Management of lingual nerve injury: a case report

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Neurological lesions of the lingual nerve (LN), during general dentistry and oral surgery practice, are still frequent nowadays, despite the existence of three-dimensional diagnostic radiology, stereolithography, up-to-date surgical techniques and instruments with sonic and piezoelectric technology resulting in a gentler treatment of soft tissues.

Abstract

One of the most common complication associated with oral surgical procedures are iatrogenic injuries to lingual branch of trigeminal nerve. Lingual nerve damage may result in permanent lingual sensory deficit leading to symptoms, including lost or altered sensation and the development of unpleasant neuropathic pain, with consequent impaired quality of life. The surgical removal of mandibular third molars is one of the most common oral surgical procedures and it is associated with a number of perioperative complications, including nerve injuries. This paper show how to manage lingual nerve injuries.

Keywords: lingual nerve injury, third molar extraction, paresthesia, neurorrhaphy.

Anatomy

The LN is a sensory branch of the third trigeminal branch and provides tactile and thermal sensitivity of the oral floor and the anterior two-thirds of the tongue. This nerve also distributes the visceral efferent and visceral afferent fibers of the intermediate facial nerve transmitted through the chorda tympani: the former reach the submandibular and sublingual salivary glands, the latter follow the fibers of the lingual nerve to the taste buds. Once separated from the mandibular nerve, it runs between the internal pterygoid muscle and the medial wall of the mandibular ramus. At the retromolar trigone and molar (particularly the third) level, the nerve runs on the upper medial margin of the alveolar ridge and can be very superficial. The LN then runs into the oral floor and terminates in the lingual pelvis (1).

Anatomical studies of the LN mainly focus on its course at the oral cavity floor and the retromolar trigone level, as it is most susceptible to injury during surgical procedures (2-6). In a cadaver dissection study, 669 LNs were analyzed. 14.05% were located above the lingual crest, 0.15% in the retro molar trigone and 85.80% in the typical position, i.e. at a vertical distance from the lingual crest of 3.01±0.42 mm and at a horizontal distance from the lingual plate of 2.06 ± 1.10 mm (7).

In its typical position, the LN, in 23.27% of the cases, is directly in contact with the lingual plate of the alveolar process. However, when the LN is located in the retromolar area, it runs between the mandibular ramus and the medial pterygoid muscle, instead of proceeding in its normal course along the medial surface of the mandible and lying near the roots of the third molars. It heads towards the retromolar trigone, then it runs posterior to the third molar and, finally, it descends at an acute angle in the direction of the medial surface of the mandible, resuming its normal course (8).

Aetiology of lingual nerve injury

The most frequent cause of LN lesion is to be sought in the extraction surgery of the lower third molars: LN is, in fact, damaged during 0.6-2% of extractions of these tooth elements (9, 10). However, implant surgery, removal of calculi from the Warton's duct, treatment of ranula located in the postero-lateral portion of the mouth floor, removal of mandibular cysts, of impacted or supernumerary teeth, of benign lesions or demolition for malignant neoformations, orthognathic surgery, osteoradionecrosis, osteomyelitis and maxillofacial trauma may also be among the causes of LN injury (11, 12).

Performing truncular anaesthesia can also cause neurological injury. The incidence of temporary injuries of the LN following the performance of truncular anaesthesia ranges between 0.15% and 0.54%, while permanent ones range 0.01% approximately (13, 14).

The etiopathogenetic mechanism may be related to a needle injury, to the potential neurotoxicity of the anaesthetic agent and its ischaemic effect with possible subsequent degeneration of axons (15).

Classification of nerve injuries

The most widely used classification for assessing neurological impairment is Seddon's classification of 1943, which identifies three types of nerve injury:

- Neuropraxia: consisting of a conduction block, related to compression or stretching of a nerve trunk during surgery or postoperative perineural edema. Stimulating the axon in the proximity of the lesion causes no distal response, while stimulation downstream gives a completely normal response. Neuroapraxia allows spontaneous and relatively rapid healing.
- Axonotmesis: characterized by anatomical interruption of the axons, while preserving the nerve sheaths. The distal nerve stump undergoes Wallerian degeneration, while the proximal stump degenerates as far as the first node of Ranvier. Nerve regeneration is possible and restarts from the intact proximal stump at a rate of about 1 mm per day, following the guide shown by the intact nerve sheaths. Functional recovery can be achieved upon complete regeneration. However, it may also require a few months.
- Neurotmesis: consisting of interruption of both the axons and the nerve sheaths. In this way, spontaneous regeneration is not possible and surgery is required (16-18). In 1951, Sunderland considered it appropriate to divide axonotmesis into two degrees of severity, based on the nerve's ability to recover full or partial function, and neurotmesis into two further levels, based on the continuity or discontinuity of the nerve, thus proposing a classification into five degrees of injury (19). In 1989 Mc Kinnon added a sixth degree, in relation to an injury involving several fascicles in the same nerve (20).

The patterns of LN injury in oral surgery are heterogeneous and depend on both the type of surgery performed and the instruments used. They can be summarized into a few groups: compression damage, stretch-induced damage, partial or complete resection damage. Compression of the LN can occur as a direct consequence of an improper use of surgical instruments such as retractors, elevators, malleable spatulas, specifically employed to protect this nerve structure. The prognosis is generally good and restitutio ad integrum usually occurs within a couple of weeks to a couple of months.
Stretch injury is caused by the traction of the nerve along its major axis and the consequent extension of the same nerve. In this case, the resolution of symptoms may occur within 6 months. Partial and total resections occur through accidental trauma with surgical instruments or through displacement of the lingual plate of the alveolar process, e.g. during extraction of mandibular third molars. In the case of partial resection, recovery, albeit partial, may require up to 12 months. On the contrary, a clean cut of the nerve results in the formation of two stumps, and the prognosis is poor, as spontaneous functional recovery is not possible. This is due to the retraction of the two stumps and the frequent formation of an amputation neuroma near the proximal stump, composed of axonal fibers and scar tissue, which generates spontaneous pain or touch-evoked pain.

Symptomatology of neurological lesions

The International Association for the Study of Pain (IASP) distinguishes the symptoms resulting from a nerve injury into:

- Anaesthesia: complete absence of sensitivity in the innervation territory.
- Paresthesia: altered sensitivity.
- Hypoesthesia: a decrease in normal sensation (to either tactile, thermal and painful stimuli).
- Hyperesthesia: an abnormal increase in sensitivity to stimuli. In the case of a painful stimulus, it is described as hyperalgesia.
- Dysesthesia: altered sensitivity associated with burning/pain. This sensation, most unpleasant for the patient, can be either spontaneous or triggered by a stimulus that is not typically pain-inducing (Allodynia). The altered sensitivity of the tongue involves only the affected half that is related to the injured nerve. The patient reports a feeling of "swollen tongue" determining eventual discomfort: a frequent morsicatio of the lingual margin with consequent traumatic lesions, while the decreased proprioceptive capacity within the oral cavity may compromise food distribution between the dental arches and the act of deglutition, phonatory difficulty, and partial taste alteration. When the main symptom is pain, and not anaesthesia, the quality of life is greatly impaired because the patient experiences spontaneous pain despite the absence of tactile and gustatory sensitivity of the tongue.

Timing and injury management

In the case of a confirmed LN injury, there are two possibilities. The first is the immediate repair, through microsurgical procedure, of the iatrogenic damage occurred accidentally during another scheduled treatment. This particular situation requires the surgeon to be skilled in microsurgery, as well as the available suitable instrumentation, high-magnification loupes, or, even better, a surgical microscope. In addition, it is essential to be able to perform the surgery under balanced general anesthesia, in order to ensure complete anesthesia of the affected nerve and immobility of the patient throughout the procedure. If the above conditions are not feasible, the microsurgical repair should be performed as soon as possible, preferably within a month.
However, it is not always possible to make an immediate diagnosis of a confirmed LN injury, as such an incidental event may occur during noninvasive procedures. The pain felt by the patient in the intraoperative phase is therefore often mistaken for a failure of local anaesthesia during dental treatment, thus making it difficult to diagnose neurotmesis from compression or stretch. In addition, it is often the patient, during the days following the treatment, who reports to the dentist discomfort or altered sensitivity of the tongue.
Once the diagnosis of nerve damage has been made, a follow-up period of at least three months is needed in order to assess any possible improvement in the symptomatology, or to decide if surgical procedure is necessary. During the follow-up period, subjective assessment tests of sensitivity should be performed, stimulating the tongue with pressure stimuli at different points and re-

cording any eventual improvement. If the anaesthesia does not disappear after 3 months or if the hypoaesthesia does not improve within 8 months, surgical treatment of the lesion should be considered (21).

The repair of nerve damage in case of anaesthesia can be performed using different techniques, depending on the overall clinical situation.

The neurorrhaphy technique consists of reconstructive suture of the two nerve stumps. There are four types of peripheral nerve reconstruction: epineural, perineural, epi-perineural and fascicular suture. Neurorrhaphy is performed using epineural sutures, in a circumferential manner. The lingual nerve, in fact, has a diameter ranging from 1.5 to 3 mm and the individual nerve fascicles are not distinguishable within it. Therefore, perineural or fascicular suture cannot be performed. Such procedures are more suitable for larger nerves or well-defined nerve bundles, as for example the brachial plexus. The suture of the two nerve ends must be performed without any tension with 8-0 sutures made of a perfectly tolerated and non-absorbable material, in order to avoid foreign-body reactions along with scarring and subsequent failure of the procedure.

Once the two nerve ends have been identified among the soft tissues, obtaining a tension-free juxtaposition should not be very complex, as it is possible to slide them and reapproximate the two ends. It must be considered that at the lesion site there may be a neuroma, either traumatic or resulting from amputation, which must necessarily be resected, in order to allow the juxtaposition of the two ends with exposed healthy non-scar tissue. This manoeuvre may not allow the execution of a tension-free suture and make it necessary the use of a connecting graft.

The graft used may be autologous and taken from the greater auricular nerve. This technique involves an increase in surgical time, greater morbidity in the patient, possible formation of a neuroma at the donor site with subsequent pain and sensation loss of the auricle. To overcome these problems, it is possible to employ a homologous graft, using a deantigenated and sterilised donor-derived nerve tissue that, while maintaining the natural epineural sheath, acts as a scaffold for possible guided axonal regeneration (22-28).

A further possibility is the use of synthetic biological conduits and guides (first generation), resorbable collagen type I conduits (second generation), or conduits containing stem cells (third generation) which are currently being studied and tested (29, 30). When painful symptoms of severe dysesthesia without regression occur a few weeks after the traumatic event, intervention by performing neurolysis is necessary. This consists of freeing a compressed nerve from a pathological adhesion, e.g. scar tissue, to allow the recovery of its functionality. There are two techniques of neurolysis. Troncular neurolysis is a procedure that involves the liberation of the nerve from compression alongside its entire circumference. It is performed when the nerve is suffused with fibrous tissue attributable to an injury in neighboring tissues. Fascicular neurolysis is performed on an injured nerve visualized under a microscope and consists of removing the fibrous tissue surrounding each individual filament.

Management of lingual nerve injury: Case report

T.I., a 30-year-old female patient, underwent an extraction surgery of the mandibular lower left third molar under local anaesthesia (Fig. 1). During the extraction, the distal root of the lower left third molar was accidentally dislocated into the soft tissue on the lingual side. After attempting an intra-alveolar recovery of the remnant, the procedure was suspended and a suture performed, as a significant amount of time had passed since the extraction. In addition, the excessive bleeding of the site and the consequent impossibility of having a clear view

Figure 1. Preoperative orthopantomography of the lower left third molar extraction surgery.

to identify the fragment, the increase in perceived pain, the consequent state of agitation of the patient and the increasing stress for the dentist, led to a picture that was no longer manageable in an outpatient dental clinic environment of basic level.
The days following the extraction, the patient immediately reported classic symptoms of anaesthesia of the tongue in the left side, followed by periods of dysesthesia and burning. However, she was treated for the first six months using NSAIDs, cortisone, and B-complex vitamins, probably hoping for a resolution of the damage despite the root remnant being dislocated in the soft tissues.
The patient arrived at the U.O.C. (Complex Operative Unit) of Oral Surgery and Odontostomatology A.S.U.R. Marche (Regional Healthcare Agency), A.V. 2 (Provincial Administration) of Ancona where she was examined. The objective oral examination revealed injuries from biting. Moreover, complete lack of sensitivity of the left tongue was ascertained using the three assessment tests: puncture test, tactile test and proprioceptive discrimination test. Dysesthesia and persistent burning sensation also made normal oral hygiene manoeuvres painful for the patient. A CTA and a new orthopantomography were conducted (Fig. 2). Radiographic examinations showed the presence of the root remnant and a discontinuity of the lingual alveolar wall of the lower left third molar (Fig. 3-8). Surgery to remove the root remnant, along with the concomitant attempt to repair the nerve lesion, was then scheduled under balanced general anaesthesia, although the recommended timing had already passed.

Figure 2. Postoperative orthopantomography of the lower left third molar extraction surgery.

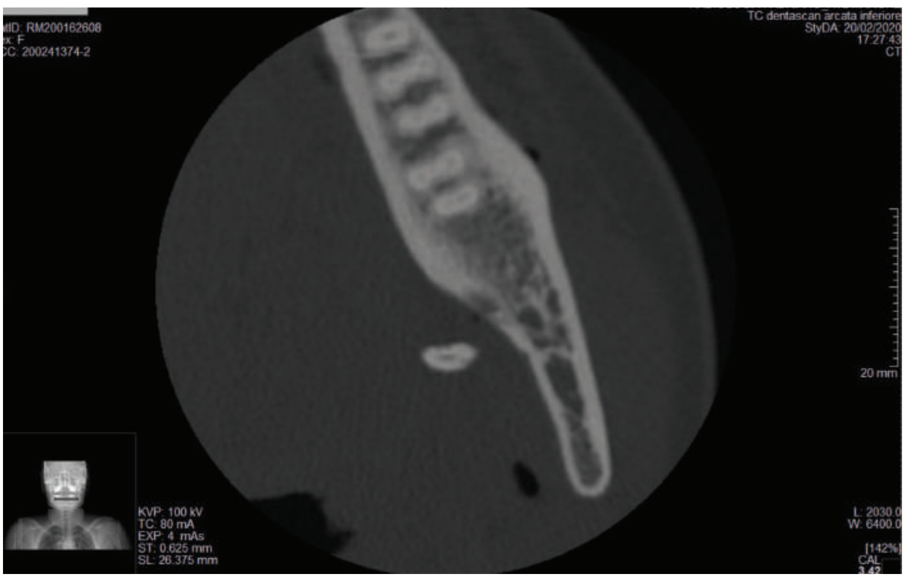

Figure 3. CBCT.

Figure 4. CBCT.

Figure 5. CBCT.

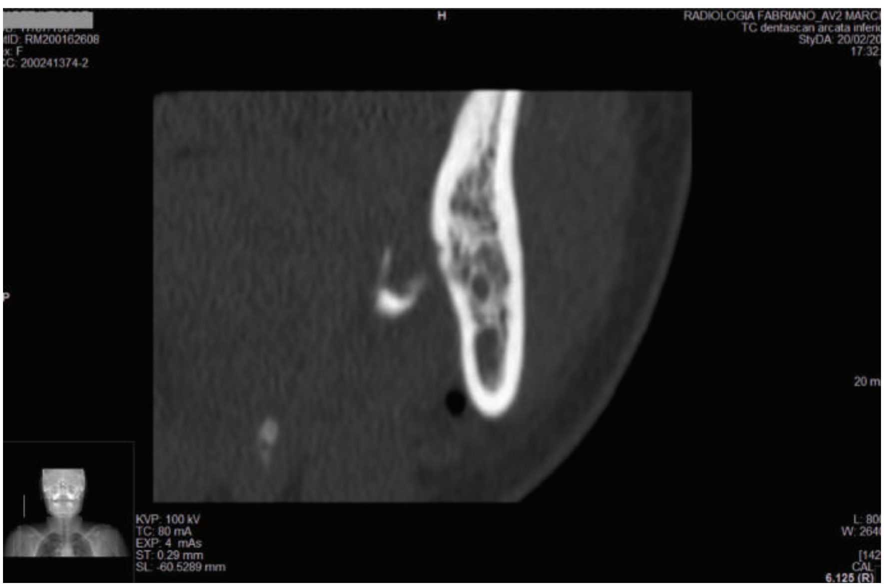

Figure 6. CBCT.

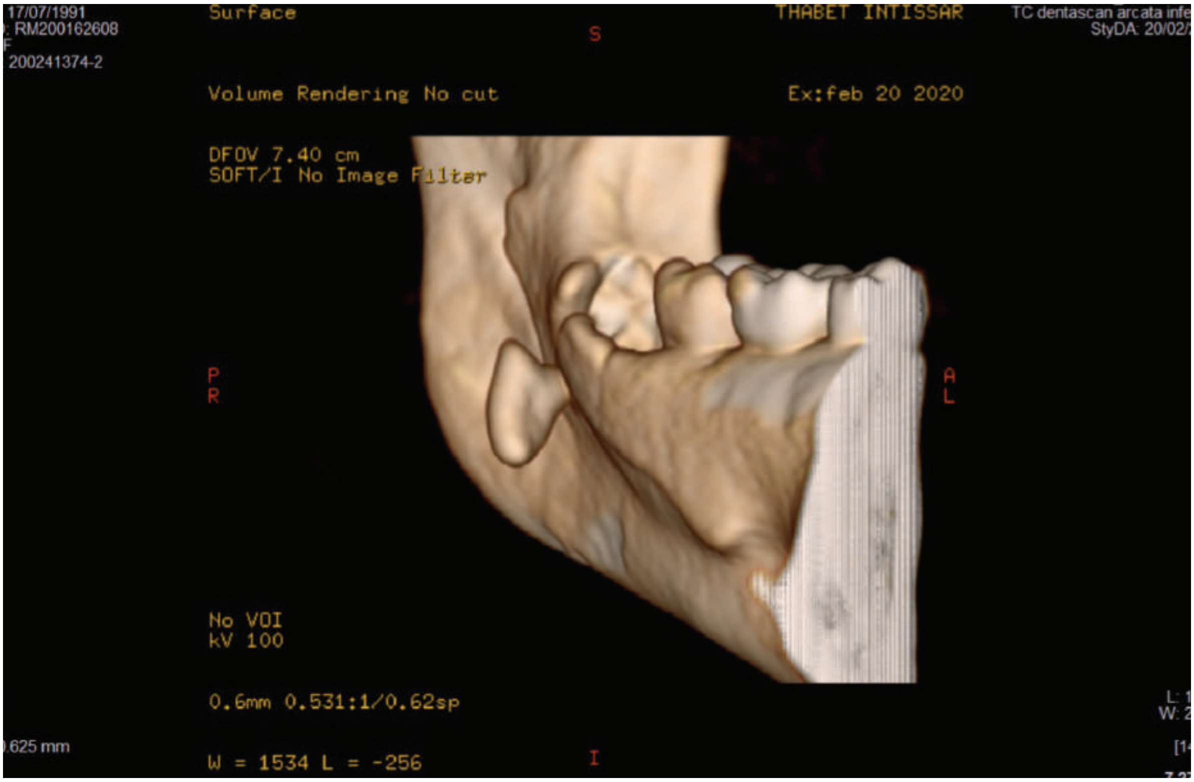

Figure 7. CBCT.

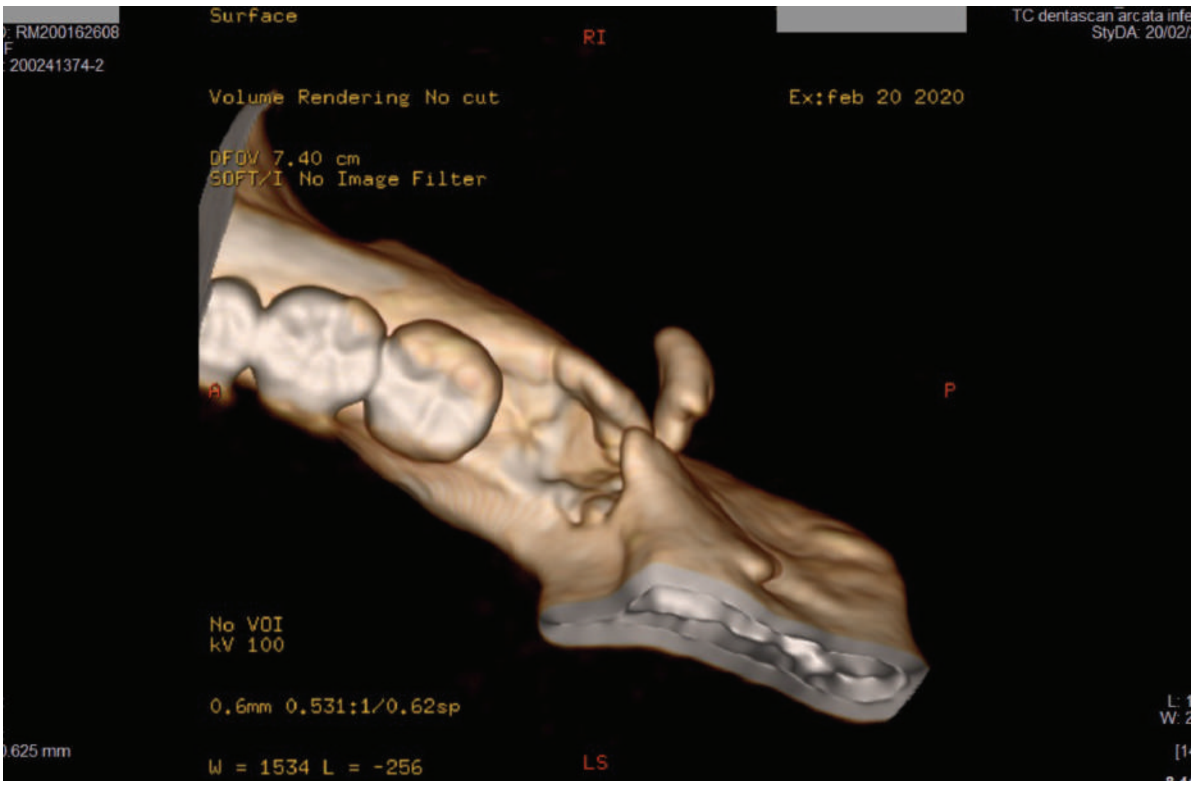

Figure 8. CBCT.

Once the state of narcosis had been induced, the left retromolar trigone and the left oral floor, both distally and mesially, were infiltrated with adrenaline to achieve optimal bleeding control (Fig.9).
A full-thickness incision was performed using an electrosurgical unit, in the attempt to follow, as much as possible, the scars of the previous surgery. The surgical field was widened lingually in order to clearly expose part of the upright branch of the mandible and part of the root remnant up to the premolar region.
At first, the root remnant had to be located through the soft tissues by the maxillofacial surgeon, who dissected them using blunt dissection technique. Once located, the fragment was removed by a Klemmer forcep (Fig.10-11). Performing again the atraumatic blunt dissection technique, the ends of the injured LN were isolated. The ma-

Figure 9. Preoperative image.

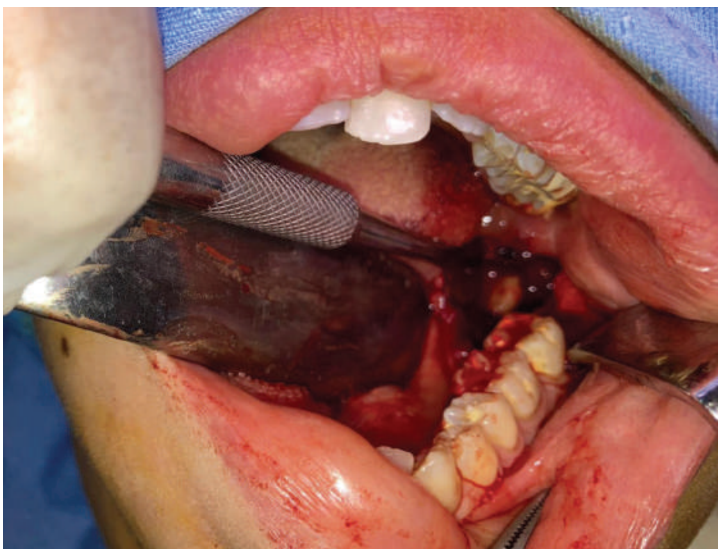

Figure 10. Operative phase of isolation and extraction of the dislocated root in soft tissue.

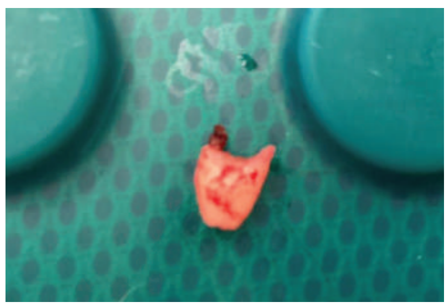

Figure 11. Detail of the removed root remnant.

noeuvre proved to be complex, as the nerve had actually been cut in two parts, a diagnosis which was never certain, because - as aforementioned - such lesion occurred during a noninvasive procedure, and this resulted in the consequent sliding and distancing of the two ends. In order to provide an effective recovery, an intraoperative microscope (under 16X magnification) was employed. Once the two ends were identified, a few millimetres of them were surgically removed to eliminate the scar tissue constituting the amputation neuroma and free them from the fibrous tissue that covered them, surrounding the neuroma. At this point microsurgical neurorrhaphy technique was performed using 8-0 polypropylene sutures (Fig. 12). After the subsequent washing of the surgical field, the operation was terminated by suturing the flaps of the incision (Fig. 13). Once discharged, the patient continued home treatment for three weeks, being administered antibiotic coverage therapy, together with

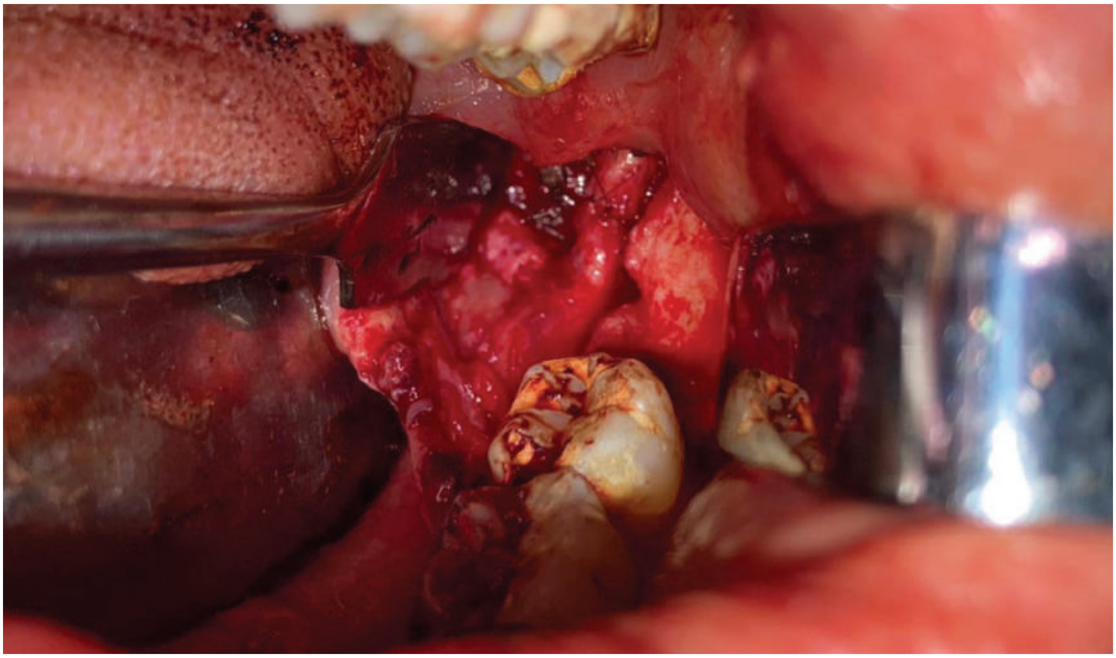

Figure 12. Detail of the suture of the neurorrhaphy.

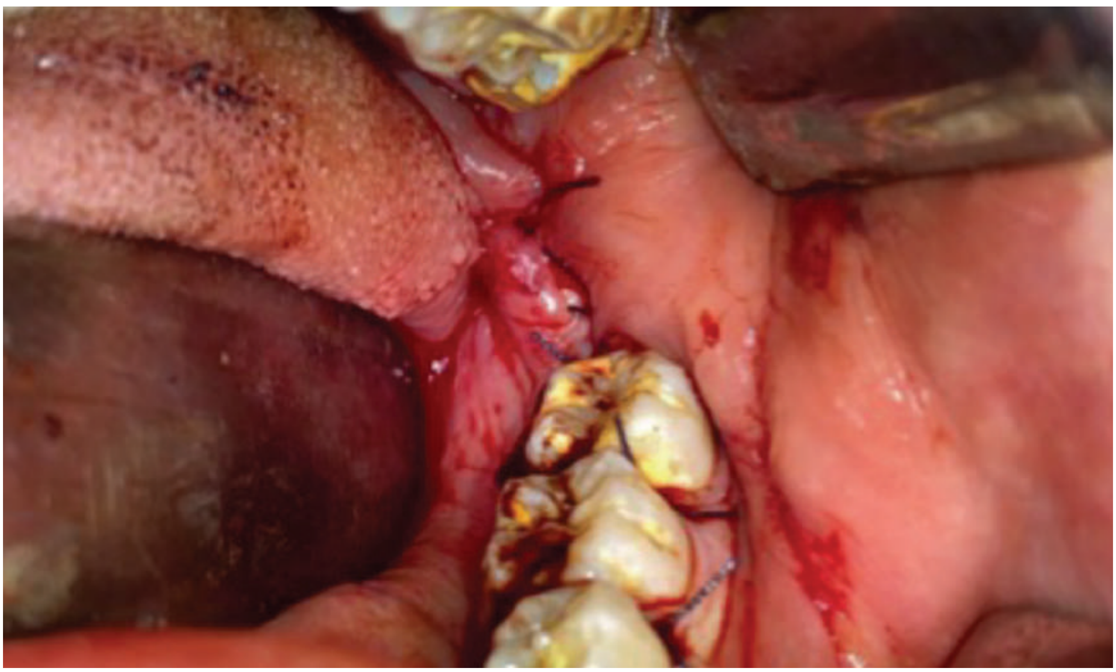

Figure 13. Suture.

NSAIDs and corticosteroids anti-inflammatory therapy and L-acetylcarnitine.
Eight months have passed since the neurorrhaphy surgery was performed, and during check-ups the patient no longer presents dysesthesia, hyperesthesia, burning pains, and the traumatic biting lesions have disappeared. Furthermore, she has resumed performing oral hygiene manoeuvres without any symptoms of discomfort. She reports an improvement in sensitivity on the ipsilateral lingual margin and dorsum, although far from being considered a restitutio ad integrum, it allowed her to resume normal chewing and physiological tongue mobility (Fig. 14). A delayed intervention has most certainly lowered the percentage of chances of a successful neurorrhaphy, nevertheless, performing this type of surgery has eliminated all that algic symptomatology reported by the patient and this, in neurology, can be considered a success.

Figure 14. Control at eight months after surgery.

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