Exposition of the inferior alveolar neurovascular bundle in an atrophic mandible - anatomical evidence and clinical restoration

Konstantinos Natsis¹, Theodora Karanikola², George Paraskevas¹, Anastasios Tsirlis², Prokopios Tsikaras¹

¹Department of Anatomy, Medical School, Aristotle University of Thessaloniki, Greece
²Department of Oral Surgery and Implantology, School of Dentistry, Aristotle University of Thessaloniki, Greece

ABSTRACT: The mandible with the ageing process is susceptible to alterations in terms of its shape and size. At the old age, after the collapse of teeth, the alveolar process is absorbed and, as a result of this, the mandibular canal and the mental foramen are found to be close to the superior border.

The body of the mandible resembles the basic part of the mandible. There is reference to a case with an evident atrophic mandible and exposition of the inferior alveolar neurovascular bundle on an 81-year-old male cadaver who carried a complete denture in the mandible. The above case is also remarked on a 70-year-old male patient who could not bear the denture for ten years. The patient rehabilitated with an implant-overdenture retained on two endosseous osseointegrated implants. The final result was functionally and esthetically a success.

The exposition of the inferior alveolar neurovascular bundle in an atrophic mandible is almost rare but it presents anatomical and clinical interest.

Key Words: Inferior alveolar neurovascular bundle, Atrophic mandible, Implant-supported overdenture.

INTRODUCTION

Every tooth extraction leads to the remodelling of the alveolar bone, including osteoclastic resorption of the residual alveolar ridge, especially the labial wall, as well as bone deposition within the extraction socket¹.

Results presented by Edwards² suggest that after loss of the natural teeth, the body, rami, condyles and coronoid processes also undergo changes during long edentulous periods as a result of the less intensive use of the masticatory muscles, which promotes bone growth. A description of the disorganisation and remodelling of the trabecular system in the mandible after loss of the teeth has been given by Nuefeld and Carlsson et al.³,⁴

The rate of bone resorption is highest during the first 3 months, with significant slowing after 6 months. Remodeling is generally complete and stabilized after 1-2 years¹. The average rate of resorption in the mandible (approximately 0.2 mm/year) is 3-4 times higher than in maxilla⁵,⁶. In extreme cases of atrophy, the mandible may lose up to 70% of the original bone volume in the region of the mandibular body, thus being one of the bones in the human body that is most severely affected by atrophy⁷.

During all stages of atrophy of the alveolar ridge, characteristic shapes result from the resorptive process, as influenced by anatomical alterations in the alveolar bone. The characteristic shapes of the edentulous mandible that result from the resorption of the alveolar process during certain stages of mandibular atrophy were described by Atwood⁸,⁹. A common feature of all stages of resorption is the progressive loss of height of the alveolar bone and the resulting decrease of the distance between the alveolar crest and the mandibular canal. Atwood⁸ proposed a classification of the edentulous mandible in six categories (Figure 1).

The acutely resorbed alveolar processes which

Reprint requests to: Dr Natsis Konstantinos, Laboratory of Anatomy, Medical School, Aristotle University of Thessaloniki, 54006 Thessaloniki, Greece, Tel.: +30 2310 999681, Fax.: +30 2310 999681, e-mail: natsis@med.auth.gr

are classified in Classes V and VI, especially in the mandible, present many difficulties in the prosthetic treatment with the conventional denture. So, the use of implants is introduced in dentistry as well.

Although in the past, dental implantology was dealt with skepticism, until the end of 70s, implants were almost placed in acute alveolar processes or only in these cases.

It has been indicated through anthropological discoveries in Europe, Near East and Central America that early in history, man attempted to replace lost teeth with the use of autologous or alloplastic materials including human and animal teeth, carved bone, pieces of ivory and mother of pearl.

To date, overall positive experiences and the improvement of the technology have targeted the immediate future at a time to establish endosseous den-

enal implant as a routinely applied treatment modality in dentistry.

In recent years, many authors suggested ways to provide implant - prosthetic therapy even for patients with advanced resorption of the alveolar ridge in the posterior segment of the mandible\(^\text{10-16}\).

Our study refers to two cases which present complete absorption of the alveolar process and exposition of the inferior alveolar nerve. Gabriel was the first to mention to disappearance of the superior border of the mandibular canal and mental foramen, exposing the inferior alveolar neurovascular bundle\(^\text{17}\).

MATERIAL AND METHODS

In this study there are two cases with exposition of the inferior alveolar neurovascular bundle in an atrophic mandible (Class VI according to Atwood)\. In the first case the completely resorbed alveolar process was found in an 81- year-old male cadaver. Following dissection and exposition of the full length of the inferior alveolar nerve, it became clear that the bone had been resorbed at least in height along the inferior alveolar nerve from the mental foramen to the mandibular foramen (Figure 2).

This dissection took place at the Department of Anatomy of Medical School at the Aristotle University of Thessaloniki.

According to Atwood, the above case is classified as Class VI. The man wore a complete conventional denture. However, it is not known if he used it only for esthetic purposes or during mastication as well. It is hardly possible that he was able to use this denture during mastication due to the irritation of the inferior alveolar nerve and neuralgia which developed.

The second case of exposition of the inferior alveolar neurovascular bundle (Class VI) was found in a 70 year-old male patient (Figure 3). The patient...
lost all his teeth at the age of 40 and wore a denture until the age of seventy. When the patient was almost 60 years old, the resorption of the mandible led to the exposition of the inferior alveolar neurovascular bundle and the development of an acute neuralgia because of the pressure of the denture on the nerve. As a result of this the patient did not wear the denture in the last decade. This case was dealt with the use of two dental implants which were placed in the interferonera region (Figure 4).

The next step was the placement of a bar with distal extensions on the implants and the prosthetic treatment was completed with an implant - supported overdenture (Figure 5). The overdenture is mainly supported by the two implants so no irritation on the nerve arises.

**Implant Surgical Procedure**

The implant surgical procedure started with the use of local anaesthesia in the interferonera region so to the labial as to the lingual aspect. The basic principles of sterility must be followed. The surface of the skin of the perioral region should be disinfected using a broad-spectrum microbicide e.g betadine and the patient should rinse the oral cavity for 2 minutes with a chlorhexidine solution 2%.

The patient was given antibiotics (amoxicillin) 1 day before surgery and he continued the antibiotic regimen for 8 days at least.

A two-stage multicomponent implant system was used and two surgical procedures were performed. During the first one the implant body («fixture») was seated in the bone and completely covered by mucoperiosteal flaps. With the fixture «buried» in this way, bone healing was allowed to occur. (1<sup>st</sup> surgical phase). During the second stage 3-4 months after surgery, the implants were uncovered to subsequently receive the prosthetic components (2<sup>nd</sup> surgical phase).

After the precise clinical determination of the implant location and the ensuring of the significant local infiltration of the anterior region of the edentulous mandible, the operation was carried with a simple incision along the crest of the ridge until the mental foramina without exposing them.

The design and course of the incision must secure an excellent view of the surgical field as well as achieve a safe wound closure. A broad exposure of the bone of the surgical field, with effective illumination and suction, is necessary for adequate access. In general, the larger the field of operation is, the less trauma there will be to the wound margins\(^\text{18}\).

Following the elevation of mucoperiosteal flaps (and the flattering of the sharped ridge) a small round bur is used to mark the locations of each implant. Each implant is placed 5 mm from the mental foramen towards the symphisis menti.

Next, a standardized instrumentarium is available for preparation of the implant bed (the instruments are stored and sterilized in aluminum tray boxes).

The implant must exhibit primary stability in bone and should extrude approximately 0.5-1 mm from the bone. Finally, healing caps were inserted and screwed into place.

Three or four months after the surgery, the osseo-integrated fixtures must be surgically exposed. The patient, during all this time, had a full lower denture
which was relieved in the region of the implants. The procedure is performed using infiltration around the implants location. The soft tissue flaps must securely suture around the transmucosal implant components. We put a round bar with distal extensions on the implants and the patient carried an implant-supported overdenture. Also, the patient wears a conventional full denture in the maxilla. The final result is functionally and esthetically a success (Figure 6)\textsuperscript{19,20}.

**DISCUSSION**

Following a detailed study of literature, one observes the rareness of our cases.

In fact, not only is the completely resorbed alveolar process a rare phenomenon, but it is difficult for a patient to wear a conventional prosthetic treatment.

The mandible, as times flies by, is susceptible to alterations in terms of shape and size. At birth, the two halves of mandible are united by a fibrous synostosis menti. At this stage the body is a mere shell, enclosing imperfectly separated sockets of deciduous teeth.

From the first to the third years after birth the two halves of mandible join at their symphysis from below upwards. The body elongates, especially behind the mental foramen, providing space for three additional teeth\textsuperscript{21}.

After the eruption of permanent teeth the mandibular canal is placed somewhere above the mylohyoid line and the mental foramen occupies its adult position. As the mandible increases in size, bone is added to the posterior borders of the ramus and the coronoid process while absorption occurs at the inferior anterior border. This remodelling continues until adult size is reached, allowing the alveolar parts to accommodate the permanent molar teeth\textsuperscript{22}.

In adults alveolar and subalveolar regions are approximately equal in depth, with the mental foramen being midway between the upper and lower borders and the mandibular canal nearly parallels the mylohyoid line.

In the old age, the bone is reduced in size as teeth are lost and the alveolar region absorbed as a result the mandibular canal and mental foramen are nearer to the superior border (Figure 7). The upper border of the above entities may even disapear, exposing the inferior alveolar nerve\textsuperscript{17}.

The inferior alveolar nerve is a branch of the posterior trunk of the mandibular nerve. The nerve enters the mandibular canal via the mandibular foramen. Below the lateral pterygoid muscle is accompanied by the inferior alveolar artery, a branch of the maxillary, with associated veins, enters the canal as well. In the canal, the nerve runs downward and forward, generally below the apices of the teeth until below the first and second premolars. It divides into terminal incisive and mental branches. The former continues forward in a bony canal or in a plexiform arrangement, giving off branches to the first premolar, canine and incisor teeth, and the associated labial gingivae\textsuperscript{21}. Nortje and Khaledpour described the anatomical variation of the inferior alveolar nerve in man\textsuperscript{23,24}. The nerve lies a few millimeters below the roots of the teeth or
much lower in the mandible near the lower border of the bone. According to Miller the nerve may lie on the lingual or buccal side of the mandible, slightly more commonly on the buccal\footnote{25}.

After extraction the alveolar process is gradually reduced in height and it is called residual alveolar crest. Various factors lead to the resorption of mandible. The resorption of mandible is a biomechanic procedure that occurs due to a joined action of anatomical, metabolic and mechanical (functional-prosthetic) factors (Figure 8). Certainly, the ideal prevention of the bone resorption is the maintenance of natural teeth (permanent teeth). Unfortunately, this is impossible and therefore in the case a patient who starts to lose his/her teeth, the clinical diagnosis helps to design an individualized prosthetic restoration.

The clinical diagnosis includes not only the clinical examination, but also means taking a precise medical and dental history. Moreover, a radiographic control will help the dentist to complete his/her diagnosis.

A patient may have lost a tooth or all his/her teeth. In case he/she loses his/her teeth, the dentist will proceed with the construction of a conventional denture.

The «ideal» patient for prosthetic treatment of the edentulous mandible using a full denture will present the following characteristic: minimally mobile mucosa of average thickness, free of scarring and without high frenum attachments. The alveolar process will be of average height, round in shape, wide enough, and with an even horizontal profile; the musculature will be inserted deeply and exhibit resilience and the intermaxillary relationship will be characterized by a sufficient vertical distance as measured by the vertical interrelationship between maxilla and mandible. Unfortunately, such patients are rare.

Most patients present varying degrees of alveolar resorption. In particular, the following clinical morphologic condition presents the dentist with serious difficulties, more specifically:

1. The band of attached gingiva is significantly narrower than expected from the degree of alveolar crest resorption.
2. The external oblique line and the mylohyoid ridge are high, with resultant prolapse of the floor of the mouth.

3. The genioglossal muscle spin extends beyond the alveolar ridge in the faciolingual plane.

Patients who present these anatomical conditions often cannot be successfully treated with a conventional complete denture from the functional point of view.

Due to the special prosthetic difficulties often associated with the edentulous mandible, in recent years attempts have been made to improve the treatment result with the help of endosseous dental implants\footnote{1,26}.

However, there are some cases of edentulous patients, e.g. our case, in which only a treatment with implants can be used for the following reasons:

1. In this patient there is a complete resorption of the alveolar process and as a result of this, the ability of support of the complete denture is reduced.
2. The interforamina region is possible to accept small length of implants (8 mm) due to the bone's composition and the absence in the region, of any anatomical structure that will restrict the placement of implants.

There should be a safety vertical extent of bone available for implantation between the alveolar crest and the opposing anatomical boundaries (e.g. sinuses, mandibular canal, etc.). Implants should be placed with a safety margin of 1-2 mm from those structures. The accepted minimal length for cylinder or screw-type implants is 10 mm. Exceptions to this general
rule may apply if the compact bone is very thick, for example in the mandibular symphysis region of a severely atrophic mandible, where 8mm implants can be used. Whenever possible, longer implants should be used in order to increase the bone-implant contact surface area.

One of the most significant factors in every implant case is the amount of available bone in the area where implants are to be placed. According to Misch available bone can be determined with the use of diagnostic aids (e.g. radiographs, study models etc.) with regard to height, width and shape\textsuperscript{27-29}. Also, the implant-to-crown relationship that will exist, when the case is completed should be taken into account.

In practising dental implantology not only should the dentist possesses a profound biologic biomechanical, surgical and restorative knowledge, but also a broad therapeutic spectrum related to the patient treatment as well. Long-term success with endosseous implants in dental practice requires practical experience and deep knowledge fields areas such as oral surgery, prosthodontics, periodontology and preventive treatment. Should there be lack of knowledge in any of the above mentioned areas, it is recommended that the dentist must collaborate closely with a specialist.

CONCLUSION

In conclusion, we can underline that the resorption of the alveolar crest is a phenomenon that nowadays occurs in people. Young and old ones, men and women, people in good health or sick, people who have their own teeth or wear denture may have to deal with this problem. The cause of the above problems does not relate to the previous reason of the loss of teeth (e.g. decay, periodontitis etc.).

The factors that may lead to the resorption of the alveolar process have been mentioned and discussed above. However, the extent of their influence cannot be assessed with a high precision.

Yet, it can be mentioned that nowadays life expectancy has increased on one hand thus esthetics plays an important role. On the other hand, the results of a resorption of the alveolar process may marginalize a patient from society.

Patients give the impression of being older due to the dropping of profile while mastication is reduced or become non-existent as it happened in our case.

In this case, the conventional prosthetic treatment cannot be applied due to the small amount of bone available and the lack of ability to support the denture\textsuperscript{30}. It should be pointed out that, from a prosthetic point of view, extreme atrophy resulting in residual ridge Classes V and VI is one of the main indications for additional use of implants\textsuperscript{31-34}. Especially, the location of implants in the intraforaminal region for mandibular rehabilitation can be considered a very precious contribution to treatment of patients who would otherwise be considered a hopeless case from a prosthetic standpoint.

We believe that both the anatomical evidence and the presentation of clinical restoration in a patient with exposition of the inferior alveolar neurovascular bundle will help the dentist and the maxillofacial surgeon to pay attention to it so as to diagnose the problem in the initial stage and deal with this effectively. Furthermore, the finding is of great importance for the professor and the student of anatomy.
Apostolypsi toun kato phantiasou aggeiovenyfrados deumatoun se atrofiskis kato gnavo - Anatomiako eurhima kai kliniki antimetropsi

Konstantinos Nastos1, Theodora Karanikola2, Georygio Paraskevas3, Anastasios Tzirlis3, Prokopis Tsaiaras2

1 Ergasthrio Perigrfwsis Anatomeias, Iatriki Scholi, Aristotelio Paideiston Theoasalwias, Ellada
2 Ergasthrio Odontofarotiasias Kheirourgwn - Kheirourgwn Evmunteumatolugias kai Aktinologias, Odontiatrikis Scholi, Aristotelio Paideiston Theoasalwias, Ellada

ΠΕΡΙΛΗΨΗ: Η κάτω γνάθος με την πάροδο της ηλικίας επιδέχεται μεταβολές στο σχήμα και το μέγεθος. Στη γερόντικη ηλικία μετά από την απόπτωση των δοντιών η φατνιακή απόφυση απομεινάει και αναπτύσσεται ο γναθιαίος πύρος και το γενειακό τρήμα βρίσκεται κοντά στο άνω χέρκος του οστού. Το σώμα της κάτω γνάθου σχηματίζεται από τη βασική του μοίρα. Παρουσιάζεται μία περίπτωση με εκσεσμασμένη ατροφία της κάτω γνάθου και αποκάλυψη του κάτω φατνιακού αγγειονευρώδους δεματίου σε πτώμα ανδρός 81 ετών που έφερε ολική οδοντοστοιχία κάτω γνάθου. Η παραπάνω περίπτωση παρατηρήθηκε και σε ασθενή, ανήλικα 70 χρόνων ο οποίος έμεινε ολικά νυκτός επί 10 χρόνια και έβαζε κοσμήματα. Η απόφυση του κάτω γνάθου έμεινε μικρά αμοιβαία με την κίνηση και την εναποφάσιση του σώματος. Η παραπάνω περίπτωση είναι σημαντική και ενδιαφέρουση για τον ιατρικό κλάδο.

Αποκάλυψη του κάτω φατνιακού νεύρου, Επένθετη οδοντοστοιχία σε εμφυτεύματα.

REFERENCES