PTERIGOID IMPLANTS: A viable alternative for the rehabilitation of the posterior sectors of the atrophic maxilla

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Abstract

Osseointegrated implants are considered one of the best treatments for dental prosthetic rehabilitation. (Papaspyridakos et al., 2013, Brånemark et al., 1969).
In cases of posterior maxillary atrophy, dental rehabilitation with osseointegrated implants is challenging as there is less bone volume (pneumatisation of the maxillary sinus) and poor bone quality (type III and IV according to Misch's classification).
In 1989, Tuslane and Tessier first described pterygoid implants, which can now be considered one of the rehabilitation solutions for patients with posterior maxillary atrophy.
The present study was conducted to evaluate the survival and success rates of pterygoid implants 3 years after placement.
The surgical activity was conducted from January 2017 to January 2019 with a sample of 37 edentulous patients (partially and/or totally) characterized by poor bone quality and quantity in the posterior maxillary area.
The results of this study supported the research hypothesis because the survival and success rates of the pterygoid implants were 99%.

Introduction

Osseointegrated implants are considered one of the best treatments for dental prosthetic rehabilitation.
In cases of posterior maxillary atrophy, dental rehabilitation with osseointegrated implants is complex because there is less bone volume (pneumatisation of the maxillary sinus) and poor bone quality (type III and IV according to Misch's classification). Various treatment modalities have been proposed for these clinical conditions, including inclined implants, short implants, zygomatic implants, and sinus elevations.
In 1989, Tuslane and Tessier first described pterygoid implants, which can now be considered one of several rehabilitation solutions for patients with posterior maxillary atrophy. The technique,, in this case,, does not involve recreating bone where it should be present but rather "going to find it" where physiologically it certainly is there, i.e., in the pterygomaxillary fossa located immediately behind the jaw. The walls of the pterygomaxillary fossa are represented anteriorly by the tuberosity of the maxilla, posteriorly by the pterygoid process of the sphenoid, laterally by the communication with the infratemporal fossa (pterygomaxillary hole), and medially by the perpendicular lamina of the palatine bone. The pterygomaxillary surface of the sphenoid bone represents the roof of the fossa. The internal maxillary artery passes approximately 1 cm above the pterygopalatine suture when it enters the pterygopalatine fossa. Therefore, the distance from the artery to the lower end of the pterygomaxillary suture is 25 mm. Due to the absence of vital structures in the area of implant insertion, this area can be defined as a safe area for the surgeon. Any bleeding in this region comes from the veins of the pterygoid muscle and can be stopped quickly once the implant is inserted.
Previous studies have suggested that the ideal angle of the pterygoid implant should

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reach the pterygoid plate. The average anteroposterior angulation axis of the pterygoid implant varies from 45 to 70°, relative to the Frankfurt plane, and the buccopalatal angulation axis ranges from 10 to 15°. Some anatomical and radiological studies have proposed that pterygoid implants should be at least 13 mm long to engage the dense cortical pterygoid plate. Furthermore, some studies have suggested that longer implants (13-22 mm) have better survival rates in this region.
It is essential to clearly distinguish pterygomaxillary implants from pterygoid implants as the former include short implants placed only in the maxillary tuberosity, inclined implants placed in the tuberosity or the pterygomaxillary region not reaching the dense cortical pterygoid plate, which in contrast is reached by pterygoid implants.

Materials and methods

The present study was conducted from January 2017 to January 2019.

The sample

The sample included 37 patients, of whom 22 were men and 17 women aged between 38 and 65. Partially edentulous and edentulous patients with poor bone quality and quantity in the posterior maxillary area and with a residual tuberous bone ridge of less than 7 mm between the sinus floor and the alveolar ridge (atrophic maxilla) were included in this study. The criteria for exclusion from the study were: poor bone quantity in the tuberosity region (< 3 mm); patients with bruxism; the presence of uncontrolled systemic diseases; emotional instability; ongoing maxillary radiotherapy; ongoing chemotherapy; patients with sufficient bone height bilaterally in the posterior maxilla to allow implant placement according to the standard protocol.
All patients underwent OPT and CBCT X-ray examinations to assess bone size and bone quality of the upper jaw and for implant planning. On the day of surgery, participants were treated under local anesthesia using articaine with epinephrine 1:100000. Tooth extractions, when necessary, were performed as atraumatically as possible, trying to preserve the buccal alveolar bone. The extraction alveoli were cleaned of any granulation tissue. Functional and aesthetic dental rehabilitation was designed on D3 and D4 bone density with pterygoid osseointegrated implants used as implant abutments for Toronto bridges (46 pterygoid implants for 23 patients) and three-unit bridges (14 pterygoid implants for 14 patients).

Pterygoid implants

Pterygoid implants are placed in the posterior area of the maxillary tuberosity, which is closely connected at the bone level with the pterygoid process of the sphenoid and the wall of the pyramidal process of the palatine, thus representing an appropriate anatomical structure, characterized by compact bone, suitable for supporting dental implants. The pterygoid implant is an endosseous fixture of 15 to 22 mm in length; the greater length of the implant, compared to a standard fixture, makes it possible to reach the pterygoid fossa and thus the sphenoid abutment of the same name on which the anchorage of the apical part of the implant takes place, gaining primary stability. The pterygoid implant is generally characterised by an external connection type for prosthetic ease. The pitch of the implant coils is wide in the most coronal part of the implant to allow better integration with the spongy bone characterizing the maxillary tuber; in the most apical part of the implant, the coils will have a narrower pitch, making contact with the compact bone of the pterygoid process.

Surgical procedure

Flap opening and site preparation:
Make a full-thickness maxillary tuberculum crest incision followed by vestibular and palatal release incisions. The greater the bone atrophy, the more the ridge incision will be vestibular to remove the anatomical risk of the palatine artery. Proceed with skeletalization of the posterior-upper maxilla and identification of clinical and radiological anatomical landmarks.
Creation of the implant site Use the “spear” or “ball” drill to create an invitation on the cortical bone, which is useful for positioning the tip of the depth drill. We use the Ø 2.20 mm depth drill to make the pilot hole to the pterygoid fossa. Finally, we use the depth gauge to check the clinical length of the pterygoid implant. We enlarge the hole using a Ø 2.80 mm reaming bur and then a Ø 4 mm reaming bur.
Implant insertion: Insert implant with extended handpiece prehensile spanner with drill extension. Apply a maximum torque of 50Ncm and a maximum speed of 25 RPM. It is also possible to insert the implant with a manual fitter and a dynamometric reversible ratchet to assess the final implant insertion torque. Finally, insert the cap screw.

Clinical cases

Pterygoid implants were used for the Toronto bridge (46 pterygoid implants for 23 patients) and the three-unit bridge (14 pterygoid implants for 14 patients). We present two clinical cases, one for a prosthetic Toronto bridge and one for a prosthetic three-unit posterior bridge.

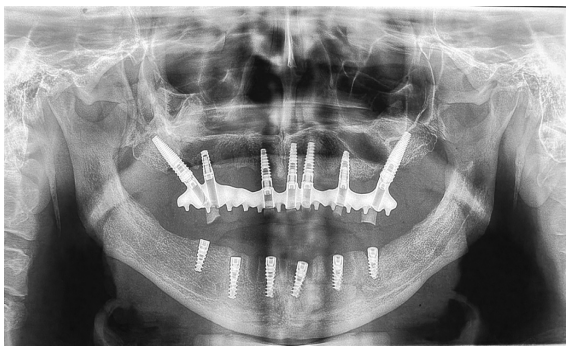

Figure 1.

Clinical Case II

The 65-year-old patient underwent a dental examination for quadrant II rehabilitation. Following a careful analysis and study of the radiological images in 2D and 3D, a fixed partial working plan on 3 implants with position 2.4; 2.5 and 2.8 (pterygoid) was proposed. (Fig.2)

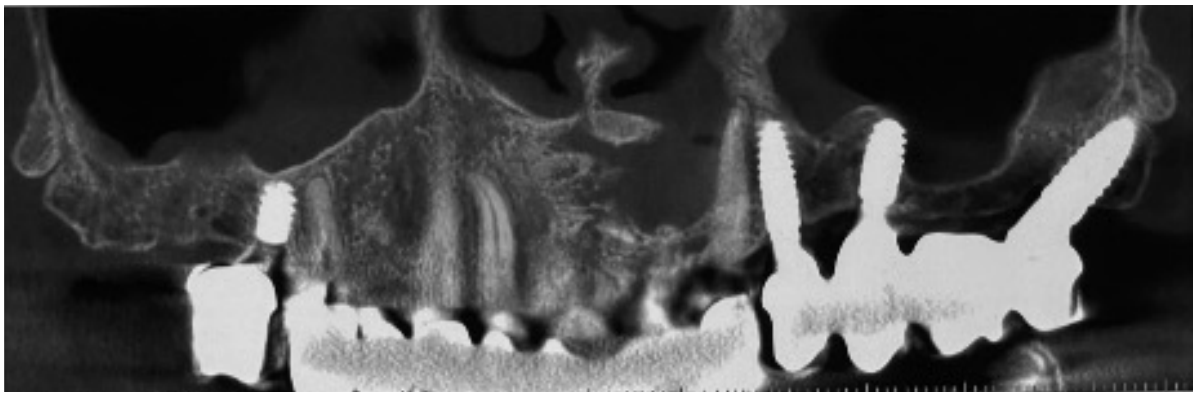

Figure 2

Sample analysis

A control orthopantomography (OPT) and a Cone Beam Computed Tomography (CBCT) with 2-year follow-up were performed on all test patients evaluating the following parameters:
assessment of vestibular and palatal bone cortical thicknesses, implant mobility, bleeding on probing (BoP), and keratinized gingiva width (KGW). The thickness of the buccal and palatal bone ridges was assessed through a three-dimensional cross-sectional examination and using the calibration and measurement tools intrinsic to the software in use, Sistema Imagind Dentale - MyRay. The measurement of horizontal bone thicknesses, both vestibular and palatal, was calculated at 3 mm apically at the implant neck. Bleeding was analyzed through the use of a PCP11 millimetric periodontal probe (Hu-Friedy Tuttlingen-Möhringen, Germany), classifying it as present (yes) or absent (no). Implant mobility was assessed as present or absent. The width of keratinized tissue, according to existing literature, supports the need for ≥2 mm (KTW) around the implants, as its presence is associated with a reduction in mucosal inflammation, brushing discomfort, and plaque levels.

Results

A total of 60 implants were placed in 37 patients. The overall survival rate of the pterygoid implant at two years was 99%. At two years after surgery, the vestibular bone about the pterygoid implants maintained an average thickness of 1.48 mm; the palatal bone an average thickness of 1.94 mm; the width of the keratinized gingiva demonstrated an average structure of 2.14 mm; 2 implants demonstrated bleeding on probing and no implants showed mobility (Tab.1)

Discussion

We know the sinus lift technique as an alternative to pterygoid implants for rehabilitating the atrophic posterior maxilla. The latter technique not only gives excellent results but also requires more rehabilitation time than pterygoid implants, as the complete healing of the operation is achieved in approximately 5 to 6 months. Complications concerning the sinus lift technique are also known to occur, including perforation of the Shneider's membrane, severing of the anastomosis between the posterior and superior alveolar artery and the infra-orbital artery, and the risk of non-integration of the graft and therefore failure of the work.
The present study evaluated the 3-year implant survival of pterygoid implants in participating patients with severe posterior maxillary atrophy. The results of this study supported the research hypothesis because the survival and success rates of pterygoid implants were 99%. The pterygoid implants were placed in the maxillary tuber with an

Table 1.

N° implants	Vestibular ridge thickness (mm)	Ridge thickness Palatal (mm)	Bleeding	Mobility of the plant	KGW (mm)
1	1,31	1,3	No	No	4,03
2	1,25	2,02	No	No	3
3	2,01	1,45	No	No	2,1
4	2,03	2,13	No	No	2,03
5	1,1	2,3	No	No	2,88
6	1,02	3,01	No	No	1,09
7	2,1	1,98	No	No	1,23
8	1,35	1,35	No	No	1,34
9	1,42	1,67	No	No	1,29
10	1,54	1,56	No	No	1,9
11	2,13	1,78	No	No	1,95
12	2,09	2,34	No	No	2,76

continue

13	1,37	2	No	No	2,59
14	1,34	1,45	No	No	2,46
15	1,23	2,34	No	No	2,56
16	1,24	2,1	Si	No	1,55
17	1,33	2,01	Si	No	1,89
18	2,02	1,67	No	No	2,02
19	1,4	1,46	No	No	1,45
20	1,56	1,56	No	No	1,56
21	2,34	1,34	No	No	1,8
22	2,23	1,45	No	No	2
23	2,04	1,79	No	No	2,78
24	1,12	1,97	No	No	1.05
25	1,01	2,67	No	No	2,78
26	1	3,03	No	No	2,98
27	2,01	1,3	No	No	3,04
28	1,45	2,34	No	No	3,23
29	1,55	2,45	No	No	4
30	1,57	3	No	No	2,06
31	1,02	1,97	No	No	1,87
32	1,67	1,67	No	No	1,01
33	2,01	1,85	No	No	1,87
34	2,09	2,01	No	No	1,66
35	2,13	2,89	No	No	2,44
36	1,04	2,78	No	No	1,97
37	1,12	1,54	No	No	1,55
38	1,01	2,01	No	No	2,79
39	2,01	2	No	No	3
40	1,3	1,75	No	No	1
41	2,03	3,01	No	No	1,96
42	1,1	1,78	No	No	2,11
43	1,03	1,45	No	No	2,34
44	1,05	1,36	No	No	2,78
45	1,2	1,78	No	No	1,67
46	1,4	1,68	Si	No	1,98
47	1,13	2,56	No	No	1,78
48	1,09	3,01	No	No	2,45
49	2,3	1,98	No	No	2,78
50	1,2	2	No	No	2,01
51	1,02	1,78	No	No	2
52	1,09	1,21	No	No	1,96
53	1,34	1,09	No	No	1,78
54	1,22	1,77	No	No	2,43
55	1,04	1	No	No	2,09
56	2,01	1,67	No	No	2,06
57	1,45	2,09	No	No	1,98
58	1,34	3,34	No	No	2
59	1,6	1,97	No	No	2,03
60	1	1,12	No	No	1

anteroposterior and vestibulopalatal inclination dictated by the study of 3D Cone Beam radiographic examinations. After the maxillary tuber, the implant makes contact with the pyramidal process of the palatine bone and, finally, with the pterygoid process of the sphenoid bone.
In palatine-pterygoid bicorticalism, the implant obtains its primary stability, determining its success.
The internal maxillary artery is located within the pterygopalatine fossa about 25 mm from the surgical site, close to the posterior wall of the maxillary sinus, and is, therefore, not at risk of surgery. Planning the insertion with cone beam computed tomography and staying within the soft tuberosity bone until impact with the compact bone of the pyramidal and/or pterygoid process is mandatory to avoid damage to the artery.

Conclusion

From these data, it is possible to conclude that the use of pterygoid implants is currently a viable alternative for rehabilitating the posterior sectors of the atrophic maxilla, also giving the possibility of prosthetic restoration up to the upper second molar. However, the pterygoid implant technique offers the possibility of exploiting the patient's native bone, has reduced post-operative complications, pathologies of the maxillary sinus do not prevent the work from being carried out, and guarantees a high clinical success rate. Knowledge of the anatomy, preoperative planning, and the appropriate surgical skills are indispensable for a favorable result.

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