REHABILITATION TECHNIQUES OF THE ATROPHIC JAW IN FRONTAL AND LATERAL AREAS

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ABSTRACT

In practice off each implant clinician, an atrophic and edentulous jaw case, represents a challenging path full of many details and tricky decisions. Although there is insufficient remaining bone for implant placing, there are plenty of treatment methods that can improve the patient's status and lead to a better bone characteristics. On one hand, it is possible to do augmentation of the bone, but on another hand, use the remaining bone from the jaw. In this article will be approached treatment planning, evaluation of the patients and not the least - contemporary methods which can be used for implant based rehabilitation for maxilla and mandibula.

Key words: atrophic jaw, rehabilitation techniques

INTRODUCTION

The greatest loss of bone in the maxilla occurs facially. Horizontal bone resorption can approach 50% of the ridge width at 12 months[1]. The use of a soft tissue borne–prosthesis causes continued medial resorption and loss of vertical bone height. As a result, the atrophic residual ridge may be signifi- cantly palatal to the prosthetic tooth position. Efforts to reconstruct the atrophic maxilla to its original form usually require buccal bone augmen- tation. The surgeon must also contend with the maxillary sinuses and nasal cavity as anatomic limi- tations that may need bone grafting. The maxillary bone is often less dense than the mandible, espe- cially in the posterior regions below the sinuses.[1] Aesthetic zone reconstruction in the partially edentulous anterior maxilla can be especially chal- lenging when a high lip line exposes gingiva.

There are several methods available to augment the atrophic maxilla, including onlay bone grafting, sinus/nasal bone grafting, guided bone regenera- tion, interpositional grafting, ridge splitting, and distraction osteogenesis. The choice of a particular technique depends on the need for horizontal or vertical augmentation, degree of atrophy, type of prosthesis, and clinician or patient preference. Autogenous bone grafting offers a well-proven predictable method for ridge augmentation and defect repair for dental implant placement. There are several advantages to using autogenous bone grafts. Autogenous block bone grafts have a shorter healing period than other approaches such as guided bone regeneration using bone substitutes. This graft usually requires only 4 months of healing before implants may be inserted. On incorporation, the quality of the graft often exceeds the density of the native maxillary bone. This enhanced quality improves implant stability and can shorten healing time. [2] The cost of autogenous bone is obviously much less than using bone substitutes, membranes, and/or re- combinant growth factors. Block bone grafts may be preferred to osteotomy techniques (ridge splitting, interpositional grafts) because they can 3-dimensionally reconstruct the lost anatomic ridge contour. Autogenous bone grafts have proven to be most effective in managing larger bone defects. Although sinus bone grafting may not require

the routine use of autogenous bone, autogenous bone use may be beneficial when treating large pneumatized sinuses with minimal remaining bone.

MATERIAL AND METHODS

Patient history, examination and investigation are, as always important in treatment planning. Smoking, diabetes, and a weakened immune system, along with various medications, including those taken for osteoporosis, can all reduce the success of bone grafting and subsequent implant treatment. In order to evaluate the intermaxillary relationship, a clinical examination is performed together with the health of the oral cavity to exclude any pre-existing oral pathology. [5]

The measurement of the floor of the face, the smile line should be documented in cases of maxillary rehabilitation to ensure that the transition area between the oral mucosa and the prosthesis is hidden under the upper lip.

By scanning the CT essential in the treatment planning process, it allows the clinician to accurately visualize both the volume and the configuration of the residual bone . In addition, the upper jaw allows you to assess the state of health and the degree of pneumatization of the sinus cavities. [6]

AUGMENTATION OF THE REMAINING MAXILLARY

BONE MAXILLARY REHABILITATION OPTIONS

Table 1. Maxillary rehabilitation options

Augmentation of the remaining bone	Utilization of the remaining bone
Sinus floor elevation +/ grafting Onlay bone graft Le Fort 1 osteotomy + bone graft	Short implants Tuberosity implants Pterygoid implants "All-on-4 " Zygoma implants

1. Sinus Floor elevation

The sinus lift using the side window technique was first described by Tatum over 40 years ago. The technique consists of access to the maxillary sinus obtained through a lateral bony window. The window is raised and rotated upwards and medially, taking care at the same time to ensure the preservation of the sinus membrane. Residual materials from this process will be stored and used to graft the sinus floor, including autogenous bone, alloplastic materials as well as carrier devices that contain growth factors. If enough bone remains for primary stability, then implantation and grafting can be performed simultaneously. Del Fabbro et al.2 conducted a systematic review of studies in over two thousand patients who underwent surgery for sinus lift and subsequent implantation. Nearly 7,000 implants were followed for 12-75 months, with an overall survival rate of 92.5%. [6] The highest implant survival rate of 95.9% was reported with the use of non-autogenous grafting materials, compared to 87.7% for autogenous bone. A graft-free procedure has also been described in which the gap under the sinus membrane is filled with a blood clot that allows bone to form.

2. Onlay bone graft

Where we have significant bone deficiency, it can be grafted onto the anterior jaw. This can be done in combination with sinus lift. The bone can be obtained from a variety of local and regional sites, the largest available reservoir being the hip. Depending on the clinical situation, implantation may be performed simultaneously or alternately after the graft has healed. [7] A systematic analysis of this technique reported an average implant survival rate of 87.75%, however a relatively high complication rate was reported for both the donor (10%) and the recipient (22%). Most complications occur if the graft is exposed or infected, in which case there may be partial or total loss.

3. Le Fort I osteotomy

To address an unfavorable intermaxillary relationship and bone deficiency, a Le Fort I osteotomy may be combined with an interpositional bone graft. The jaw can be repositioned both forward and downward, and the graft is fixed to both the nasal and sinus floors. Implantation is usually more common as a two-step procedure. Due to the high bone requirement, the balance is used as the donor site. Due to the complexity of the procedure, a high incidence of complications has been reported at both the donor and recipient site. [7]

UTILIZATION OF THE REMAINING MAXILLARY BONE

1. Short implants

Multiple early studies have confirmed lower success rates with short implants, but with improvements in implant surface technology, it is no longer necessary. Finite element analysis (FEA) confirms that maximum stress occurs along 5–6 mm from the top in implant, and the diameter of the implant is larger for voltage distribution than length. [6]

Adequate width and a height of 5 mm of bone remaining up to the maxillary sinus and the use of a short implant can avoid the need for bone addition. Nisand and Renouard7 in 2014 has reviewed several studies comparing short versus implants of standard length with different vertical enlargement procedures and found similar survival rates. However, the use of short implants has led to faster and cheaper treatment with reduced morbidity. They reported 29 series of cases involving 9780 short implants and found a cumulative overall survival rate of 96.67%.[8]

2. Tuberosity implants

An implant can be placed in the maxillary tuberosity if there is enough bone behind the sinus cavity. Lopez et al.8 reviewed studies that followed 113 patients with 289 implants and reported an overall 6-144-month survival rate of 94.63%. Due to the prevalence of type III and IV bone in this region, none of the studies reviewed the reported load or immediate function of the fasteners. An experienced surgeon with knowledge about anatomy, paying special attention to the largest palatal arteries, should perform implant placement in this region. [9]

3. Pterygoid implants

A pterygoid implant is anchored in the pterygoid plate of the sphenoid bone, through the maxillary and palatine bones with an angle between 35 and 55 and a length of 10–20 mm. In a review of studies reporting a total of 1053 pterygoid implants in 676 patients, Candel et al.9 reported a 90.7% success rate. Pterygoid implants may have an advantage over tuberosity implants because they engage dense cortical bone, however they may be difficult to restore due to their posterior location, and the patient must have a mouth opening of at least 35 mm. 10

4. ‘All-on-4 ’

The contemporary "All-on-4" jaw evolved from Branemark's original 1977 work, in which 4-6 vertically oriented implants were placed in the premaxilla, however, in many cases this led to a distal console. too long. To overcome this problem, Matteson et al.10 in 1999 described a modification of the technique in which the posterior implants were placed at an angle parallel to the anterior wall of the maxillary sinus. The “All-on-4” immediate function concept was developed by Malo et al.11 in 2003 and first applied to the mandible. Later, in 2005, he used same principle in the jaw. [11] A comprehensive recent article by Chan and Holmes12 confirms the high success rate of the technique as reported by various independent authors (95.2–100%) with follow-up between 1–7 years. Currently this technique uses 4

implants: Straight anterior fixations are combined with two distal devices that are tilted posteriorly and placed anteriorly by the maxillary sinuses. The implants are inserted at a torque of> 35 Ncm and are immediately restored. The implant placement can be performed by a conventional open surgical procedure or, alternatively, as a guided one, using the NobelClinicianTM software and the NobelGuide surgical template (Nobel Biocare AB, Zurich-Flughafen, Switzerland). [12] An interesting variation of the standard technique, which looks promising, has been described by Jensen et al.13 for use in those patients who have significant mesial pneumatization of the sinus cavities, but adequate bone stock remaining previously. In these cases, the transsinusal placement of the inclined implants was performed in combination with the grafting of the bone morphogenetic protein 2 of the sinus floor. Of the 19 transsinusal implants placed, 18 remained integrated at 1-year follow-up. This has been presented as an alternative treatment strategy for cheekbone implants. As the maxillary atrophy progresses, there may not be enough bone left for the standard "All-on-4" or any of its variants, and in these cases cheekbone implants may be needed. [13]

5. Zygoma implants

Use of long implants to engage bone stock in the cheekbone was first described by Branemark14 in 1998. The technique used bilateral cheekbone implants in combination with four conventional dental implants in the anterior jaw. Following the "All-on-4" concept, two cheekbone devices are now combined with two conventional implants, and in cases where there is not enough anterior maxillary bone, four cheekbone devices (quad cheekbones) are placed. [10] As with conventional 'All-on-4', fasteners are placed in immediate operation, and surgery can be performed as a conventional or guided procedure. The original Branemark technique, the devices entered the sinus cavity from a more palatal position. One of the criticisms of this the placement method was that fixing head was placed too far to the palace leading to a bulky prosthesis, which was difficult to clean. [13]

MANDIBULAR REHABILITATION OPTIONS

Table 2 Mandibular rehabilitation options

Augmentation of the remaining bone	Utilization of the remaining bone
Bone grafting Distraction osteogenesis	Short implants Nerve repositioning “All-on-4 ”

AUGMENTATION OF THE REMAINING BONE

1. Bone grafting

It is well known that there are two options of bone grafting, onlay or inlay “sandwich-method”, that can be performed. Even if they can be performed to augment the atrophic jaw, with help of particular membrane coverage, each of these treatment path has some cons. One of the main complications of onlay method is graft resorption with incisional dehiscence, plus graft exposure. That can lead to the loss of the graft. On the other hand, inlay method has restrictions of use, as it can be used only for vertical defects, also limited by the stretch of the nearby soft tissues.

2. Distraction osteogenesis

Usually used in the posterior or anterior zone of the atrophic mandible, vertical distraction osteogenesis (VDO), has a major advantage besides bone grafting because is no donor morbidity. Also, it provides a higher vertical gain in bone than other treatments, due to interaction with hard and soft tissues. For this procedure is used a distraction device is secured

to the bone and after 7 days of latency, the superior bone is distracted 1mm per day.
Not to forget that there is a high level of reported complications that occur after this procedure (43.2-79.1%). Some of these are: fracture of the transport segment or mandible, injury of the inferior alveolar nerve and lingual tilting of the transport segment. The rate of implants placed survival is similar to other treatment methods in cases of the atrophic mandible.

UTILISATION OF THE REMAINING BONE

1.Short implants
One of the biggest challenges in implant placement is the posterior segment - situated distal from the mental foramen at the atrophic mandibule. To avoid additional surgical procedures that have always risks, it is commonly used to place short implants in this area. It is required some anatomical aspects for this procedure to be done: the residual bone height above the nerve canal has to be at least 8 mm (ex: 6 mm IM +2 mm safety zone) and of course sufficient width.

2. Nerve repositioning
In cases when the patient has no sufficient bone above the nerve canal at the lower jaw, implant clinicians can resolve it due to nerve repositioning- either lateralization or transposition. Durin lateralisation, the nerve is exposed and retracted during implant placement and released. In the case of transposition, the mental foramen is included in the procedure of osteotomy, and the nerve is moved to a new, more posterior position.
Due to lateralisation - only 3,4% of cases accuse permanent neurosensory disturbance, but for transposition-22,1%.Using Piezoelectric devices instead of rotary devices - can minimise the risk of injury. Although, the rate of success of these procedures is between 93,8-100%.

3.“All-on-4”
In the case of maxillary atrophy, the implants are inserted with a torque of 35Ncm or bigger, as to perform the “All-on-4” procedure. This will allow immediate loading. But for the mandibular zone, is placed into the parasymphyseal region with distal implants titled. That will help to avoid the anterior loop of the inferior alveolar nerve and minimisation of the cantilever. Due to Malo et al. clinical studies, it is known about the success of full-arch immediate loaded mandibular prosthesis.
Despite the fact that it has a high rate of success of 95,4% and marginal bone loss of 1,81 mm, there are some severe atrophy cases, when this method must not be used. It can lead to jaw fracture. As a alternative, the solution can be two implants placed into the parasymphyseal region - as the base for implant-retained overdenture. This method can be considered a real treatment alternative. Although mastication ability, stability, and retention can be improved, many studies have shown good long-term prosthetic and implant survival rates and not at least -patient’s high level of satisfaction.

DISCUSSION

The purpose of implant placement is to achieve a long-lasting anchorage in the best possible position for a functionally and aesthetically optimal prosthetic solution. Thus, implant placement in atrophic edentulous jaws can influence treatment, as there is often both a lack of bone. The clinician needs to be aware of the outcomes of different treatment options in order to critically evaluate the best option for each clinical situation. The treatment methods presented for use in patients seeking an implant prosthesis. Over the past decade, patient-driven demand for immediate single-stage treatment with low morbidity has seen a significant increase in 'graftless' procedures such as 'All-on-4', and longer-term data are now available in the literature to support the validity of these

approaches.The literature przinta good long-term clinical data supporting the use of
of shorter implants as well as traditional grafting procedures such as sinus lifts and onlay grafting. Due to reported complications, nerve repositioning may not be recommended.

CONCLUSIONS

The literature presents several techniques for the rehabilitation of atrophic maxillary ridges. The autogenous bone grafting procedure is considered ideal because it has osteogenic capacity and does not cause any antigenic reaction. However, this type of bone graft has some disadvantages, mainly the limited availability of donor sites. In recent years, several alternatives have been studied to combat the disadvantages of autogenous bone grafts. Studies have shown that allogeneic bone grafts, which are obtained from individuals with different genetic loads but from the same species, have been widely used. These can be indicated in cases of arthroplasty, surgical reconstruction of the knee, large bone defects and in oral and maxillofacial reconstruction. This method has applicability and biocompatibility, this type of bone is available in unlimited quantities. On the other hand, allogeneic bone can have the disadvantage of transmitting infectious diseases. Atrophic jaws can be treated with bone grafts followed by osseointegrated implants to achieve aesthetic and functional oral rehabilitation.

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