Piezoelectric repositioning of the inferior alveolar nerve

Review and two case reports

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_Abstract

In cases of moderate to severe atrophy in edentulous posterior areas of the lower jaw, diminished bone height between the alveolar crest and the mandibular canal may preclude placement of even the shortest implants. Repositioning of the inferior alveolar nerve has proven to be an excellent alternative to augmentation procedures. Especially in conjunction with piezosurgery the lateral nerve transposition provides a viable, reliable and relatively secure surgical procedure.

_Introduction

The first account about inferior alveolar nerve repositioning was published in 1977 by Alling[1] in the context of prosthetic rehabilitation of patients with severe atrophy and emergence of the mental nerve close to the alveolar crest. In 1987, Jensen and Nock[2] described the first inferior alveolar nerve transposition in conjunction with dental implant surgery.

Up to now, the nerve transposition technique has developed to an excellent alternative to augmentation procedures for placement of dental implants in the lateral tooth area of the lower jaw.

The lateralisation of the inferior alveolar nerve offers the following main advantages:

- _Implants of greater length can be inserted simultaneously.
- _No bone grafting is needed.

However, nerve repositioning is a complex procedure, with a high risk of sensory disturbances.[3]

Since the introduction of an ultrasonic instrumentation for bone cutting in 1975 by Horton *et al.*[4] ultrasound-based piezoelectric devices have been applied increasingly often in head and neck reconstructive surgery, oncological cranio-maxillo-facial surgery, dysgnathic surgery, dental surgery and even in hand surgery.[5,6]

Subsequent to a publication of Vercellotti[7] in the year 2000 about piezoelectric oral surgery this method more and more has been used in dental implantology. The also as piezosurgery known technique is used in oral surgery to section hard tissues without damaging adjacent soft tissues.

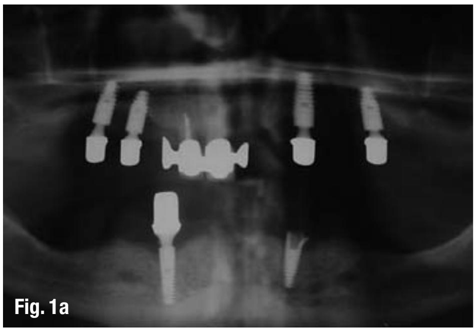


Fig. 1a


Fig. 1b

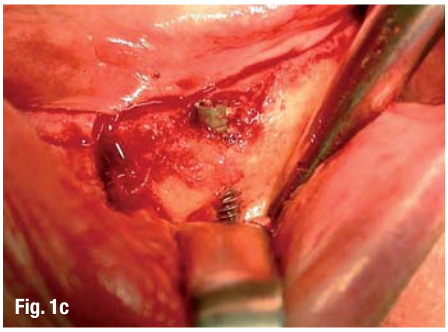
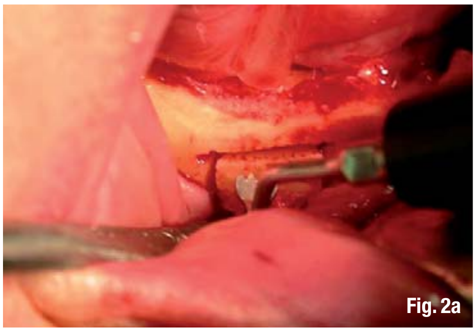
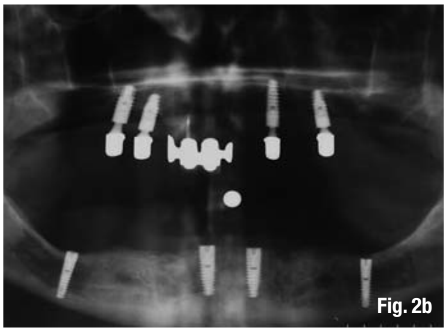


Fig. 1c

Fig. 1a_Radiographic initial situation, first case.
Fig. 1b_Clinical initial situation, first case.
Fig. 1c_Intraoperative situation before explantation of implant 44, first case.





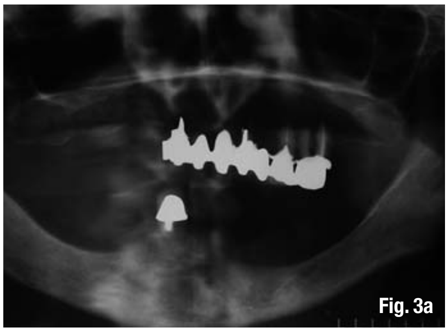


Fig. 2a_Posterior piezosurgical approach regio 46, first case.

Fig. 2b_Postoperative panoramic X-ray, first case.

Fig. 3a_Radiographic initial situation, second case.

In this connection an *in vitro* comparison of Metzger *et al.*[8] verified that the degree of nerve injury after piezosurgical inferior alveolar nerve transposition is lower than after usage of conventional rotary burs.

_Piezosurgery technique

Piezosurgery employs a specific instrument which transfers a significantly elevated level of ultrasound energy upon the bone surfaces. Thus this device is allowing osteotomy to be carried out even when the bone is highly mineralized and thick.[4]

The ultrasonic technique is characterized by a functional frequency of 25–29 kHz and the possibility of 30 Hz digital modulation. The system comprises a series of inserts of different forms with a linear vibration ranging from 60 to 200 µm.[6]

In order to prevent an excessive increase in temperature the system is connected with a peristaltic pump for irrigating physiological solution.

_Surgical Procedure

The repositioning of the inferior alveolar nerve may be accomplished with general anaesthetic or intravenous sedation, but also in local anaesthesia alone. Independent of the used instrumentation we distinguish basically two surgical techniques as described below.[9,10]

Lateralisation or anterior approach: An osteotomy is performed around the mental foramen continuing with posterior bone removal until the nerve can be retracted past the last implant site.

Fenestration or posterior approach: The mental nerve and foramen are identified as before, but a cortical window is performed posterior the mental foramen at the planned fixture site. In conventional transposition procedures fine chisels are used for nerve exposition and mobilisation. Special piezosurgical inserts instead facilitate comparatively gentle access and visualisation of the nerve.

After carefully freeing, the nerve is separated using elastic vessel loops for applying gentle traction outwards as the implants are positioned.

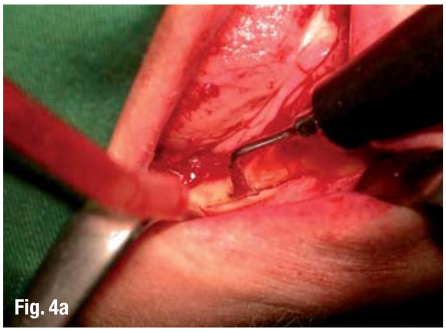
The following two case reports explain a seldom (case 1) and a typical indication (case 2) for inferior alveolar nerve repositioning in the context of implant surgery.

_Case 1

In 2007, a 68-year-old male patient in good general health was referred by his dentist for explantation of two implants regio 34, 44. Overload induced, each implant- and abutment-screw-fractures and additional periimplantitis regio 44 had caused failure of the implants and the two years old crown- and sleeve-coping denture (Figs. 1a, 1b & 1c). Simultaneously and at most with a minimum of bone augmentation four implants ought to be inserted. As soon as possible, the patient wanted to be treated with an implant-supported fixed bridgework. Four implants should be placed regio 32, 42 and in combination with an inferior alveolar nerve transposition regio 36, 46. Subsequent to a detailed consultation, study casts and a CT scan the patient was treated in local anaesthesia. After the extraction of the implants 34, 44 again two implants were installed interforaminal, regio 32, 42. Additionally, regio 36 and 46 implants were placed each in combination with a piezosurgery-assisted inferior alveolar nerve transposition (Figs. 2a & 2b). In the upper jaw already four Ankylos® plus implants (DENTSPLY Friadent, Germany) had been fixed for a tooth and implant supported removable denture. Accordingly Ankylos® plus implants also were used in this procedure. In combination with an uneventful healing process regular nerve function was assessed already two weeks post-surgery.

_Case 2

In 2008, a 69-year-old female patient in slightly reduced general health was referred by her dentist. In the upper and lower jaw all remaining teeth had to be extracted and each six implants ought to be



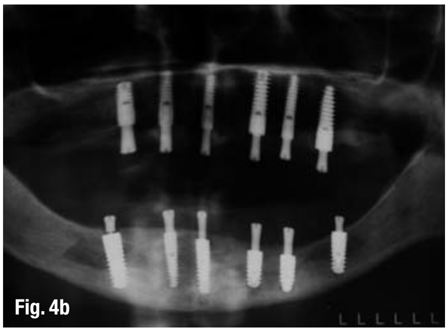


Fig. 3b_Clinical initial situation, second case.
Fig. 4a_Posterior piezosurgical approach regio 46, second case.
Fig. 4b_Postoperative panoramic X-ray, second case.

fixed minimal-invasive with preferably less bone augmentation effort. In as short a timeframe as possible the osseointegrated implants should be ready for screwed implant-supported bridges in both jaws. After an extensive consultation, study casts and a CT scan the patient was treated in local anaesthesia as follows: In the mandible tooth 43 was extracted, four implants were inserted interforaminal and regio 36, 46 each one implant was placed post piezosurgical transposition of the inferior alveolar nerve. In the maxilla the teeth 12, 21, 23, 25, 26 were extracted and again sic implants were anchored (Figs. 3a, 3b, 4a & 4b). Each Ankylos® plus implants (DENTSPLY Friadent, Germany) were used. Comparison of the postoperative (Fig. 4b) and the postprosthetic (Fig. 5) panoramic X-ray, 5 months later, impressively clarify the fast bony regeneration in both fenestration locations. An about eight months lasting, less than 1 cm mean diameter measuring aera of minor hypaesthesia on the left chin side, did not impair patient satisfaction with the final reconstruction outcome.

_Discussion

Severe resorption of the posterior mandible poses one of the most difficult restorative challenges in dental implantology. Bone augmentation procedures (e.g. bone grafting or alveolar distraction) may increase the amount of bone in deficient areas. But these treatment options are costly, time-consuming and involve an elevated risk of inconveniences and complications.

Nerve repositioning has proved as an excellent alternative to augmentation procedures for placement of dental implants. The technique permits

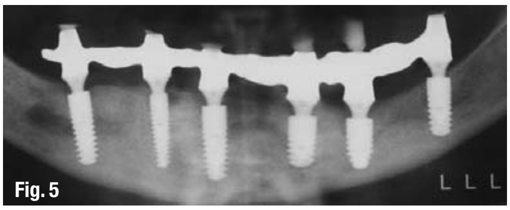


Fig. 5_Postprosthetic panoramic X-ray, second case.

implant therapy in atrophied lower jaws with insufficient vertical height superior to the mandibular canal. Integration of fixed bridges instead of removable appliances is enabled with just one surgical session even in instances, where—as described in the first case—only 2 implants can be installed interforaminal.

Safety and precision of the relocation of the inferior alveolar nerve have been further improved by the use of a new approach, the ultrasonic osteotomy. Piezoelectric surgery maintains blood-free sites and allows to perform precise linear and curvilinear osteotomies without the risk of cutting soft tissues.

Bone drills and oscillating saws represent more aggressive cutting instruments which are relatively difficult to control (e.g. due to the generation of macrovibrations) and which are more damaging to soft tissues.

Compared with these traditional cutting instruments the main disadvantage of piezosurgery concerns the increase in the operating time.

Independent of the osteotomy technique, nerve damage can be the result of an overstretched mucoperiosteal flap in the premolar area to achieve optimal view in the operating field. Especially with piezosurgery overstretching of the mental nerve can be reduced by creating smaller bone fenestrations.

Touching the inferior alveolar nerve with piezoelectric inserts results at most in roughening of the epineurium without harming deeper structures,[8] as far as heat injuries are prevented by an appropriate handling of the ultrasonic device.

Referring to the author's experience it seems to be favourable to place particulated bone around the implants just to prevent a direct nerve-fixture-contact and in order to aid the subsequent osseointegration. Additionally, or at the very least alone, the bone window should be covered by a resorbable membrane. Sensory changes after nerve repositioning seem to be less distinct after piezosurgery compared to conventional drill and oscillating devices. Nethertheless, at the first postoperative visit, a clinical assessment of the nerve function is mandatory.

Considering ethical and forensic implications, patients should be explicitly informed preoperatively that nerve injury might be expected to occur. In combination with implant placement, also the potential for mandibular fracture must be discussed with the patient.

The majority of our patients choose this treatment not in general anaesthetic or in intravenous sedation but just in local anaesthesia, which has proved to be reliably employable. In comparison to the application of conventional instruments patients detect the usage of piezoelectric devices usually less invasive. Accordingly, piezosurgery is well tolerated by the patients. Even in rare cases with persistent neurosensory deficits the patients were satisfied with the overall procedure.

Summarizing can be inferred, that especially in complex situations with compromised bone bed, the inferior alveolar nerve transposition should be taken into account as a viable treatment modality for the attainment of individually optimized implant-supported reconstructions._

_References

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Editorial note: The whole literature list can be requested from the author.

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