*Int. J. Oral Maxillofac. Surg. 2016; 45: 851–857*
http://dx.doi.org/10.1016/j.ijom.2016.01.017, available online at http://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Clinical Paper
Dental Implants

# The use of piezoelectric surgery to lateralize the inferior alveolar nerve with simultaneous implant placement and immediate buccal cortical bone repositioning: a prospective clinical study

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*J.C. de Vicente, I. Peña, P. Braña, G. Hernández-Vallejo: The use of piezoelectric surgery to lateralize the inferior alveolar nerve with simultaneous implant placement and immediate buccal cortical bone repositioning: a prospective clinical study. Int. J. Oral Maxillofac. Surg. 2016; 45: 851–857.* 

*Abstract.* A prospective study was conducted to assess a variation of inferior alveolar nerve (IAN) lateralization. This study included 13 patients. An osteotomy was made with a piezoelectric device, and the IAN bundle was moved buccally. Dental implants were then inserted medial to the nerve bundle, and the inner surface of the buccal cortical bone plate was shaped to reduce its thickness. Finally, the bone plate was repositioned to restore the original shape and contour of the mandible. Neurosensory examinations of the lower lip and chin were performed using three tests: light touch, pain, and two-point discrimination. Three months after surgery, the function of the IAN was judged to be completely restored at 11 of the 13 surgical sites. Differences in the tests comparing the operated and non-operated sides were not significant. No implants were lost, and all patients were satisfied with the result. Although IAN lateralization in conjunction with dental implant placement is rarely indicated, the use of a piezoelectric device to perform a buccal osteotomy with final repositioning of the buccal cortical plate over the bony defect contributes to the recovery of the contour and shape of the mandible, without impairment of IAN function.

Key words: inferior alveolar nerve; nerve lateralization; neurosensory disturbance; dental implants; piezoelectric surgery.

Accepted for publication 28 January 2016
Available online 17 February 2016

0901-5027/070851 + 07 

Implant rehabilitation of the edentulous jaws requires a sufficient quantity of bone. Thus, when the posterior mandible presents severe atrophy, the quantity of bone above the inferior alveolar nerve (IAN) may not be sufficient for the placement of dental implants of an optimal length without causing an IAN injury. Consequently, various complementary therapeutic approaches have been developed to deal with the lack of bone height in the severely atrophic posterior mandible, in order to avoid IAN damage. These include the lateral mobilization of the IAN,[1] alveolar distraction, onlay or inlay autogenous bone grafts, guided bone regeneration with barrier membranes, and short implants. In rare situations when the bone height above the IAN canal is less than 5 mm and the inter-arch distance is not adequate to accommodate onlay bone grafts, lateral mobilization of the nerve is the only option to rehabilitate patients with osseointegrated implants. The selection of this technique will also depend on the surgeon's skill and ability to manipulate the IAN with as little trauma as possible.

There are two main methods for the lateral mobilization of the IAN, with variations thereof, which may be performed in conjunction with other techniques: (1) IAN transposition through an osteotomy that includes the mental foramen as well as the area of implant placement, and (2) IAN lateralization through a bone window posterior to the mental foramen. In IAN lateralization, the nerve is exposed and retracted laterally, held in this position during implant placement, and then allowed to fall back into place against the implants. This technique allows the installation of long implants, increasing their primary stability, which is an essential prerequisite for the osseointegration process. In fact, implant survival rates at IAN lateralization sites vary from 93.8% to 100%.[2] The main disadvantage of IAN mobilization is the risk of postsurgical neurosensory deficits due to stretching of the IAN or vascular damage, and this may have important functional consequences. Both approaches require extensive stretching of the IAN, but lateralization yields lower degrees of nerve deficiency.

In order to minimize trauma to the IAN, various authors have suggested alternative osteotomy designs performed with either burs or saws.[3] The literature also presents several cases of pathological mandibular fracture as a result of IAN lateralization and implant placement in the edentulous atrophic posterior mandible.[4] Piezoelectric surgery has recently been introduced in IAN mobilization. It has been suggested that piezoelectric surgery results in advanced bone healing and allows highly precise cutting of the hard tissue while preserving the adjacent soft tissues.[5] Despite these positive aspects, piezoelectric surgery has some limitations, including less power and the longer time required to perform an osteotomy. At the end of the surgical procedure, the cortical plate harvested from the buccal or lateral mandibular surface is usually used for ridge augmentation or to cover any dehiscence on the buccal aspect of the implants. A modification of this technique is presented here. As the piezoelectric device provides narrow and precise cutting, the buccal cortical plate can be replaced in its original position at the end of surgery. A theoretical problem resulting from this would be compression of the IAN causing a neurological disturbance. To overcome this drawback, the thickness of the inner half of the cortical bone is reduced.

This article reports the results from a series of 13 patients in whom a piezoelectric device was used for the IAN lateralization approach. At the end of the procedure, the vestibular cortical plate was repositioned to recreate the shape and contour of the mandible. The aim of this study was to describe this variation of the IAN lateralization technique, as well as to evaluate its influence on neurosensory function.

## Materials and methods

### Patients

The STROBE Statement for improving the quality of observational studies was followed in reporting the present study (http://www.strobe-statement.org). A prospective cohort study was designed, and the clinical study protocol was approved by the local ethics board. The study population comprised all patients referred for implant surgery in the posterior mandible between 2000 and 2013. Thirteen consecutive patients (12 women and one man, ranging in age from 45 to 68 years) were selected for treatment with a distal fixed partial denture supported by dental implants placed in conjunction with lateralization of the IAN using the modified surgical procedure described below. The medical status and medications were recorded in each case. Patients with immunological diseases, uncontrolled diabetes mellitus, or other systemic contraindications were excluded from the study. All patients enrolled in this study were non-smokers. Smoking patients were not excluded.

Panoramic radiographs and computed tomography (CT) scans were obtained for all patients. In all cases, the CT scans revealed that the patients had less than 7 mm of bone height between the alveolar crest and the mandibular canal at the planned implant sites. There was 5–7 mm of available alveolar bone in all patients, but not at all implant sites. Patients were included in the study on the basis of a requirement for at least two implants, one of which was frequently placed posterior but close to the mental foramen. Three of the 13 patients had 7–10 mm of bone over the IAN canal in the mandible immediately behind the mental foramen, while the availability of bone was less than 7 mm in posterior areas.

All aspects of the operation were discussed with the patient, and all of the patients agreed to undergo surgery with the IAN lateralization technique. All were informed of the possibility of experiencing some postsurgical neurosensory disturbances, and written informed consent for the treatment was obtained in each case. A total of 27 dental implants were placed at the time of nerve lateralization. All of them were cylindrical type, measuring 13–15 mm in length and 3.8–4.1 mm in diameter.

### Surgical procedure

The IAN repositioning surgical procedure was undertaken under local anaesthesia, obtained by infiltration of mepivacaine 1% containing 1:100,000 epinephrine. All patients received preoperative antibiotics (2 g amoxicillin 1 h before surgery) and were asked to rinse with 0.2% chlorhexidine gluconate antiseptic solution immediately prior to surgery.

The procedure was started with a midcrestal incision extending from the retromolar region to the mesial portion of the cuspid tooth region, where an oblique relaxing incision was made. A posterior relaxing incision was made in the retromolar region and then a full-thickness mucoperiosteal flap was reflected and the lateral surface of the mandible up to the inferior border of the bone and mental foramen was exposed. The osteotomy defined a rectangular bone window that was centred on the position of the IAN canal (Fig. 1); this was made with an ultrasonic bone-surgery device (Piezosurgery, Mectron Medical Technology, Carasco, Italy) and two inserts in a bevelled shape (Piezosurgery OT7 and OP1). The OT7 insert with a thickness of 0.55 mm was used to