the injury to the nerve and the prognosis of paresthesia.

In our case, the rapid recovery achieved on removing the tensile stress 5 days after the onset of paresthesia supports the theory that the cause was ischemia due to compression. Although orthodontic treatment is a potential cause of paresthesia, if the symptoms do not begin to subside two weeks after inactivating the orthodontic appliance, the case will require a more thorough examination to rule out other abnormalities not visible on the Orthopantomography [3,5]. This is so, given that the isolated neuropathy of a cranial nerve may be the first symptom of an intra- or extra-cranial focal lesion [3].

The phenomenon of paresthesia following orthodontic movement appears to originate due to invasion of adjacent neurovascular structures. Although the mandibular canal path can be classified using radiographs, only 3D dental imaging systems have been able to show the interrelationship between intraosseous structures (nerves and tooth roots) [5,12,15]. The CBCT imaging system has a higher sensitivity (93% *vs* 70%) and specificity (77% *vs* 63%) than radiography [5].

In recent reported cases of paresthesia resulting from orthodontic treatment, CBCT has also been used in addition to carrying out a panoramic radiograph to discern the relationship between the mandibular canal and the roots of the molars, as it is not possible to demonstrate a direct relationship between the root and the nerve by means of a simple radiograph. In our case, CBCT has enabled us to distinguish the influence of the tooth root on the neurovascular bundle. CBCT is a very useful tool for preventing the risk of nerve injury when performing orthodontic treatment [7,12,16,19].

Conclusion

Inferior alveolar nerve paresthesia is a possible complication of orthodontic treatment. Before positioning the appliance, it is advisable to assess the risk resulting from the anatomy or position of the dental apices in relation to the neurovascular complex by means of CBCT. This enables us to know the precise anatomical relationship of the dental apices with these structures, thus allowing us to prevent paresthesia or, if it should appear, to determine its cause and act accordingly. This diagnostic option should even be included in the informed consent of susceptible patients. When orthodontic treatment is the possible cause of paresthesia, the fixed appliance should be inactivated. If the symptoms do not begin to subside after two weeks, the case should be referred for further study.

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