Review Article

PTERYGOID IMPLANT- For Atrophic Posterior Maxilla

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Abstract
The replacement of missing teeth in the posterior maxilla is often a task for the implant surgeon, as the posterior maxilla has many barriers in terms of consistency, quantity, maxillary sinus anatomy, and inaccessibility.There are many surgical procedures to resolve these defects, such as sinus raise, bone augmentation, tilted implants, short implants, and zygomatic implants. As these procedures have their own limits, the pterygomaxillary area provides us with an ideal location for implant placement and posterior maxilla recovery. This series discusses the use of the pterygomaxillary area for implant placement to restore the posterior atrophic maxilla without any additional surgery.
Keywords: Graftless solutions, petrygomaxillary implants, posterior maxilla.

INTRODUCTION

Dental implant/endosseous implant/fixture, a surgical component that interacts with the jaw or skull bone to support a dental prosthesis such as a crown, bridge, denture or facial prosthesis.[1]Implant placement through the maxillary tuberosity and into the pterygoid plate has been defined as pterygoid implant.[2]It has been used primarily in the rehabilitation of atrophic maxilla patients or for the prevention of maxillary sinus augmentation procedures. It was first offered in 1975 by Linkow and described in 1992 by JF Tulasne.This anatomical advantage was identified in 1989 by Tulasne and the use of pterygoid implants in the pterygomaxillary area was first described. Because of the consistency and volume of available native bone and the presence of the maxillary sinus, implant placement in the posterior maxilla is a great challenge.The drawbacks include higher surgical morbidity, bone grafting criteria, and increased cost and time of care. They still have do not allow immediate loading/function in patients with edentulosis.[3]The causes of insufficient bone volume deficiency, especially in the posterior maxilla, may be due to bone resorption, sinus pneumatization or a combination of both. In these cases, the insertion of implants remains extremely unpredictable in this area.[4]For the placement of dental implants, the posterior area of the maxilla has many limitations[5,6,7]such as low bone volume, the presence of the maxillary sinus, accessibility issues, and the difficult hygiene that they require..[8,9]Many surgical techniques, including sinus floor augmentation, alveolar distraction, directed bone regeneration, zygomatic implants and the use of pterygoid, pterygo-maxillary or pterygo-tuberosity implants, have been identified for the reconstruction of the posterior maxilla.[10]One of the methods that can be executed to address this issue is the sinus lift procedure with bone grafting. In recent years, this technique has gained popularity, but it has its own disadvantages, such as the need for a double surgical site with a consequent rise in patient morbidity.

However, with this treatment, the risk of sinus membrane perforation as well as the likelihood of graft resorption around the implant remains. Besides this, in patients with chronic maxillary sinusitis, the treatment can be difficult. If minimal bone height is not present, the vascularity of the graft is also uncertain.[11]

DISCUSSION

The key finding of this systematic analysis is that pterygoid implants have a high survival rate for posterior atrophic maxilla dental rehabilitation. All the included studies stated, in general, that pterygoid implants can osseointegrate and remain functionally stable. Six months after implant installation surgery and before implant loading, most implant failures occurred.After the first year, pterygoid implants stayed stable and functional after osseointegration. Pterygoid implants are required for posterior atrophic maxilla rehabilitation. In other regions of the maxilla, the survival rates measured are as high as traditional dental implant survival rates. The procedure of pterygoid implant surgery follows the same fundamental concepts of traditional implant surgery.A simpler surgical approach can be considered to be the pterygoid implant technique, since it does not require a bone grafting procedure. Less overall morbidity, lower care rates, and faster recovery times are correlated with this strategy.From a prosthetic point of view, due to the emergence of pterygoid implants in the second molar region, dental rehabilitation with pterygoid implants has the benefit of eliminating long distal cantilevers.Although the cleaning of prostheses of the pterygoid implants that arise in the posterior region of the maxilla may be a concern for both patients and professionals, this factor has not been reported in any of the posterior region of the maxilla the research involved. A high degree of patient satisfaction related to final prosthesis recovery was also recorded by Curi and Penarrocha. Excellent primary stability of the implant may also provide opportunities for rapid loading of the implant and prosthetic recovery. Rodriguez et al. (Rodrıguez et al., 2015) analysed 202 cone bean computed tomographic files of atrophic maxilla patients and found that compared to the tuberosity zone, the bone density of the pterygoid plate area was three times greater. Bone density ranged from 285.8 to 329.1 DV units in the tuberosity zone, and density varied

from 602.9 to 661.2 DV units in the pterygoid plate sector, with a 95 percent DV band.

An anatomical analysis of the pyramidal process of the palatine bone in relation to the implant placement in the posterior maxilla was recorded in some studies with a minimum implant length of 13 mm for pterygoid implants and measured the height and anteroposterior and mediolateral distances of the pyramid process. An anatomical analysis of the pterygomaxillary region with 100 cone beam computed tomography was recorded by Rodriguez et al. (2014); a mean bone corridor height of 22.5 mm was found. In this systematic analysis, if implants had a minimum length of 13 mm, they were called pterygoid only. One research that has not listed the duration of the pterygoid implant. While these authors did not mention the length of the implant, they identified the complete pterygoid implant technique, with the apex of the implant engaged in the pterygoid plate.

ANATOMY OF UPJAW (MAXILLA)

Except for the largest bones of the skull, the maxilla is
Via their union, the mandible, and form, the entirety of Your upper jaw.Each helps to shape the limits Three cavities, that is to say, the roof of the mouth, the floor The lateral wall of the nose and of the orbital floor; It also includes the formation of two fossas, Two fissures, the infratemporal and pterygopalatine, and The orbital and pterygomaxillary of the inferior Each bone has a body and four procedures. Frontal, alveolar,zygomatic, and palatine. (Fig 1)

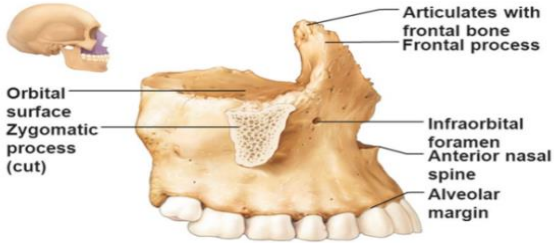

Fig.1 (a): Maxilla (Lateral view)

The Body (corpus maxilla). The body is a little pyramidal in form,The maxillary sinus is a large cavity and contains (antrum of Highmore).
There are four surfaces—
Superior or orbital, lateral, posterior or infratemporal, superior,and a nasal or medial one.

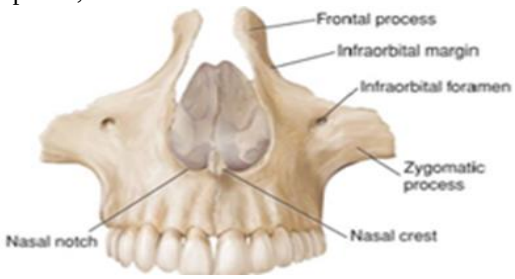

Fig.1 (b): Maxilla (Frontal view)

SURFACES:

SURFACE ANTERIOR:

The surface of the anterior is directed forward and lateral.
It presents a series of eminences at its lower portion
Corresponding to the locations of the teeth roots. A depression, the incisive fossa, is just above that of the incisor teeth, And gives rise to the Depressor alae nasi; the alveolar nasi; A slip of the Orbicularis oris is affixed to the boundary below the fossa; The Nasalis occurs above and slightly lateral to it.Another depression is lateral to the incisive fossa, the canine Fossa; it is broader and deeper than, and is larger than, the incisive fossa. Separated from it by a vertical ridge, the eminence of the canine, referring to the to the canine tooth's socket. The infraorbital foramen, the end of the infraorbital canal, is above the fossa; it transmits the infraorbital foramen, the infra-orbital vessels and nerves are transmitted.

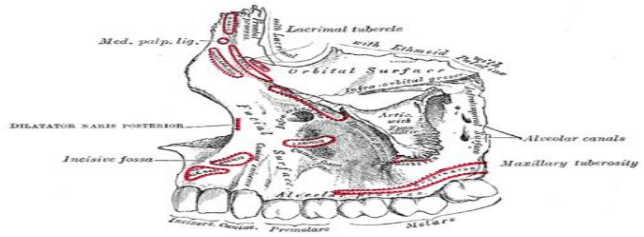

Fig. 2: Anterior surface of maxilla

MAXILLARY SINUS:

•A large pyramidal cavity is the maxillary sinus,
Within the maxilla's body: its apex, The zygomatic is formed by a directed lateral direction, Method; its basis, guided towards the media, by the processThe nose's lateral wall.
•Its walls are unusually thin everywhere,Nasal orbital, anterior, and correspond to The bone and the subtemporal surfaces of the body.
•The nasal wall, or base, is present in the disarticulated area.
Bone, an irregular, broad aperture that interacts with
About the nasal cavity.This aperture is in the articulated skull.
The following bones have decreased in size a lot:
The uncinated ethmoid process above, the ethmoid process above,The inferior nasal concha ethmoidal process the vertical part ofthe palatine above, and the vertical part of the palatine above, and The sinus interacts with the middle meat of the nose, normally through two narrow openings left between the above-mentioned bones; a small section of the lacrimal above and in front.
• Typically only one small opening, near the upper part of the cavity, remains in the fresh state; the other is blocked by the mucous membrane.

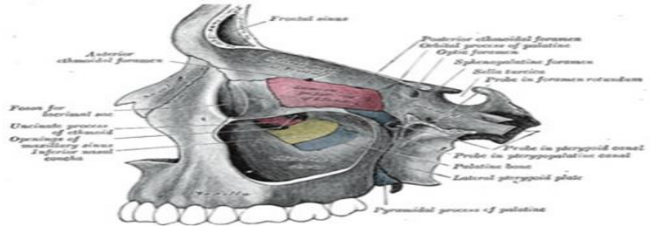

Fig.3: Left maxillary sinus opened from the exterior

PATHOLOGIC ANATOMY

MAXILLARY ATROPHY:

Bedrossian and associates divided the maxilla into three zones of potential atrophy, and their classification aids in understanding the use of zygomatic and other implants in this patient group. (Fig 4.)

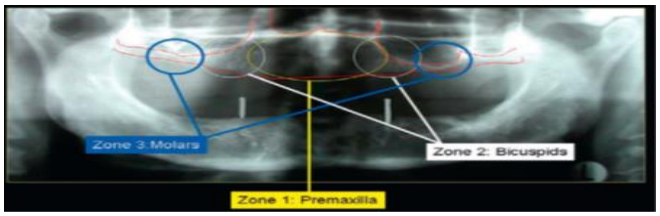

Fig. 4: Classification of the three zones of the maxilla

•Edentulous patients with an eggshell-thin posterior maxillary alveolus (zone 3) who retain 4 mm or less of vertical bone height are not candidates for simultaneous posterior implant placement and sinus lift bone grafting.
•Edentulous patients who are fortunate enough to have adequate bone in the incisor-canine region (zone 1), as well as the premolar region (zone 2), may be candidates for the simpler option of tilting the most distal implants to extend the fixture's location distally to the second premolar–first molar area as described in the "all on 4" technique.
•Patients with combined zone 2 and zone 3 atrophy must choose between staged sinus lift bone grafting followed by multiple con¬ventional root-form implants and the graftless, single-stage option of zygoma implants.
•Patients with maxillary atrophy are often elderly and may have medical co-morbid conditions that make them better candidates for a single operation to place all their implants. Such medically fragile patients may be less suitable for a multistep, multiple-surgery treatment plan involving staged sinus lift grafting followed months later by subsequent conventional root-form implant placement.

ANATOMY OF THE POSTERIOR MAXILLA

The precise structures in the posterior maxilla that offers potential assistance for the positioning of implants. Maxillary bone tuberosity, the palatine bone pyramidal process,and the sphenoid bone pterygoid process.(Fig.5)

Fig. 5: Region of a skull demonstrating the inferior relationship of the tuberosity, the palatine bone pyramidal process, and the sphenoid bone pterygoid process.

TUBEROSITIES

oThe tuberosity the convexity of the maxillary alveolar ridge is the posterior one. The pyramidal approach is its medial and posterior limit. The palatine bone's pyramidal process and the sphenoid bone's anterior surface of the pterygoid process are situated behind and slightly medial to the tuberosity. In order to achieve the best fixture position, the implant needs go through the tuberosity, bone palatine and finallyends inpterygoidprocess. (Fig 6).

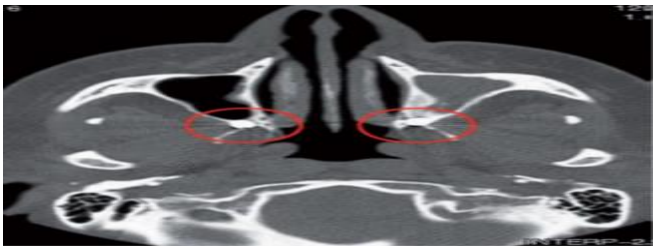

Fig.6: Patient CT with implants correctly anchored into the pterygoid process.

PTERYGOID PROCESS:

Pterygoid processes are two more compact bone columns than superior maxilla. They go down from the sphenoid bone to the lower area. The pterygoid process is compound by three parts: upper base, wing and pterygoid groove. The distance from the alveolar crest at second molar level to the medium region of pterygoid process is usually 15 mm.Due to this, at least 13 mm of length is necessary to reach the pterygomaxillar process. Only by this way the fixture will be called pterygoid implant[11] (Fig 7).

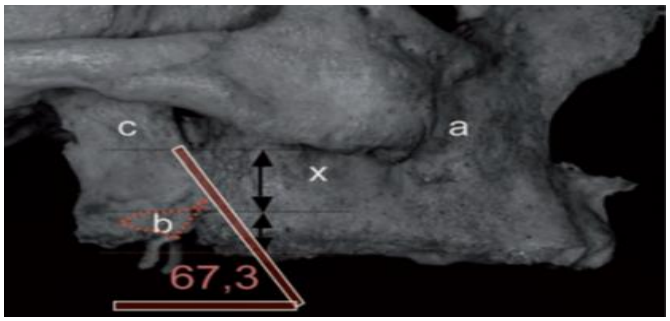

Fig. 7: Pterygo-palatine-maxillar area in a lateral view
a) Superior maxilla. b) Bone palatine pyramidal process. c) Sphenoid bone pterygoid process. x) Pterygomaxillary suture length (12 mm). y) Tuberosity length (5 mm).Anthropometrically the position of this bone column compound by the tuberosity, the palatine bone and the pterygoid process, has been analyzed and the angulation change according to presence or absence of the dentition. In dentulous maxilla,there is no resorption then, the tuberopyramid- pterygoid column angulation is 76, 5±SD 3, 0ºin mesio-distal way respect to the Frankfurt plane and 17,2º ±SD 2,7ºof bucolingual angulation. In edentulous maxilla, the column angulation is 67, 3º ±SD 5, 0º in mesio-distal way respect to the Frankfurt plane and 14,1º ±SD 2,1º of bucolingual angulation[12]. The pyramidal process conforms the pterygomaxillar suture width. Pterygomaxillar suture inthe half lower part is compound by three bones: tuberosity, pyramidal process and pterygoid process.
If we observe these bones in lateral view, we can find four different shapes: (FIGURE 8).Type to I: equilateralShape of triangle. Type II: rectangleShape of triangle. Type III: narrow rectangletriangle shape. Type IV: there is no shape in lateral vision.

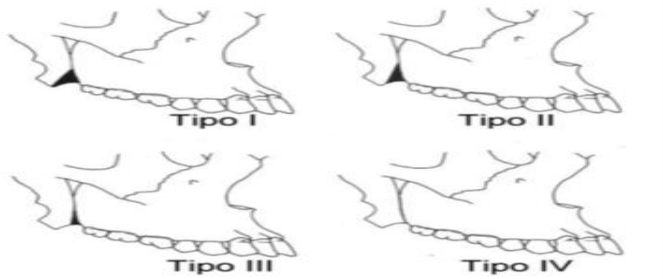

Fig. 8:Palatine bone pyramidal process from buccal view.
In caudal vision, we can distinguish three types:Type to I: equilateralShape of triangle. Type II: rectangleShape of triangle. Form III: narrow rectangleShape of triangle.According to Lee, the length of the pterygomaxillary suture or the pyramidal palatine bone process height is 13.1 mm and the antero-posterior width is 6,5mm. 45 (83%) of the 54 measured skulls by Lee, showed higher height than 10 mm.

PTERYGOID IMPLANTS

Endosseous implant inserted via the maxillary tuberosity and the pterygoid plate; suggested for dental or maxillofacial prosthesis retention in the maxillae.[26]

Implants of Pterygoid are when located in the pterygoid process, the length of fixtures of 7 mm to 20 mm enables prosthetic regeneration without graft in the posterior maxilla. They need mesial abutment usually located in the premolar area.(Fig: 9)

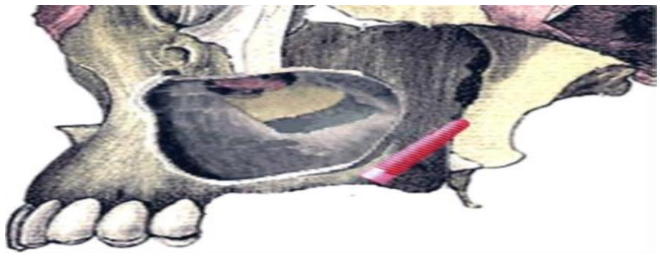

Fig 9: Pterygoid implants

This technique consists of using the near compact bone (pterygoid process – palatine bone) as a fixture support. When we use this technique it's not necessary to harvest the compact bone from donor site to the sinus. The applied forces go to the pterygomaxillar buttress and they spread to the skull.[28]

AREA OF PLACEMENT :

2 separate anatomical locations where pterygoid implants are inserted are described in the literature: the pterygoid process (Fig: 10) and the pterygomaxillary area (Fig: 11).

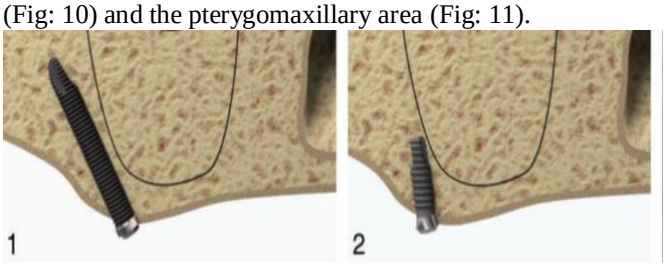

Fig 10. In the pterygoid phase, an implant**Fig 11**. In the pterygomaxillary an implant

DESCRIPTION IN PTERYGOID IMPLANT :

Implant lengths ranged from 7 mm to 20 mm. In the pterygomaxillary area, shorter implants were implanted and longer implants were anchored in the pterygoid phase. Longer implants were used in the pterygoid process to compensate for the poor quality of the posterior maxilla and to achieve sufficient intraosseous fixation. The majority of the implants used were 15 mm long (approx. 97 percent). The use of implants <15 mm in length in this field has been defined in several studies; however, it would be very difficult to include these implants in the pterygoid plate according to the present findings. Pterygoid implants are typically mounted at an angle of 45 ° to 50 ° to the horizontal plane with a diameter between 3.75 and 4 mm.

INDICATIONS:

1.Patients with partial arches of edentula.

2. Absolutely exuberant arches. In maxillary complete arch fixed implant-supported prosthetic rehabilitation, they are particularly helpful when four implants do not sufficiently provide force distribution and prosthetic support.

3. Rehabilitation of maxillectomy defects.

CONTRAINDICATIONS:

Patients with trismus or reduced mouth opening,when there is an absence of maxillary tuberosity. Entry to the pterygomaxillary area is obliterated by the presence of an affected maxillary third molar.

ADVANTAGES:

No bone graft is necessary, integrity of the sinus is preserved, the architecture of the sinus (e.g., septafed sinus) is rarely a technical problem, the outcome is predictably successful (of 50 fixtures placed, six have been unsuccessful), the anterior-posterior spread is maximized; there is no need for cantilevering,the fixture is pioced at an easy angle to restore, there is little morbidity, tuberosity reduction or other tissue pasty can be done simultaneously, treatment time is shorter than with sinus grafting.

DISADVANTAGES:

The procedure is technique sensitive—it is a semi blind procedure through 15 to 20 mm of bone, adequate bone support is necessary in the tuberosity and pterygoid raphae region.

PREOPERATIVE EVALUATION

A high-quality panoramic radiograph is usually all that is necessary to evaluate the area radiographically. Consideration should be given to the degreeof sinus pneumatization,the shape of tuberosity, the relativethe density of bone of the pterygoid plates. Knife-edged maxillary ridges are rarely o problem in this area, because the maxilla tends to increase in width as it approaches the second and third molars. Computerized tomography provides a clearer picture, but has been used by the author only in patients with severe maxillary atrophy.

The size of the sinus determines both the angle and anteroposterior placement of the implant (Figs 10 to 11).

PATIENT SELECTION:

Until surgical procedure, a systematic preoperative assessment of the patient is needed. Before initiation of surgical procedure, all surgical and prosthetic needs must be considered in order to allow for a consistent outcome.The quantity of residual bone in the pterygomaxillary region is taken into account by the preoperative assessment procedure. Patients had to be in good general health and a minor oral surgical procedure had to be tolerable.

ANATOMICAL AND RADIOLOGICAL APPROACH:

All patients should receive a preoperative orthopantomography. In the panoramic radiograph, the patient should be positioned through the guides lights along three major axes (anterior-posterior, vertically (Frankfort plane), and midsagittal alignment) to standardized the radiologic measures. Thus computed tomography of cone beams (CBCT) and panoramic tests are done to assess the following parameters:

1.) Implant angulation of the anteroposterior axis relative to the Frankfort plane on a reconstructed panoramic view (Fig. 12);

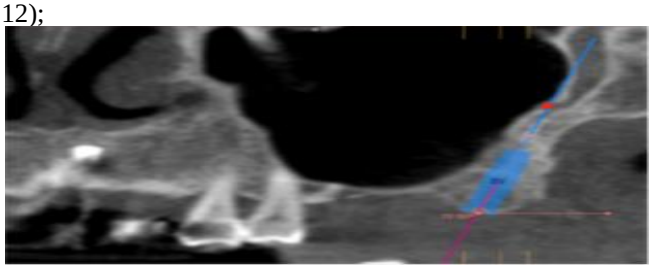

Fig 12: Virtual implant placement following the pterygoid bone corridor; the mesiodistal inclination (panoramic view) is shown

2.) Distance from the alveolar ridge of tuberosity to the most apical point of the apophysis of the pterygoid following the long virtualimplant axis; Bone mass, measured in the pterygomaxillary area as the density value (DV),

1.) Density of bone (DV) in the region of tuberosity.
2.) On the buccopalatal axis, the implant angulation relative to the Frankfort plane (Fig. 13);

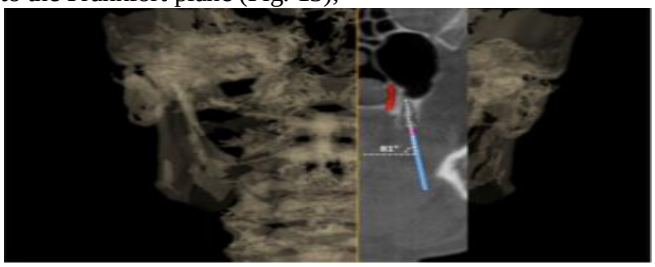

FIG 13: Picture showing the location of the virtual implant in coronal view; showing buccopalatal angulation. A protection gap of more than 2 mm should be noted between the body of the implant and the palatal artery.

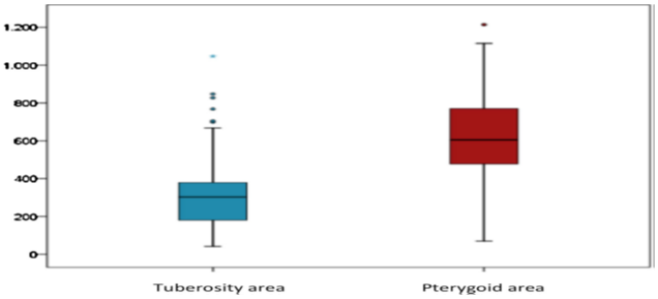

Fig 14: Density in the tuberous and pterygoid regions; importance of density in the tuberous and pterygoid regions; (DV).

OPERATIVE TECHNIQUE:

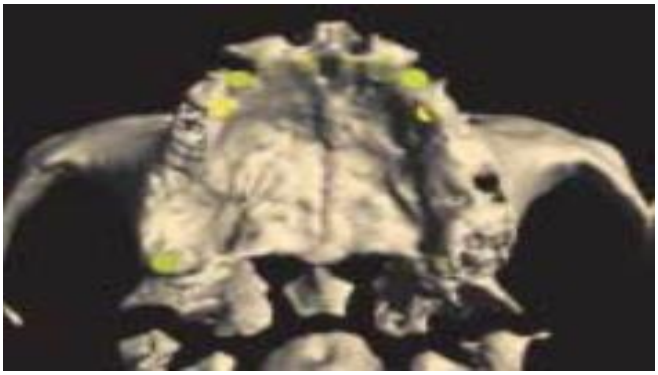

Fig 15: Digital computerized tomogram of the atrophic maxilla with the planned implant site

FIG 16: A depth probe is placed on the hamular process to help in the orientation.

The ideal implant placement is 5 mm lateral to this process. This structure is frequently palpated during the drilling phase. A full-thickness incision is made a few millimetres medial to the crest of the tuberosityto the premolar zone, from the pterygomaxillary fissure. A soothing cleavage is placed anteriorly. A mucoperiosteal flap is elevated buccally, exposing the tuberosity entirely.

Fig 17: The standard incision is made from the posterior tuberosity, slightly medial to the alveolar crest to the premolar area.

A "labial veneer" stent is preferred for the flexibility if affords the surgeon in location and angle of the fixture. Because of the angulation of the fixture, the crew access area will be in the central fossa of the first molar. The implant angle is determined by the floor of the sinus and verticalthe height of the tuberous bone. The normal tendency when this procedure is attempted for the first time is to place the fixture too far anteriorly with too little horizontal angulation.A guide hole 3 to 4 mm deep is placed in the second molar area of thetuberosity with a No, 4 or 6 round bur.

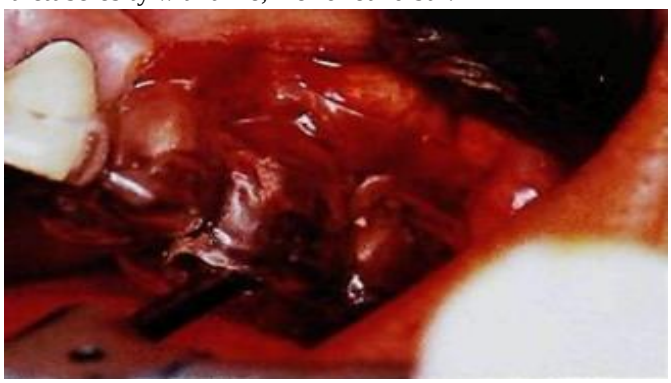

Fig 18: A guide hole is placed with the aid of a labial veneer stent.

To establish the final depth and angle of the fixture placement, a long-shaft 2-mm twist drill on a bur extension is used.

Fig 19: A long-shaft 2-mm twist drill on a bur extension is sunk through the pterygoid buttress.

The hamular process is palpated and at approximately 45 degrees to the occlusal plane, the drill is directed 5 mm laterally. The primary guide used to determine the thickest part of the pterygoid bone pillar is this procedure. If the correct direction is taken, the twist drill will meet the

pterygomaxillary thick cortical bone.The stitching area is 10 to 14 mm long. The drill will noticeably slow down, then speed up again after the pterygoid phase passes through it.The drill is removed and a probe is placed in the hole in an attempt for feel the sinus cavity. If the floor of the sinus has been perforated, a new site must be located at least 3 mm posterior to the previous one. The long shaft pilot and twist drills are used similarly. It is important to pass completely through the pterygoid plate buttress of bone. There is no countersinking.

Fig 20: An 18-mm implant is placed without countersinking.

After the implant site has been completely prepared, a depth probe with an enlarged tip is used to explore the site and determine the length of the implant to be used. Care is taken to check that the sinus has not been perforated. The implant should pass completely through the pterygoid process to establish bicorticalstabilization, a fixture that will extend 3 to 4 mm past the pterygoid process and into the fossa is selected. This is usually a self-tapping 15- to 20-mm threaded implant. It is easily placed with a long fixture mount.

COMPLICATIONS:

There are main surgical hazards that can occur during the procedure:-

•The first is a significant intraoperatory bleeding that stopped at the place of the implant.Bleeding is due to the proximity of the inner maxillary artery, 1 cm above the pterigomaxillary suture, an unusual complication of this kind.A minor venous bleeding caused by the insertion of the drill a few millimetres into the retropterygoid region was identified by Valero'n and Valero'n. With local haemostatic procedures, it was resolved.

•The second one is a hypoesthesia of the palatine nerve that was done in 4 weeks.

•The third was a pain that needs to remove the implant.

When anchoring the implants into the pterygoid process, Krekmanov reported problems. Due to drilling outside the pterygoid process, an implant was lost during placement. Due to difficulties putting them in the initially drilled implant bed and having to put them in a different location, Vrielinck et al lost 4 out of 6 implants, which resulted in inadequate bone anchorage.

•Some authors related the difficult prosthetic process as a complication.

•Raspall described 2 abscesses in 238 cases of pterygoid implants.

CONCLUSION

With the use of implant help obtained from osseous sites in remote locations such as zygomatic bone, the advancement of Osseo integrated implant principles, as they refer to rehabilitation of extremely resorbed maxillae or maxillary defects, has been significantly enhancedpterygoid process or pterygomaxillary region. The newer radiographic tools like CBCT have enabled us to place implants in previously inaccessible areas like pterygomaxillary region. We are able to successfully restore the posterior atrophic maxilla without the augmentation of the deficient bone with sinus lift procedures. This procedure, like any other procedure has certain disadvantages like the site of implant placement is anatomically complicated and poorly understood. Further, inadequate mouth opening restricts both the placement as well as prosthetic restoration of implants in this area. Although the outcomes are positive, the selection of cases is important and a detailed understanding of the risks associated with the procedure should be taken into account. Thepterygoid plate fixture has been used successfully with fixed prosthesis, partial prosthesis, and framework-supported over dentures. Many of the implants have been in function for more than 4 years. Restoring posterior maxilla using pterygoid implants is beneficial as these implants are stable biomechanically and there is no cantilevering of pontics. The success rate achieved with this implant compares favourably with implants used in other areasabout the maxilla. Implants inserted in the pterygomaxillary area provide us with outstanding posterior bone support without maxillary sinus augmentation or additional bone grafting. Long term evaluation is needed to assess the visibility of implant placement in the pterygoid plate region.

The key drawback of this procedure is that the positioning of the implant is precarious because this site's anatomy is poorly defined. To fit the hand piece and the drill, mouth opening should be sufficient.The restoration of pterygomaxillary implants is a challenge for prosthodontics since the site is inaccessible and all components should be treated with extreme caution because the components are highly likely to be aspirated. While the findings are positive, the selection of cases is very critical and a detailed understanding of the procedure's pitfalls should be taken into account.

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