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Case Report
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Inferior Alveolar Nerve Skeletization with Simultaneous Implants Placement– Buccal Cortical Plate Reposition Technique

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Abstract

Implant-supported prosthetic rehabilitation of atrophic posterior mandibular alveolar ridge is a real challenge for Implant Dentistry. The physiological inferior alveolar bone resorption after tooth loss associated with the presence of the inferior alveolar nerve limiting the available remaining bone for implant placement has led to the development of several techniques and materials to assist in the success of mandibular dental rehabilitation. The objective of this paper is to present through a case report a variation of skeletization/repositioning of the Inferior Alveolar Nerve (IAN) which promotes bone regeneration and early neurossensory function. Also, it will discuss aspects of diagnosis, planning and technical execution to allow this technique to be recognized as an accessible resource for the treatment of posterior region of atrophic mandible.

Keywords: Inferior Alveolar Nerve; Osseointegrated Dental Implants; Mandibular Osteotomy; Inferior Alveolar Nerve Skeletization

Abbreviations: IANS: Inferior Alveolar Nerve Skeletization; CBCT: Cone Bean Computed Tomography; PTFE: Polytetrafluorethylene

Introduction

The ongoing process of atrophy and remodeling of Inferior Alveolar Bone - IAB - after the loss of dental elements in the posterior quadrant of the jaw is a constant challenge to contemporary Implant Dentistry since it limits the installation and the correct placement of dental implants caused by interference of the inferior alveolar vascular nervous bundle running through this region. Various methods are described in the literature in order to rehabilitate the posterior region of resorbed jaw. Aiming at a better use of scarce bone tissue in these areas short implants were developed with 7 mm or even less [1,2]. Although well established as a viable option [3,4] especially when multiple and united by the above prosthetic structure, it is noted that greater insertion of dental implants inside bone tissue, increasing bone-implant contact surface, allows a better distribution of occlusal loads which results in a greater longevity of rehabilitation treatment [5,6]. Studies with appositional [7,8] and interpositional [9-11] block grafts, guided osseous regeneration using non-absorbable membranes of polytetrafluorethylene (PTFE-e) with titanium strengthening associated with particulate bone graft [12-14] distraction osteogenesis [15-17] and split crest technique [18,19] also appear as options to gain height and width aiming posterior implant placement. However, factors such as need for second surgical stage for installation of gum healers, autogenous donor site requirement and/or use of biomaterials and membranes, added to a high rate of local complications such as dehiscence and postoperative infection are appointed by some authors as disadvantages that discourage the holding of such techniques [20-23]. In contrast to those techniques, the Inferior Alveolar Nerve Skeletization (IANS), also known as Inferior Alveolar Nerve Lateralization or Inferior Alveolar Nerve Transposition or Inferior Alveolar Nerve Repositioning, presents itself as an alternative therapy in the management of posterior region of severely resorbed inferior jaw creating conditions for immediate installation of longer dental implants which will achieve the basal bone of cortical jaw favoring bicortical implant locking ensuring excellent primary stability that is an essential condition for osseointegration establishment [24-26]. Conceived by Alling [27] in 1977 as a means of controlling neuro sensory disorders caused by the pressure of prostheses on the mental nerve surgical protocol of the IANS technique was revised ten years later by Jensen and Nock [28] allowing simultaneous installation of dental implants in posterior regions of atrophic inferior jaws. The surgical technique is based on the exposure of the mandibular canal content through osteotomies along its path on the lateral side of the mandibular body starting from the clinical and radiographic location of the mental foramen. The vascular nervous bundle is then gently lateralized allowing conventional implant placement on the crest of the alveolar ridge then reducing the risk of injury to this anatomic structure [26,29,30]. The execution of IANS technique requires besides a high technical capacity and surgical experience, anatomical knowledge and skills to deal with potential complications intra and/or postoperatively such as neurosensory disorders (dysesthesia, paresthesia, anesthesia), mandibular fracture, osteomyelitis, bleeding and implants loss [31-34]. The neurological changes are frequent in a high percentage of operated cases being considered by some authors as a justification for the technique to be the last resource [35] or even fall into disuse [29]. Furthermore, advances in testing features images such as Cone Bean Computed Tomography (CBCT), changes in the design of the osteotomy and the use of piezoelectric technology has been raised in the literature in order to make IANS a safer procedure with more predictable results [36,37]. A clinical report illustrates this paper with a different IANS technique with the objective of promoting early bone healing and discusses the technical aspects which increase the technique predictability seeking to make it more exploited therapeutic application in clinical practice of Implant Dentistry.

Case Report

A 54-years-old female patient from Salvador - Brazil, on May 18th, 2010 sought oral and maxillofacial evaluation for bilateral rehabilitation of the posterior mandible with dental implants. Intra-oral examination showed absence of bilateral posterior teeth and a severe bone resorption in these regions which subsequently was confirmed by radiographic evaluation (Figure 1-3). After initial assessment a treatment proposal was set up for her and it was chosen by the patient the IANS technique with immediate installation of dental seven implants in two different surgical procedures. The elected surgical proposal contemplated surgery under local anesthesia in an outpatient setting associated with intravenous sedation monitored by an anesthesiologist. Preoperative pertinent exams were requested for the patient, informed consent explained and signed, instructions and a list of postoperative medications given. On the morning of the surgery day 8 mg of dexamethasone was given and maintained the same dosage twenty four to forty eight hours after surgery, plus 1 g of dipyrone every six hours for twenty four hours in case of slight pain and in case of strong pain codeine associated to paracetamol was available. Also 875 mg of amoxicillin combined with potassium clavulanate every twelve hours for seven days. Mouth rinsing with 0.12% chlorhexidine digluconate during seven days was indicated. Vitamin C and B complex were prescribed for about thirty days plus laser therapy (low-power laser). Intravenous sedation along with analgesic medications was administered before and during the surgical procedures, respectively. After antisepsis and anesthesia of the surgical site mucoperiosteal incision was carried out along the crest of the alveolar ridge extending from the retromolar region to the height of the lateral incisor. A relaxing incision was performed from the distal papilla of the lateral incisor to the bottom of the buccal fold. The dissection was performed detaching the whole flap with its elevation with the neurovascular bundle identified and carefully dissected to better flap mobility (Figure 4A-4B). Using piezoelectric ultrasonic device a rectangular bone window along the mandibular canal path was performed medially circumscribing mental foramen. The piezo-osteotomy involved only a buccal cortical plate thickness (Figure 5). In order to define boundaries and dimensions of the piezo-osteotomy some parameters were followed as described below:

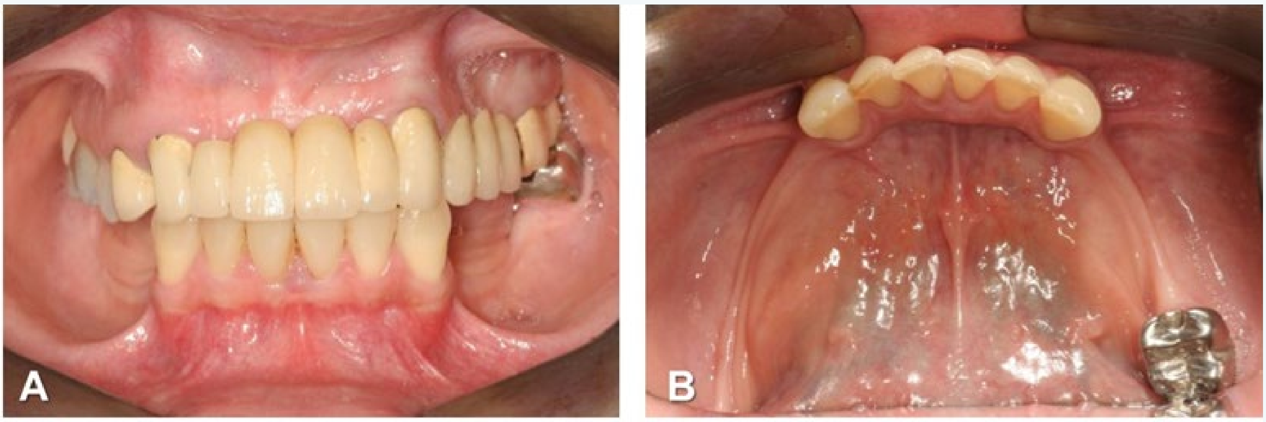

Figure 1A: Initial clinical aspect.
Figure 1B: Severe bone resorption of the inferior alveolar ridge in edentulous regions is observed.

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1. The top horizontal osteotomy was performed with approximate 5 mm distance inferiorly to the ridge crest minimizing the risk of fracture of the upper bone plate;
2. The lower horizontal osteotomy was 5-7 mm distally positioned from the top horizontal osteotomy seeking to create favorable conditions for later repositioning and semi-rigid fixation of the removed bone fragment, as well as to have a good access to nerve manipulation;
3. The posterior limit of the two horizontal osteotomies was 3 mm posteriorly to the intended position of the most distal implant previously determined by the surgical guide;
4. Before removing the buccal plate and expose the medullary bone four demarcations were made in the remaining bone structure and in the bone window for further guidance, reposition and semi-rigid fixation of the buccal bone plate.

Figure 2: Preoperative panoramic radiograph. Proximity of bilateral mandibular canal with the crest of the alveolar ridge can be seen.

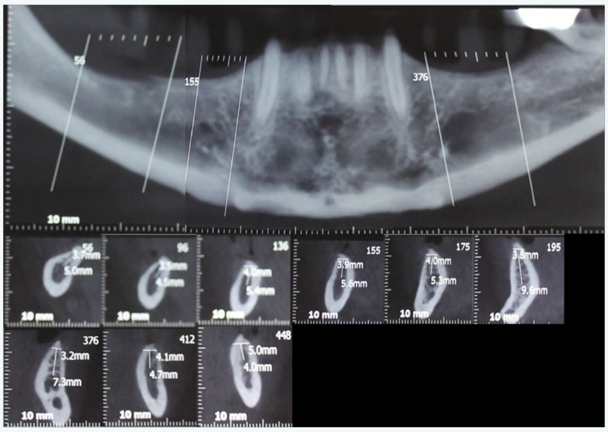

Figure 3: CBCT of edentulous regions. Reduced vertical bone availability is confirmed with this exam.

The buccal bone fragment was carefully displaced using chisels and delicate retractors. It was maintained inside sterile saline for posterior usage. With the aid of a honeycomb curette the remaining cancellous bone was removed creating conditions for neurovascular bundle exposure. After identification and release of the neurovascular bundle (Figure 6) it was pulled away and laterally displaced from the inner aspect of the mandibular canal using a gentle detacher allowing bone drilling and immediate installation of three dental implants measuring 3.75 mm x 13.0 mm on the left mandibular crest and four dental implants on the right mandibular crest measuring 3.75 mm x 13.00 mm (two), 4.1 mm x 13.0 mm and another one of 5.0 mm x 11.5 mm. During dental implant placement on the right side a thin fracture line running along the alveolar ridge crest affecting primary stability of the most distal implant was observed (Figure 7). The bone fragments were reduced with its inner face the bone through delicate piezoelectric scrapers wear to avoid compression of nerves at the time of adjustment and the particulate autogenous bone obtained by scraping maneuver was used for coating the threads of the implant. With the nerve gently reposition the bone holes were drilled at two points in its uppermost portion, and the upper jaw bone the remaining channel being relocated and stabilized with 2.0 of steel wire (Figure 8). Finally, the mucoperiosteal flap was repositioned and sutured with simple stitches with nylon 4.0. Postoperatively the patient developed bilateral paresthesia as expected and her follow-ups occurred within seven, fourteen, thirty and ninety days. Measurement of gradual paresthesia symptoms regression by gentle stimulation with needle and demarcation with a millimeter ruler (Figure 9-11) were recorded culminating in complete return of sensitivity within ninety days. The monitoring for this patient has been annually conducted for the past four years and she is in complete regression of paresthesia. Unfortunately the most distal implant on the right side which had lost its initial stability had to be removed nine months after its placement but it did not alter the final rehabilitation. The remaining dental implants are completely stable to the present date.

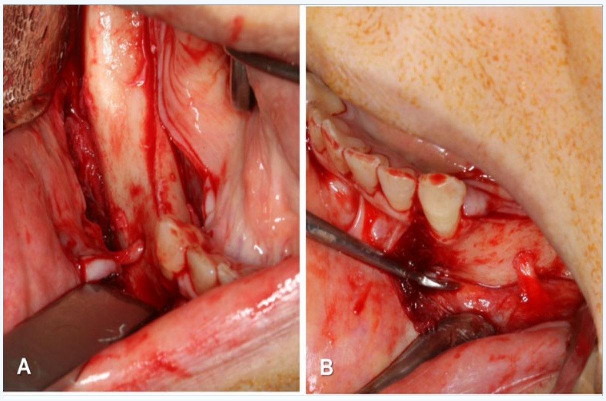

Figure 4: Surgical access and operative field visualization. Mental nerve was bilaterally exposed.

Figure 4A: Mandible right side.

Figure B4: Mandible left side.

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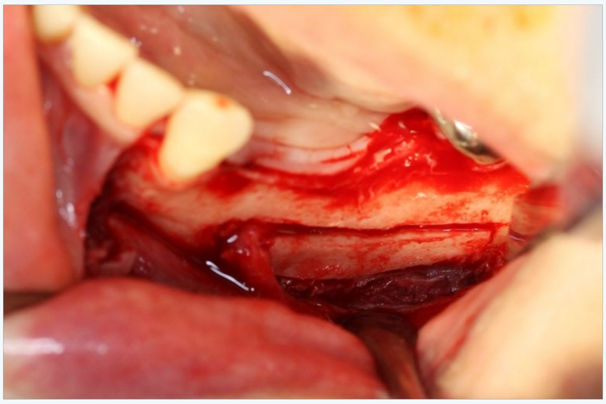

Figure 5: Piezo-osteotomy of buccal bone plate running along the mandibular canal on the mandibular left side.

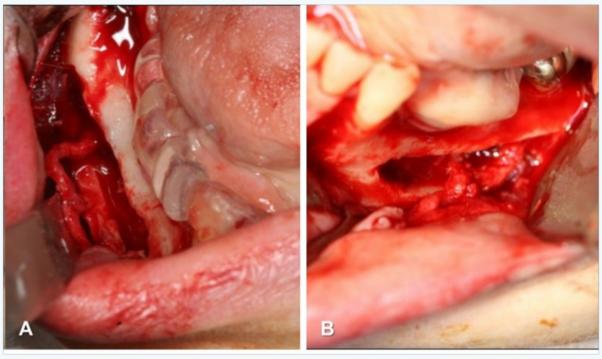

Figure 6: Presentation and delicate removal of the IAN.

Figure 6A: Right side.

Figure 6B: Left side.

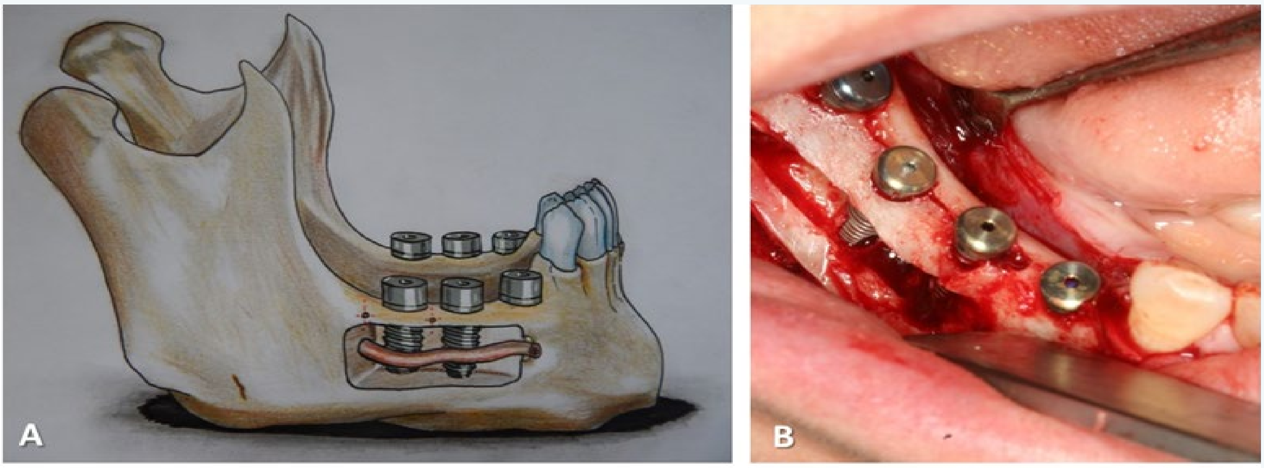

Figure 7: Dental implants placement after the lateralization of the IAN.

Figure 7A: Technical illustration of the surgical procedure.

Figure 7B: Dental implants installed on the right side referring to teeth numbers 27, 28, 29 and 30. Observe the fracture line running along the crest of the alveolar ridge.

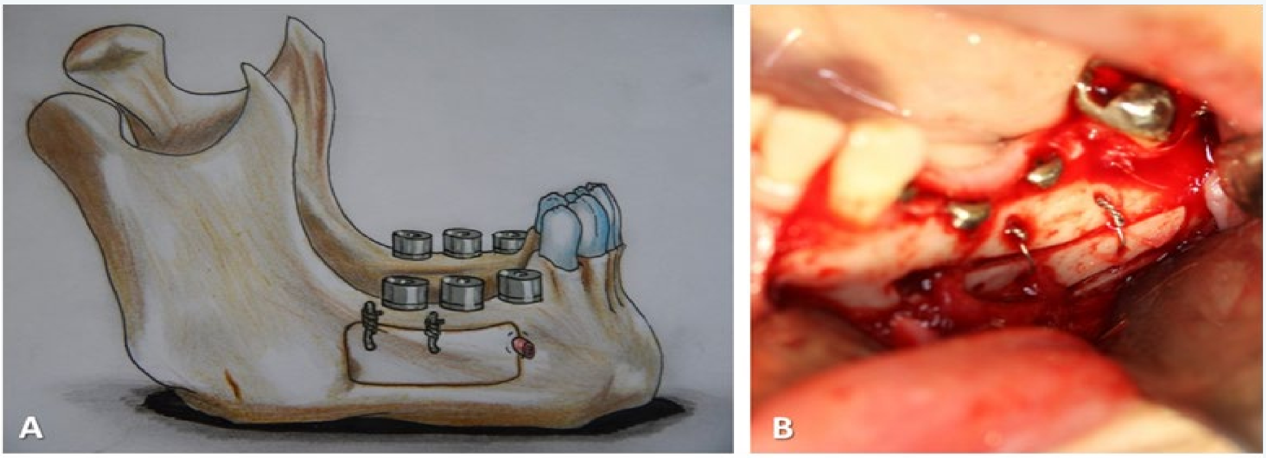

Figure 8: Repositioning and stabilizing the buccal bone plate with surgical steel wire 2.0.

Figure 8A: Technical illustration of the surgical procedure.

Figure 8B: Buccal bone plate semi-rigid stabilization on the left side.

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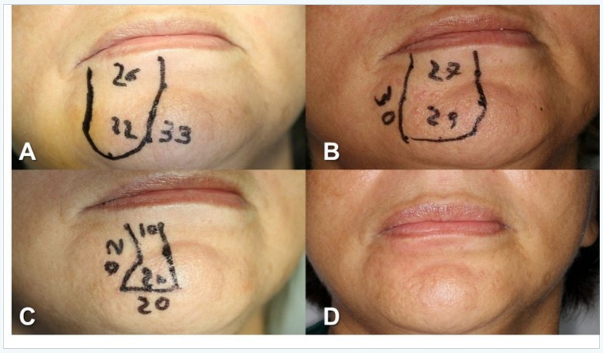

Figure 9: Skin of the chin was marked to monitoring the postoperative numbness on the right side.

Figure 9A: Demarcation after seven days.

Figure 9B: Demarcation after fourteen days.

Figure 9C: Demarcation after thirty days.

Figure 9D: Demarcation after ninety days.

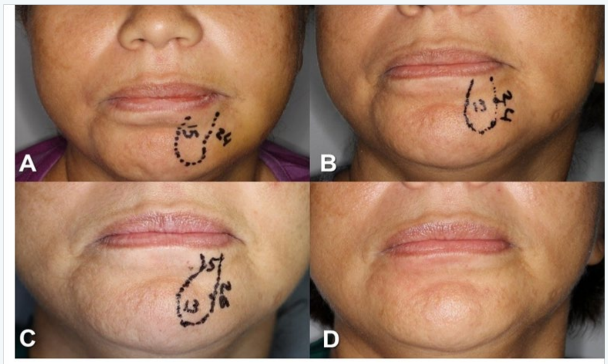

Figure 10: Skin marking on the chin to monitoring postoperative numbness on the left side after IANS.

Figure 10A: Demarcation after seven days.

Figure 10B: Demarcation after fourteen days.

Figure 10C: Demarcation after thirty days.

Figure 10D: Demarcation after ninety days.

Figure 11: Postoperative panoramic radiograph after four years.

Discussion

The improvement of techniques and materials to enable the installation of implants in unfavorable situations such as in areas with little available bone and/or restricted by noble anatomical structures has drawn special attention to skeletization of the IAN as a means to assist the posterior mandible rehabilitation in moderate to severely resorbed jaws. According to literature [38-40] the IANS enables better biomechanical solution for supporting a prosthetic implant when using larger implants resulting in a better distribution of masticatory loads and increased predictability, and longevity of the treatment. The literature [41] also shows that lack of a second operative time for the installation of dental implants contributes to technical acceptance by the patient. Although not widely used because it is a delicate surgery and subject to frequent postoperative complications related to neurosensory changes, some authors raise the argument that the sensitivity changes resulting from IAN manipulation are treated as a consequence and not as a complication of the technique, helping to demystify the technique and makes it a more utilized therapeutic resource [35]. The literature also shows that postoperative neurological disorders are temporary and most patients undergoing this technique refer that the sensory changes did not interfere with their daily routine so that they would undergo IANS again [42,43] as it was presented here in which the patient underwent the technique in two different moments. In order to prevent complications and make IANS safer the surgeon must seek the ideal planning through more advanced image resources such as CBCT which enables three-dimensional visualization of distances and dimensions of the anatomic structures [36]. The appeal of using specific softwares for tomographic images guarantees exact mapping of the mandibular canal across its path and accurately measures the thickness of cortical plate which will be osteotomized besides the trabecular bone density in the region, minimizing injuries to the IAN and ensuring quick return of sensory functions [44,45]. Piezoelectric technology use is also raised by many authors as a salutary feature of the technique for security and predictable results [37,46,47]. Piezosurgery principle is based on cutting mineralized tissue without interfering with the integrity of surrounding soft tissues. The ultrasonic vibration waves emitted by the device promote deformation and breakdown of hydroxyapatite crystals and once in contact with soft tissue cutting device can ceases its activity preserving the integrity of vessels and nerves, accidentally compromised with drills and saws usage [48]. A controversial point in the literature refers to nerve-implant interface and some studies argue that direct contact of implant threads with neural structure produce hyperesthesia by dissipation of mechanical strength and/or thermal conductivity [49]. Although some authors recommend placing biological membrane barriers [50] or bone substitutes [51] to separate the implant from the neurovascular bundle there is no absolute consensus on what type of material to be used nor clear scientific evidence that the use of these materials reduces the incidence of post-operative neuro sensory changes [29]. This case report the authors´ used bone marrow collected from the surgical site associated with shaved bone from internal aspect of the bone windows to cover implants threads with subsequent repositioning and fixation of buccal plate with 2 mm surgical steel wire. Although some authors [52] take a contrary stand to this variation of technique described in this article affirming that the repositioning of the buccal bone plate could compress the neurovascular bundle leading to aggravation of neuro sensory postoperative complaints the authors believe that reducing the thickness of bone window by scraping its inner surface allows for of neurovascular structure passive accommodation favoring the early bone repair and nerve regeneration. It is noted that the literature [31,35] is unanimous stating that postoperative neurosensory changes are more directly associated with the proper handling nerve than to bone cavity grafting procedures. Regarding the assessment of neurosensory function postoperative studies [34,36,53,54] using subjective and objective tests have demonstrated the occurrence of sensory changes in a high percentage of cases. However the sample of patients operated by different surgeons turns very difficult to standardize the surgical technique. The two point discrimination test used in this work appears to be the most appropriate and provides the numerical value for the functional changes of alpha sensory fibers which are more easily damaged during such surgery where the trauma occurs by traction and pressure [25,55]. In this case report the patient experienced gradual improvement of sensory function and even complete regression of symptoms like paresthesia. It contributes to the authors understanding that minimum and cautious handling of the nerve during surgery, gentle and not rigid stabilization of the bone buccal plate puts no pressure on the IAN.

Conclusion

The IANS technique is presented as a viable therapeutic option and nowadays increasingly as an auxiliary method for oral rehabilitation with dental implants in posterior portion of atrophic jaws. The professional who wants to make use of it should be attentive not only to the precise knowledge of technique and anatomy of the region, but also backed by adequate resources for diagnosis and planning that allow its safe execution with increasing predictable results. According to the authors clinical observations it is believed that the repositioning and fixation of the buccal cortical bone in a non-compressive form to the nerve contributes to bone regeneration and regain of neurosensory function as early as possible.

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