IMPLANTS

Options for atrophic edentulous jaws

BACKGROUND

After tooth loss, alveolar bone can undergo complete resorption. In addition, overloading with ill-fitting dentures can cause basal bone loss. With advanced atrophy, implant positioning and prosthetic rehabilitation can be compromised. Each case requires careful patient assessment and either augmentation of the remaining bone or alternative methods that can work with the remaining bone.

PATIENT ASSESSMENT

Treatment planning includes a review of the patient's history, physical examination, and further investigation as indicated. Patients who smoke, have diabetes, have a compromised immune system, or take various medications, such as those indicated for osteoporosis, can have lower success rates for bone grafting and implant treatment.

The intermaxillary relationship, health of the oral cavity, and presence of oral pathology are evaluated. In addition, the resting vertical dimension of the face and height of the smile are measured and photographed. Cone beam computed tomography (CBCT) scans allow the clinician to accurate assess both the volume and the configuration of residual bone. In the maxilla the health and degree of pneumatization of the sinus cavities can be assessed, whereas in the mandible, an orthopantogram can properly assess the adequacy of bone for implantation.

MAXILLARY OPTIONS

Bone Augmentation

Various techniques have been suggested to augment maxillary alveolar ridge width and height (Table 1). In sinus floor elevation, access to the maxillary sinus is obtained through a lateral bone window, which is elevated and swung upward and medially while preserving the sinus membrane. Various materials are then grafted to the sinus floor. If sufficient bone remains for primary stability, implantation and grafting can be performed in the same procedure.

Table 1. Maxillary Rehabilitation Options

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

(Courtesy of Spencer KR: Implant based rehabilitation options for the atrophic edentulous jaw. *Austral Dent J* 63:S100-S107, 2018.)

Onlay bone grafts can be used when the alveolar crest width is significantly reduced. The graft is done onto the anterior maxilla, sometimes in combination with sinus lifting. Implantation can be performed at the same time or after the graft has healed.

Le Fort I osteotomy can be combined with interpositional bone grafting to address a combined unfavorable intermaxillary relationship and insufficient bone stock. Grafting and implantation have been done simultaneously, but more often these procedures are done in 2 stages.

Using Remaining Bone

Finite element analysis (FEA) indicates that implant diameter is more important than implant length with respect to stress distribution. Thus short implants can offer a valuable option when maxillary bone is lacking. A short implant can avoid the need for augmentation and achieve survival rates comparable to standard-length implants with a shorter time needed for treatment, lower cost, and reduced morbidity.

Tuberosity implants can be used if the bone posterior to the sinus cavity is sufficient. The placement of these implants requires an experienced surgeon with knowledge of anatomy who pays special attention to the greater palatine artery position. Pterygoid implants may also be used. These are anchored in the pterygoid plate of the sphenoid bone, through the maxillary and palatine bones, with an angulation of 35 to 55 degrees and a length of 10 to 20 mm. They offer the advantage over tuberosity implants in that they engage dense cortical bone. However, they may be hard to restore because of their posterior location and the patient must have a mouth opening of at least 35 mm.

The 'All-on-4' technique uses 4 implants, with 2 straight anterior fixtures and 2 distal fixtures that are tilted posteriorly and placed anterior to the maxillary sinuses. A conventional open surgical procedure or a guided one can be used. Patients who have a significant mesial pneumatization of the sinus cavities but adequate bone stock anteriorly may be able to have trans-sinus implants placed in combination with bone morphogenetic protein 2 grafting in the sinus floor. As maxillary atrophy progresses, there may be insufficient bone left for standard 'All-on-4' or its variants to be used and zygoma substitutes may be needed. Various zygoma placement surgical approaches have been used.

MANDIBULAR OPTIONS

Bone Augmentation

Either onlay grafting or inlay 'sandwich' bone grafting can be performed in the mandible (Table 2). Grafts include corticocancellous blocks placed via intraoral or extraoral incisions,

Table 2. Mandibular Rehabilitation Options

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

(Courtesy of Spencer KR: Implant based rehabilitation options for the atrophic edentulous jaw. *Austral Dent J* 63:S100-S107, 2018.)

particulate material with membrane coverage, or combinations of these. Complications with this approach include graft resorption and incisional dehiscence and graft exposure, which can lead to loss of the graft. Inlay grafting corrects only vertical defects, and the amount of vertical gain is anatomically limited.

Vertical distraction osteogenesis (VDO) can be used either anteriorly or posteriorly in the mandible. Its advantages include no donor site morbidity and the ability to obtain greater vertical gain in bone height than grafting procedures. In an atrophic edentulous mandible, the remaining bone is seldom sufficient for posterior distraction to be used. VDO is associated with a high rate of reported complications that make it a less desirable choice. Survival rates for implants are similar to those for other methods to augment bone.

Using Remaining Bone

A short implant in the posterior segment distal to the mental foramen avoids the need for more surgical procedures with their associated risks and added cost. Short implants require sufficient width of bone and a residual bone height above the nerve canal that is at least 8 mm (6 mm implant plus 2 mm safety zone).

Mandibular 'All-on-4' is done by placing fixtures into the parasymphyseal region. Distal implants are tilted to avoid the anterior loop of the inferior alveolar and minimize the distal cantilever. The implants are inserted with a 35Ncm torque or greater, as in maxillary cases, to allow immediate loading. If the 'All-on-4' cannot be used and the patient cannot or is unwilling to undergo an adjunctive procedure to permit implantation, a fixed implant-retained prosthesis may not be feasible. Two implants can be placed in the parasymphyseal region as the basis for an implant-retained overdenture in some cases. Retention, stability, and chewing ability can all be improved in this manner, and long-term prosthetic and implant survival rates, as well as patient satisfaction levels, have been excellent.

Nerve repositioning can be available to permit implant placement in the posterior mandible of patients lacking sufficient bone height for conventional implant placement. Success rates with lateralization can be between 93% and 100%. The technique cannot be recommended, however, because of the risk of permanent neurosensory injury.

DISCUSSION

The goal of implant placement is to achieve long-lasting anchorage in the best possible position to create a functional, esthetic prosthetic solution to the patient's oral challenges. Having atrophic edentulous jaws can introduce a degree of difficulty that requires creative alternatives to the conventional techniques. The clinician must understand the outcomes of the options and critically evaluate which option is best in each situation.

Clinical Significance

In addition to considering the functional and esthetic consequences of an implant approach with challenging bone loss situations, the clinician must remember the patient-driven demand for an immediate, single-stage treatment approach that carries low morbidity. The use of graftless procedures such as 'All-on-4' has increased as a result. Longer term data indicate that some of these approaches are valid and useful, especially the use of shorter implants, sinus lifting and onlay grafting.

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IONIZING RADIATION

Radiographs in orthodontics

BACKGROUND

The use of radiographs in orthodontic treatment is guided by basic information about the risks of ionizing radiation to patients along with consideration of the benefits to the patient and the therapeutic decision-making that can be realized by the information the radiographs provide. The relevant evidence was explored along with general guidelines and specific recommendations regarding ionizing radiation exposure's risks and benefits in