Placement of Screw-Type Implants in the Pterygomaxillary-Pyramidal Region: Surgical Procedure and Preliminary Results

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A surgical technique for the placement of titanium screw-type implants (Brånemark system) in the pterygomaxillary-pyramidal region is presented. The correct direction, location, and length of the implant is decided during surgery. Cylindric osteotomes are used as bone-site formers, thus minimizing the use of drills in bone preparation. This not only conserves bone, but greatly reduces the potential surgical risks, especially of hemorrhage.

Key words: Brånemark implant, osteotomes, pterygomaxillary-pyramidal region, surgical technique

In spite of the great advances made by the osseointegration concept in the oral rehabilitation of both completely and partially edentulous patients, there are patients for whom its application becomes especially difficult. In treating patients with resorbed edentulous posterior maxillae, a small quantity of subsinusal bone with low density and pneumatization of the maxillary sinus are usually found. These abnormalities are usually not only the result of tooth extraction, but also of other local and systemic factors. Therefore, the posterior maxilla is a zone where few implants are placed.

This report is concerned with the rehabilitation of patients with edentulism affecting the posterior maxilla. In cases of total edentulism, the oral handicap is generally higher, so more aggressive rehabilitation techniques are justified (general anesthesia, multiple surgical areas, bone autografts, and so forth).

In the rehabilitation of a partially edentulous patient using an implant-supported prosthesis in the resorbed posterior maxilla, one of two available techniques can be used: the sinus lift technique, or placement of an implant in the pterygomaxillary area.

Many studies regarding sinus lift and filling techniques have been reported. While it is not the aim of this report to make an exhaustive comparative analysis between the two aforementioned techniques, a series of firmly tested concepts justify a preference for placing implants in the pterygomaxillary-pyramidal region. Although liophilized and decalcified bone may be promising materials, their use is less predictable than is the use of autogenous bone; and when using autogenous bone, that of membranous origin gives better results than that of endochondral origin. Implants placed together with bone grafts usually present a higher frequency of bone resorption around the implant and have less chance of survival in comparison to those implants placed directly into residual bone.

Sinus augmentation using autogenous bone requires a double surgical area, either intraoral or
extraoral, to obtain enough bone to fill the maxillary sinus. Consequently, implant placement in the pterygomaxillary region is preferred because, although only a few studies regarding implants in this area have been reported, they all present possibilities of being as successful, or more so, than do reports of the use of other techniques.

**Materials and Methods**

The anatomic fundamentals of the use of implants in the pterygomaxillary region have been previously reported. The aim of this technique is to embed the apical portion of the implant into dense bone, which is formed by the joining of anatomic structures: the anterior border of the pterygoid process of the sphenoid and the posterior border of the maxillary tuberosity. The middle area between the two structures of the pyramidal process is formed by the horizontal portion of the palatine bone. This pyramidal process is of great interest, as it is a structure of compact bone several millimeters thick, providing bone volume for implant placement, while the other two anatomic structures are thinner (Fig 1).

In addition to the usual radiographic study (panoramic radiograph, tomographies, skull side view, and so forth), preoperative computerized axial tomography is needed to help establish the exact location, quality, and quantity of the bone available in the described anatomic region. This preoperative study should also include an assessment of the occlusion, a study of potential prosthetic space, and the fabrication of templates for radiographic and surgical positioning. It is important to determine the patient's degree of mouth opening, since the operation is performed with local anesthesia in the most distal portion of the maxilla, and the lack of patient cooperation and/or mouth opening could present a great handicap, making the use of these techniques impossible.

Even though an extensive preoperative workup is done, it is very difficult during surgery to exactly reproduce the implant situation as simulated and planned during preoperative studies, because bone access is achieved following an oblique direction anteroposteriorly and inferior-superiorly (Fig 2). Therefore, access to the bone resembles the hypotenuse of an imaginary triangle, that (to simplify calculations) we consider as a triangle rectangle (Fig 3).

Translated into basic trigonometry, this means that

\[ a = \frac{c}{\cos b} \]

If “c,” the distance from the access point of the maxilla to the posterior edge of the maxillary tuberosity, can be determined in the preoperative study, then variations in \( \cos b \) will determine “a,” or the length of the implant. The purpose is to discourage distal drilling of the pterygoid process and thus avoid the risk of hemorrhage. Using this technique, the exact angle, direction, and length of the implant to be placed will be determined intrasurgically, using drills as little as possible during access to the bone, resulting in an important conservation of bone.

Under local anesthesia, a paracrestal incision is performed, slightly displaced towards the palate, that goes mesiodistally from the posterior edge of the maxillary tuberosity to a few millimeters distal to the last existing tooth. In this way, the distal gingival papilla of the tooth will be preserved when releasing incisions are made towards the buccal vestibule. A mucoperiosteal flap is elevated towards the vestibule and kept in place with the help of a retractor, so that vision is not affected in any way during surgery. An acrylic resin surgical template is used to locate the access point to the maxilla as determined in the preoperative study. At that point, a small perforation of the cortical bone of the maxilla is made with a
Cylindric osteotomes (Site Formers SF0/SF1/SF2/SF3/SF4/SF5, Osteo-Ti, Vale, Guernsy, England) (Fig 4), which are calibrated in millimeters in a set of six instruments of increasing diameter, are used for further bone preparation. Number 0 has a 0.5-mm diameter, no. 1 a 1-mm diameter, no. 2 a 2-mm and no. 3 a 3-mm diameter (nos. 4 and 5 are not used). First, the no. 0 instrument, the only one with a sharp end, is introduced through the cortical access, made with the round bur. With the appropriate angle and direction (based on preoperative radiographic studies), it is moved slowly through the porous bone of the maxillary tuberosity. The impulsion and rotational movement will be continued until dense bone, the pterygomaxillary-pyramidal junction, is reached. At this point, an intraoral and intrasurgical radiograph is obtained or laser-visiography is used to access the angle and location, so that alterations can be made if necessary. Because the osteotomes are graduated in millimeters, the exact length of space existing between the access point and the apical embedding point of the implant will be known (Figs 5a and 5b). It is not difficult to know when the dense bone of the pterygomaxillary-pyramidal region has been reached, as the osteotome will advance easily through the porous bone of the maxilla, while it is difficult for it to penetrate and progress in the dense bone.

Once it is known that the direction is correct, use of the no. 1 osteotome is indicated. Its round head is slowly introduced into the hole made previously with the no. 0 instrument. With impulsive and rotary movements, it will advance slowly and carefully, so as not to alter the direction of the initially obtained path, as well as to allow dilation and microfracture of the cancellous portion of the porous bone. This procedure is continued until the entire length of the no. 0 osteotomy is reached; osteotomes nos. 2 and 3 are then used in an identical manner. After finishing with these instruments, a 3-mm wide tunnel in the bone will have been created from the access point at the cortical ridge of the maxilla as far as the pterygomaxillary-pyramidal region (Figs 6a and 6b). Because no drills have been used, there has been no bone loss; on the contrary, it has been compacted at the tunnel walls, which will envelope the turns of the implant's threads. All osteotomes are used under continuous irrigation. The length of the osseous tunnel is known exactly in millimeters and, through preoperative radiographic and tomographic studies, the measurement in millimeters of the apical embedding area in the mesiodistal direction (pterygomaxillary-pyramidal region) is also known.

For example, let it be assumed that a measure of 5 mm is attained. To the known length of the tunnel (X), a number of millimeters (Y) will have to be added to ensure that the apical portion of the implant is embedded in compact bone and it coincides with the length of the implant of the system being used. If X is 14 mm, it would be necessary to increase 4 mm (Y = 4 mm) to ensure good apical embedding and to enable the use of an 18-mm implant.

Once this new working length (X + Y) is determined, long-shaft drills (SDIB-133, Nobel Biocare, Göteborg, Sweden) are used; the drills are mounted on a handpiece to facilitate the correct working angle, marked at a working length (X + Y), and operated at low speed with copious irrigation. They are used in sequence, working not all along the osseous tunnel, but only in the last few millimeters (Y mm) of the pterygomaxillary-pyramidal region (Figs 7a and 7b). The operation is completed with careful countersinking of the cortical maxilla and the placement of a self-tapping implant, type Mark II (Nobel Biocare SDCA). The result is the placement of an implant with part of its apical portion embedded in dense bone and its coronal portion in the cortical maxilla.

It is important to achieve good initial stability of the implant. When osseointegration is achieved, implants in this area will support forces well, which, because of their angle, will be nonaxial forces.
None of the implants placed to date have failed under function. Failures are normally detected during the second surgical stage and would be the result of lack of osseointegration.

**Results**

Nineteen patients, 11 women and 8 men ranging from 32 to 65 years of age, were selected for the present study. Nine patients were edentulous in the posterior maxilla; seven patients presented with posterior unilateral edentulism, and the remaining three had maxillae which were completely edentulous. A total of 31 implants were placed in the pterygomaxillary-pyramidal region of these patients. These implants have been supporting the load of implant-supported prostheses, all of them for more than 15 months and some for over 3 years.

There have been two failures, both detected during the second surgical stage; their mobility was cause for removal. Thus, a 93.5% survival rate was determined. These results are very similar to those reported for implants in this anatomic region,\(^2^0,2^1\) and are considered preliminary.

**Discussion**

It is generally accepted that the best augmentation material for the maxillary sinus is autogenous bone, that of endomembranous origin being the best choice.\(^1^6,1^7\) To achieve the best results, all sinus lift techniques should probably aim to obtain such bone. This entails two surgical areas, with one or two surgical stages. However, bone resorption around implants in these cases is generally larger, and the rate of survival of these implants is lower than those placed in residual bone. Nonetheless, there seems to be a greater tendency to do sinus graft techniques than to place implants in the pterygomaxillary region.

Considering that these techniques are not mutually exclusive, it seems probable that not all opportunities for placing implants in the pterygomaxillary-pyramidal region are being exploited. Therefore, a simple technique for implant placement in this region has been presented, in which the use of drills is reduced to a minimum, thus conserving bone. Drills do not enter the retropterygoid area, so that surgical risks are reduced, mainly those related to hemorrhage, basically of the internal maxillary artery.\(^2^3\) However, this technique cannot be performed in patients with a critical lack of bone in the maxillary tuberosity.

**Conclusions**

1. A technique has been presented that conserves bone and diminishes surgical risks since there is no need to enter the retropterygoid space or the pterygomaxillary fossa with drills.

2. This technique permits rehabilitation, with implant-supported prostheses, of patients with edentulous areas in the posterior region of the maxilla, with the same or a higher rate of success as can be achieved with other techniques (Figs 8a and 8b).

3. Because of their location, implants in the pterygomaxillary-pyramidal region will be subject to nonaxial forces. However, once they have osseointegrated, they seem to resist these forces better than the rest of the implants in the maxilla.

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FIGURES

Figure 1

Fig. 1 Diagram of the surgical anatomic area.
**Figure 2**

Fig. 2 Direction of implant placement.

**Figure 3**

Fig. 3 Variations in the length of the implant according to the angle of the approach.
Figure 4

Fig. 4 Cylindric osteotomes of increasing diameter used for bone preparation.

Figure 5a

Fig. 5a Intrasurgical approach showing the use of osteotome no. 0.
**Figure 5b**

![Intraoral radiograph: location and length are determined.](image)

**Fig. 5b** Intraoral radiograph: location and length are determined.

**Figure 6a**

![Diagram of osteotome no. 3.](image)

**Fig. 6a** Diagram of osteotome no. 3.
Figure 6b

Fig. 6b Clinical photograph showing the use of osteotome no. 3.

Figure 7a

Fig. 7a Diagram of round drill at working length X + Y.
Figure 7b

**Fig. 7b** Diagram of 3-mm diameter drill at working length X + Y.

Figure 8a

**Fig. 8a** Panoramic radiograph of initial situation.
Figure 8b

![Figure 8b](image)

**Fig. 8b** Panoramic radiograph after 2 years of function.

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