

Peculiarities of Implantation in the Posterior Mandible

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Summary

The aim of the study was to investigate the clinical-anatomical peculiarities of edentulous mandibular dental segments (eMDS), situated in the posterior mandible, as well as to estimate the possibility of dental implantation for every clinical-anatomical eMDS type. One hundred and ninety-eight patients were examined, 88 male and 110 female. Orthopantomography, computer tomography, clinical examination using special ridge - mapping calipers for measurement of alveolar process width were employed to estimate eMDS. Three hundred and fifty-three screw-shaped single-stage OSTEOFIX Dental Implant System implants were inserted. In 346 (98.02%) cases implantation was successful. Concerning the results of the eMDS measurements, the literature data suggested the division of posterior mandible dental segments into the following three clinical - anatomical types: type I - atrophy of eMDS is absent or if present, proper implantation is available; type II - simultaneous implantation is available only with augmentation of the alveolar ridge; type III - only delayed implantation is available after augmentation of the alveolar ridge.

Key words: *jaw atrophy, endosseous implants, guided bone regeneration, bioresorbable membrane, deproteinized bovine bone.*

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Introduction

Branemark et al began new a era of modern implantology in 1969 when he first time announced data of an investigation in titanium dental implants (1). Although since that time the shape and surface of titanium implants has changed, this method has remained popular and reliable with average reliability of more than 90% (2-4). The success of implantation depends on proper selection of patients (5). Following evaluation of the general state of health of the patients, it is very important to properly assess anatomical features of the jaws and according to data received, in order to choose the correct treatment

method. Implantation in the posterior mandible is particular as the inferior alveolar nerve (IAN) is located in this region. Injury to the IAN is one of the most severe complications of implantation (6, 7). Following the loss of teeth because of atrophy of the jaw the height and width of the edentulous mandibular dental segments (eMDS) decreases (8). The classifications that are suggested for evaluation of jaw atrophy grade (9-12) do not usually show exact measurements of eMDS. If these could be known, appropriate treatment methods, such as guided bone regeneration (GBR) (13-16), vertical osteotomy of the alveolar ridge (17) could be applied with reestablishment of height and width of the atrophic jaw alveolar ridge.

The aim of our study was to investigate the clinical-anatomical peculiarities of the eMDS, situated in the posterior mandible, as well as to estimate the possibility of dental implantation for every eMDS clinical-anatomical type.

Material and methods

One hundred and ninety-eight patients were examined (88 male and 110 female). The age of the patients was 17 - 74 years (Table 1). Implantation or augmentation of the mandible alveolar ridge was performed only after a general examination of the patient. Contraindications for implantation were disorders of the immune system, diabetes, bone osteoporosis, chemo or radiotherapy, alcohol abuse. For implantation we used single-stage implants of OSTEOFIX OY implant system 8, 10, 12, 14 mm long, 3.8 mm and 4.2 mm diameter. The height of eMDS was measured from ortopantomograms, considering magnification of ortopantomogram view to 20%. In borderline cases, when more precise measurements of eMDS were needed, we used computerised tomography (CT). The quality of bone was assessed according to LEKHOLM - ZARB classification (18). When planning the operation, it was considered that the tip of the implant must be not closer than 2 mm to the mandibular canal, when measuring from an ortopantomogram (19) and not closer than 1 mm when CT was used (20). The width of eMDS was measured intraorally, using a pointed calliper with rubber circles that allowed rejection of the thickness of mucosa. The measurements were taken 3 and 6 mm from the crista of the alveolar ridge. The width of eMDS was recorded according to the narrowest measurement.

The implantation operation was performed according to the standard Adell et al. protocol.

After implantation primary stability of the implant was evaluated as follows: a) a fixed implant; good stability, the implant was not movable; b) a partially mobile implant which is horizontally stable but rotates; sufficient stability, when it was possible to rotate the implant along its axis; c) a mobile implant, which demonstrates lateral or vertical movement; insufficient stability when lateral movements and rotation along implant axis were possible.

In all the cases, after one to two days, clinical symptoms of IAN injury, according to patient com-

plaints, were investigated. If symptoms of IAN were found, the CT was performed in order to detect the location of the implant in relation to IAN.

According to the MDS height and width, estimated at the sites of the planned implants, and in accordance with the literature, patients were divided into 3 groups.

F. Allen et al (20) emphasizes that implantation is effective if the implant is covered by at least 1 mm of bone. As we used 3.8 and 4.2 mm diameter implants, the minimal width of eMDS had to be 5.8 - 6.2 mm.

The shortest implant used was 8 mm long. It was taken into consideration that some authors (21-23) recommend the use of 6-7mm implants only in combination with longer implants or refuse them in the case of low bone density. In order to avoid measurement discrepancies we endeavoured to keep the tip of the implant at least 2 mm from the mandibular canal if measuring from the ortopantomogram (19) and at least 1 mm if measuring from the CT. As the shortest implant used was 8 mm long, the minimal height of eMDS had to be > 9 mm. This way, Group I consisted of patients with height of eMDS > 9 mm and width 5.8-6.2 mm.

When the height and width of eMDS is more than 4 mm, primary stability of the implant may be expected. The bone defects are usually covered by applying various methods of alveolar ridge augmentation. Group II consisted of patients with height of eMDS 4-8 mm and width 4-5 mm.

Group III consisted of patients with height of eMDS <4mm and width <4 mm. In this case primary stability of the implant cannot be achieved.

Data were processed by the statistical program "SPSS/PC + version 8.0.1" (SpSS Inc., Chicago, Illinois, USA). Mean values, standard deviation (SD) were calculated.

Results

For 161 patients (70 males and 91 females) in group I 283 implants were inserted (Table 1). The vast majority of implants were inserted in the region of 46 and 36 teeth (98 and 77 implants) and less in the region of 38 and 48 teeth. During a two month

period 5 implants were removed. Three implants did not heal because of premature loading while wearing the temporary prosthesis. The cause of compromised healing of two implants remained unknown.

Slight and moderate injury of IAN was detected in 16 patients.

In group II 45 implants were inserted for 24 patients. The eMDS height for 10 patients in this group (14 implants) was sufficient (>9 mm) but there was a lack of eMDS width (4-5 mm). Thus the horizontally guided bone regeneration (GBR) using xenogenous bone transplant Bio-Oss[®] and collagenous membrane Bio-Gide[®] with fixation to the bone surface by resorbable pins Resor-Pine[®] was performed for these patients (Table 2). In all cases good primary stability of the implant was determined.

Six patients in Group II (18 implants) had eMDS height of 4-8 mm and width 5.5-7 mm, for whom vertical GBR was applied.

For 8 patients in group II (18 implants) insufficient implantation height (4-8 mm) and width (4-5 mm) of eMDS was estimated. For these patients horizontal and vertical GBR and simultaneous implantation was performed. In 4 cases sufficient implant stability was detected, when rotation of the implant along its axis was present. Two of these implants did not heal and were removed after 3-4 weeks.

For 9 patients from the Group II functional disturbances of IAN of various degrees were estimated. For 6 patients the disturbances of IAN were slight or moderate and for 3 patients - severe.

For 13 patients in Group III (6 male and 7 female) the height and width of eMDS was < 4 mm. In the case of such measurements it is impossible to insert the implant, as it would not be sufficiently stable. Consequently simultaneous implantation with GBR was not available. For 4 patients (7 implants) vertical osteotomy of the mandibular alveolar ridge, filling defect with Bio-Oss[®], was performed.

For 4 patients in Group III (6 implants) horizontal and vertical GBR with delayed implantation was applied. After the operation significant swelling of the soft tissues was determined which caused partial relapse of the sutures. Collagen membrane protected augmentation of the site and in 3 weeks the wound covered with granulations and finally epithelized.

For 5 patients in Group III (12 implants) tunnel augmentation of the alveolar ridge, suggested by the author, using Bio-Oss[®], was performed. During the operation a vertical incision near the last tooth of the teeth arch is made. Through the incision, preserving mucosa, a tissue elevator is inserted between the alveolar ridge and the periosteum. The periosteum is slowly elevated from the sides and crista of the alveolar ridge (not exceeding 2-3 mm). In this way a 3-4 mm high tunnel is created. Bio-Oss[®] is inserted into the tunnel and enlarged alveolar ridge is formed by squeezing the top of the alveolar ridge with the fingers. The wound is sutured. After the operation swelling of soft tissues was significantly lower compared to GBR, and relapse of the sutures did not occur.

In all cases delayed implantation after 6-8 months was performed.

For 2 patients from Group III slight injury of IAN was detected.

Discussion

Correct single-stage implantation was available for 161 patients, 283 eMDS (80.2%). The vast majority of implants were inserted into 46 and 36 regions of eMDS.

In Group II the height of eMDS (4-8 mm) in the region of the premolars and molars of patients was insufficient for proper implantation. Nevertheless, in the case of such heights of dental segments, sufficient primary stability of the implant is still possible. Width of eMDS of 4-5 mm was also insufficient for proper implantation. However, after implant insertion it was found that one side of the implant was covered by bone and the implant remained stable. After implantation for the patients in this group, depending on which part of the implant was not covered by bone, horizontal, vertical or horizontal and vertical GBR was needed. GBR was performed using deproteinized bone mineral (Bio-Oss[®]), resorbable collagen membrane (Bio-Gide[®]), which was fixed to the bone by resorbable pins (Resor-Pin[®]) (13-16). Horizontal GBR was usually needed.

IAN and the foramina mentalia, located at 35 and 45 regions of eMDS reduces the height of eMDS

even if there is no atrophy of the mandible. In this case eMDS was highest in the region of 36 and 46 teeth. Later, narrowing of the alveolar ridge of the mandible, measuring 3 mm from the crista of the alveolar ridge was noted, as a result of atrophy. Later atrophy increased in the second and third molar eMDS regions. It was estimated that in the case of significant atrophy of the alveolar ridge the vertical dimension of eMDS in the 45 region is greater than in the 46 region (Figure 1). This is very important when planning implantation.

The height and width of edentulous eMDS in patients in Group III was less than 4 mm. In the case of these measurements it is impossible to insert the implant, as it would not be stable. For these patients augmentation of the alveolar ridge, applying GBR and tunnel augmentation with Bio-Oss® and delayed implantation after 6-8 months was performed. Our suggested tunnel augmentation of the alveolar ridge with Bio-Oss® is less traumatic and less complicated. During this operation there is no need to use collagen membrane, which is rather expensive. Besides, it has been demonstrated that intact elevated periosteum also protects the augmentation zone from rapid growth of connective tissue and also stimulates new bone formation (25).

In the case of insufficient width of the alveolar ridge vertical osteotomy, filling the defect with deproteinized bone mineral Bio-Oss®, was performed.

After implantation in 27 patients (13.6%) functional disturbances of IAN were found. This was the most common in the patients in Group II (37.2%) who had minimal height of eMDS. In the CT it was estimated that implants were closer than 1 mm to the mandibular canal or either crossed its wall. With treatment for nerve recovery, the function of IAN recovered after 2-8 weeks. For two patients on ortho-

pan tomograms significant jaw atrophy and local or entire narrowing of the mandibular canal to 2-3 mm was determined. For that reason these patients underwent decompression of the mandibular canal with removal of its lateral wall. The wall was removed from the whole narrowed zone. After operation the same treatment for the recovery of nerve function was prescribed. In 3 patients it was found that the implant penetrated the mandibular canal. In all these cases patients were informed of the complication - direct injury of IAN. The implants were removed and treatment with medication prescribed.

As the injury of IAN is one of the most severe complications of implantation in the posterior mandible (6, 7), we did not use IAN transposition, because in as many as 77.8% of cases neurological complications of IAN are observed after this operation (7).

Conclusions

1. The main anatomical criteria for posterior mandible dental arch defects, on which indications for different methods of dental implantation depend, are minimal height and width of eMDS.
2. There are 3 types of eMDS depending on the main anatomical criteria of posterior mandible teeth arch defects:
 - a) The first type - proper dental implantation is available.
 - b) The second type - simultaneous implantation is available only with vertical or horizontal or vertical and horizontal augmentation of the alveolar ridge.
 - c) The third type - only delayed implantation is available after augmentation of the alveolar ridge.