PTERYGOID IMPLANTS – TREATMENT OPTION FOR AN ATROPHIC MAXILLA: AN ARTICLE REVIEW

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Abstract: Treating of fully or partially edentulous maxilla in the posterior part is always a challenge for an implant surgeon. Atrophic posterior maxilla has many limitations for an implant placement and prosthetic rehabilitation. Factors that are affecting implant placement are poor bone quality and quantity in the posterior part of maxilla, low level of maxillary sinus floor, difficulties in accessibility and maintaining oral hygiene. Posterior cantilevers on prosthetic construction may produce few complications, such as prosthesis fracture, screw loosening, loss of osseointegrated implant, and crestal bone resroption.
There are few options for treating maxillary edentoulism in the posterior part. Those options include maxillary sinus floor elevation, bone augmentation, zygomatic implants, short implants, tilted implants and pterygoid implants.
Pterygoid implants have been defined by the Glossary of Oral and Maxillifacial implants (GOMI) as "Implant placement through the maxillary tuberosity and into the pterygoid plate". Pterygomaxillary region provides us an excellent space for an implant placement and prosthetic rehabilitation of posterior maxilla, without any additional surgical procedures. Implants placed in this region are also known as pterygomaxillary implants and tuberosity implants.
The aim of this article is to highlight the use of pterygoid implants as a graftless solution for treating atrophic maxilla, expressing the anatomy of the region, implant insertion technique and advantages. Also, narrative review of clinical outcomes from different articles published on Pubmed, Medscape, Cochrane Library and Google Scholar are included.
Pterygoid implants have high success rate, minimal complications and good acceptance by patients. This option is a viable alternative treatment modality for rehabilitation of patients with an atrophic posterior maxilla
Keyword: pterygoid implants, atrophic maxilla, pterygomaxillary region.

1. INTRODUCTION

Prosthetic rehabilitation of edentulous maxilla using dental implants is well-established and highly predictable solution especially after the successful introduction of the concept of osseointegration by the Prof. P.I Branemark in the early 1960s. (Branemark P-I, 1969). But implant treatment of an atrophic maxilla is always a challenge mainly in the posterior part due to the limited anatomical and clinical factors. Those factors include insufficient bone volume, poor bone quality and quantity (usually Class III and Class IV according to Lekholm and Zarb), pneumatization of the maxillary sinus, problems with the accessibility and difficulties in maintaining oral hygiene (Candel E, 2012). Also, biomechanical factors must be considered as occlusal forces are higher in the premolar and molar regions than in the anterior maxilla (Martins Curi M, 2015).
Different treatment modalities have been reported in the literature to overcome those problems such as guided bone regeneration, maxillary sinus lift procedure, short implants, tilted implants, zygomatic implants. (Candel E, 2012). Anyway, aforementioned modalities require adding surgical areas and increased number of treatment stages, with higher morbidity and longer treatment periods. They also carry the risk of serious complications such as perforation of sinus membrane, graft displacement into maxillary sinus, rejection of the graft and screw-loosening of tilted implants (Nag PVR, 2019).
In 1989, buttress composed of maxillary tuberosity, the pyramidal process of the palatine bone, and the pterygoid process of sphenoid bone has been recommended by the French surgeon Tulasne for implant placement to rehabilitate posterior maxilla. Together with Tessier they introduced the idea of inserting implants in the pterygomaxillary region as a solution for the aforementioned limitations, problems and complications (Tulasne JF., 1992).

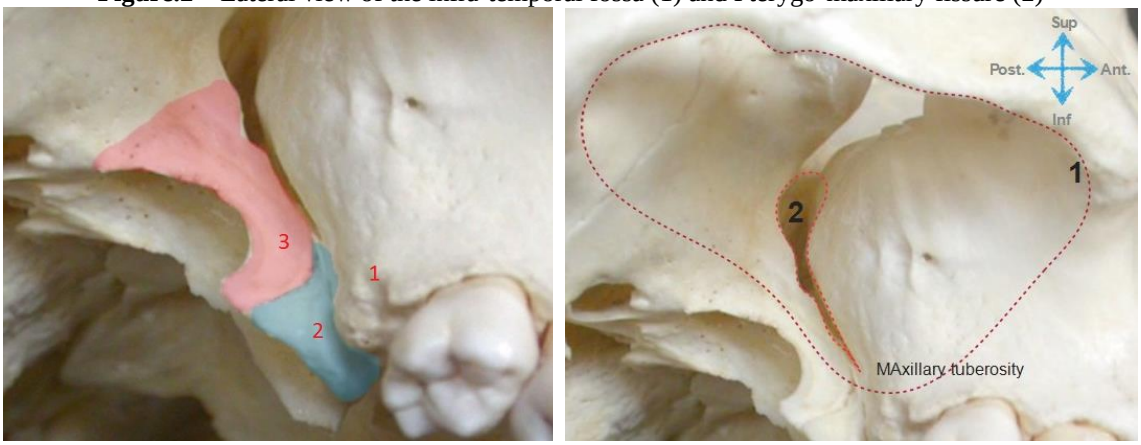
2. ANATOMY OF THE PTERYGOMAXILLARY REGION

The support for the pterygoid implants is derived from three parts (Agbaje, 2021)(**Figure.1**):

1. Tuberosity of maxillary bone
2. Pyramidal process of the palatine bone
3. Pterygoid process of sphenoid bone

Figure.1 – Lateral view of the pterygomaxillary region, showing the main three bone structures for engaging pterygoid implants

Figure.2 – Lateral view of the infra-temporal fossa (1) and Pterygo-maxillary fissure (2)

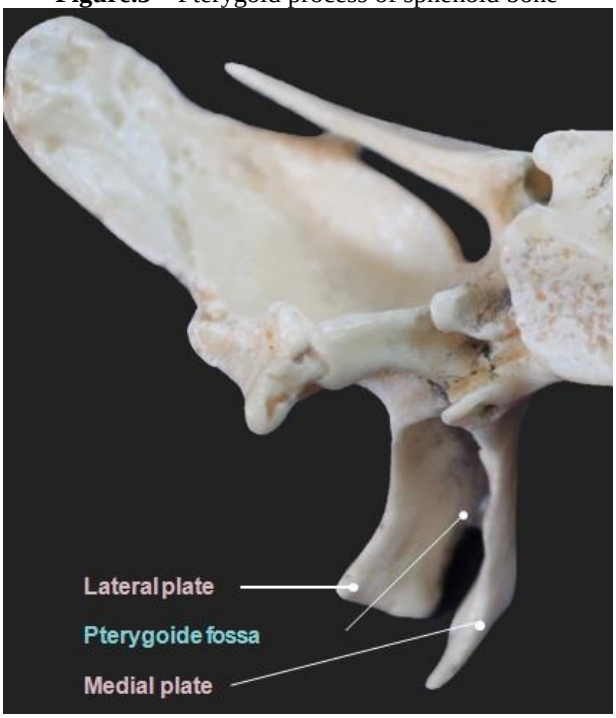


I. Maxillary tuberosity is the lower part of the infratemporal surface of the maxilla. In form of rounded eminence which gives origin to a few fibers of the lateral pterygoid muscle and medial pterygoid muscle. Maxillary tuberosity contributes in the creation of the infra-temporal Fossa and anterior wall of Pterygo-maxillary Fossa (**Figure.2**)

II. Pyramidal process is outstanding process of palatine bone. It projects backward and lateralward from the junction of the horizontal and vertical parts of the palatine bone. It serves as a link between the maxillary tuberosity and pterygoid process of sphenoid bone.

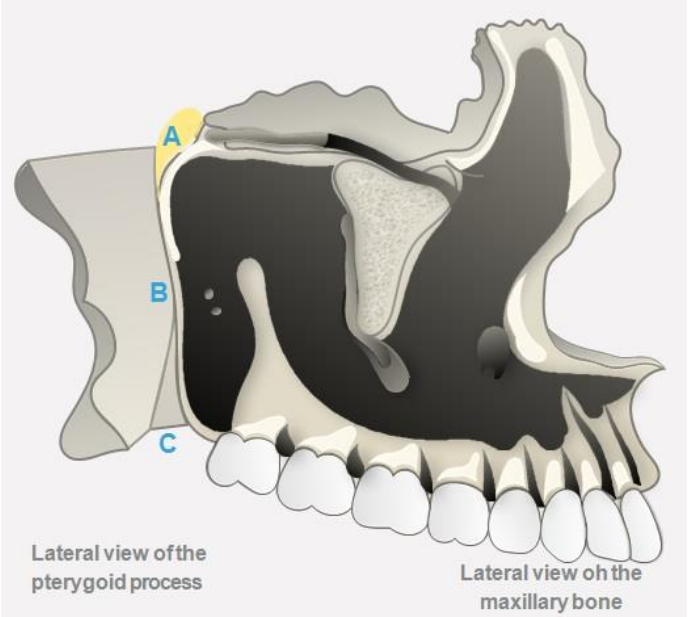
III. The pterygoid process is one of the three paired processes that projects from the body of the sphenoid bone. The pterygoid process consists of two plates that towards inferiorly, the flattened lateral pterygoid plate and thinner medial pterygoid plate. Between the two plates lies pterygoid fossa (Fahrenbach M, 2017) (**Figure.3**).

Figure.3 – Pterygoid process of sphenoid bone



Upper part of pterygoid process border bounds the pterygomaxillary fissure posteriorly. The intermediate part articulates with the maxillary tuberosity, and the lower part articulates with the palatine bone (**Figure.4**)

Figure.4 – Pterygomaxillary fissure (A), articulation with maxillary tuberosity (B), articulation with palatine bone (C)



3. SURGICAL INSERTION TECHNIQUE

Implant placement in the pterygoid process of sphenoid bone requires surgical experience and deep knowledge of the anatomy in posterior maxillary region. Radiographic information is used to plan the accurate position of the implant, its angle and to avoid perforation of the maxillary sinus. After anaesthesia of the region achived with local anaesthetic solution, surgical technique begins with making a full-thickness crestal incision on an edentulous crest as far as the back of the tuberosity, extended by a vestibular releasing incision. The incision design allows the surgeon to visualize of the entire tuberosity, including its posterior part (Agbaje, 2021). Tilted concept is used to place the pterygoid implant. Drilling of the implant site begins with pilot drill at a working speed of 600rpm, beginning from the border between second and third molar region toward the junction formed by the three bone structures (Nag PVR, 2019). The drill axis runs toward the plate at about 20-30° in the horizontal plane and about 45° from the maxillary plane and it continues up to the pterygopalatine-tuberosity suture, which is the anchorage region for the pterygoid implant. Final tapered drill is used for condensing and widening of the implant site. The implant used is 18-25mm long and 3.75mm or 4.2mm in diameter. For implant stability, insertion torque of >40N/cm are to be obtained if immediate loading is desired. The implant is anchored in the medial part of the pterygoid plate of the sphenoid bone and with distal angulation between 35° and 55°, depending on the maxillary sinus floor and the height of the bone of the tuberosity (Tulasne JF., 1992). Multiunit abutments with different lengths (3-5mm) and angulations (30°, 40° and 50°) are placed to obtain parallelism. Postoperative panoramic radiographic is needed to confirm the implant position (Nag PVR, 2019).

4. MATHERIALS AND METHOD

This survey is based on Narrative review on published articles written on English language reporting results related to the use of pterygoid implants as a solution for an atrophic maxilla. The search was made using PubMed, Medscape, Cochrane Library and Google Scholar. The search was done by using the terms as: “pterygoid implants”, “pterygomaxillary implants” and “atrophic maxilla AND dental implants”. The initial online search showed 74 articles. After implementing the inclusion criteria: review and systematic review studies published since 2011 (last 10 years) which included the key word: “pterygoid implant” only 3 studies were selected (**Table.1**).

Table.1 – Qualitative data of the final 3 systematic reviews selected in our article

Systematic review studies			
Name of the author	Year published	Study publised on:	Articles reviewed
Bidra A.S et al.	2011	Int. J Oral Maxilofac Surg.	9
Candel E et.al	2012	J Oral Implantol.	13
Araujo R.Z et al.	2019	J Craniomaxillofac Surg.	6
	Total number od articles reviewed		**28**

5. RESULTS

After the analysis of the selected systematic reviews, published on English language in last 10 years, we conclude that they analyze in total 28 articles. Some of the total 28 articles overlap, 11 of them are included in both or in all three analyzed studies. Here are presented 17 studies from 1992 to 2015, with total number of pterygoid implants – 2525 and average success of 91.88%. (**Table.2**)

Table.2 – Data summary of the studies included, analyzed and reviewed in the selected 3 systematic reviews

Study name	Year	Follow-up time	No. of implants	Success (%)
Bahat.	1992	12-37 months	72	93
Graves	1994	4 years	64	89.1
Khayat and Nader	1994	4 years	65	95
Balshi et al.	1995	1-63 months	51	86.3
Balshi et al.	1999	54 months	356	88.2
Krekmanov	2000	12-123 months	14	85.8
Vrielinck et al.	2003	6-24 months	14	71
Balshi et al.	2005	6-54 months	164	96.3
Penarrocha et al.	2007	12-45 months	11	90.9
Valeron and Valeron	2007	10 years	152	94.7
Aparicio el al.	2008	24-60 months	10	90
Penarrocha et al.	2009	12-69 months	68	97.1
Ridell et al.	2009	144 months	22	100
Park and Cho.	2010	Not reported	17	100
Rodriguez	2012	6 years	454	96.5
Balshi et al.	2013	Not reported	925	94.16
Curi et al.	2015	3 years	66	93.9
	Total No. of implants		**2525**	
		Average success (%)		**91.88**

6. DISCUSION

The main finding of Araujo RZ et al. (2019) in their systematic review of retrospective studies is that the pterygoid implants have a high survival rate in the dental rehabilitation of posterior atrophic maxilla. In general 6 included studies in this systematic review reported that pterygoid implants can osseointegrate and remain functionally stable. The 10-years survival rate of pterygoid implants was high (94.85%) in the analyzed studies. Most of the implant failure occurred 6 months after implant insertion and before implant loading. Once the successful osseointegration is achived, pterygoid implants remain stable and functional after the first year.

Bidra et al. (2011) in their systematic review analyze 6 retrospective and 3 prospective studies. They conclude that the implant survival rate (ISR) is encouraging but this result has to be interpreted with caution. Most failures occurred before implant loading. Even though the figures seem encouraging, there are insufficient data about failures that occurred beyond the first year timeline. More studies with longer follow-up periods, involving adequate

number of pterygoid implants are needed. This will help to obtain a better understanding of the survival of the pterygoid implants.

Candel et al. (2012) analyzed and reviewed 13 articles reporting 1053 pterygoid implants in 676 patients with follow-up period between 6 and 123 months. The weighted average success of pterygoid implants was 90.7%. They conclude that pterygoid implants have high success rates, similar bone loss level to those of conventional implants, minimal complications and good acceptance by the patients.

7. CONCLUSION

The placement of implants in pterygomaxillary region provides bone anchorage in the posterior maxilla avoiding additional surgery like sinus lift or bone grafting. Pterygoid implants also eliminate the effects of cantilever-induced loading forces when only anterior implants are used to support a complete fixed prosthesis. From a surgical point of view, the placement of pterygoid implants requires experience, operative skill and accurate knowledge of the anatomy of the affected region.

Based on the findings of our article review we can conclude that the pterygoid implants have a high success rates after loading, but new studies with longer follow-up periods are needed.

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