DIRECT AND INDIRECT SINUS LIFT A PROMISING TECHNIQUE FOR THE MANAGEMENT OF RESORBED POSTERIOR MAXILLA: A CASE REPORT

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ABSTRACT
The posterior maxilla presents several challenges to the implantologist. An excellent treatment modality that had been into the modern era of dentistry is implant dentistry. The application of implant dentistry could jeopardize the patients presented with deficient alveolar ridges. The most often encountered magnified problem in the posterior maxilla is ridge resorption and sinus pneumatization. This anatomic deficiency can be restored by a procedure called maxillary sinus floor lift. The purpose of this case report is to bring forward such a technique which prevents perforation of sinus lining during implant placement by doing the sinus lift with a direct and indirect approach and to compare both the sinus lift approaches.
Keywords: Sinus Lift, Bone Graft

INTRODUCTION:
Implant placement in the posterior edentulous maxilla poses a considerable challenge in implant dentistry, primarily due to severe bone loss resulting from sinus pneumatization, alveolar bone atrophy, or trauma. To address this issue, multiple sinus lifting techniques have been employed, demonstrating noteworthy success rates in preparing these sites for implant placement. A thorough understanding of the maxillary sinus anatomy not only aids in meticulous preoperative treatment planning but also plays a crucial role in preventing potential complications during sinus lifting procedures. Clinical studies indicate that patients with resorbed maxillae requiring implant treatment can significantly benefit from sinus augmentation. This article delves into the fundamental techniques—direct and indirect—utilized for maxillary sinus elevation and augmentation.[1,2]

Things to consider in maxillary sinus anatomy- Understanding sinus anatomy is crucial for clinicians in order to make accurate assessments and effectively plan and manage sinus lifts. Diagnostic imaging plays a vital role in treatment planning for

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oral rehabilitation in the posterior maxillary region. Cone-beam computed tomography (CBCT) offers precise measurements of residual bone height and density, along with valuable information about the maxillary sinus membrane, vascularization in the lateral sinus wall, existence of pathologies, and whether or not septa are present.

Anatomical landmarks- Located para-nasally, the maxillary sinus is the largest pyramid-shaped sinus averaging 36–45 mm in height, 23–25 mm in width, and 38–45 mm in length. With an average volume of 15 ml, its anterior wall extends from the inferior orbital rim to the maxillary alveolar process, housing the infraorbital neurovascular bundle. A thin superior wall serves as the floor of the orbit. The posterior wall acts as a barrier between the maxillary sinus and the pterygopalatine fossa, accommodating the posterior superior alveolar nerve and blood vessels, the pterygoid plexus of veins, and the internal maxillary artery.

The medial wall aligns with the lateral wall of the nasal cavity, featuring the primary ostium, which functions as the primary secretory drainage channel. The lateral wall forms the buccal aspect of the sinus and is adjacent to the posterior maxillary and zygomatic processes. It's the lateral wall which provides access for the lateral wall sinus graft procedure.

Maxillary premolars' and molars' roots are closely adjacent to the inferior aspect of the maxillary sinus. Molars' roots are nearer to the sinus than premolar ones. Mesiobuccal root apex of the second molar is closest to the maxillary sinus wall, whereas lingual root apex of the first premolar is furthest from the sinus wall.

Maxillary sinus septa (FIG. A) can be categorized based on their origin, with primary septa developing during maxillary growth and tooth emergence, and secondary septa acquired during maxillary sinus pneumatization following tooth loss. Predominantly, septa are situated between the second premolar and first molar region. The existence of septa often complicates sinus lifting procedures [2]. In cases where a septum fully partitions the sinus, creating more than one lateral window as part of the sinus opening becomes necessary to navigate around the septa.

Schneiderian Membrane

The Schneiderian membrane lines (FIG. B) the maxillary sinus ranging in thickness from 0.13 to 0.5 mm. Complete separation of the membrane from the caudal area is necessary for effective sinus lifting. That said, caution is advised as the distal side of the sinus may extend significantly. The

likelihood of sinus membrane perforation is contingent upon the angle between the lateral and medial walls of the sinus. Narrower angles are associated with a higher risk of perforation [3].

Overfilling the maxillary sinus with bone graft material may lead to membrane necrosis, sinusitis, and potential graft loss into the sinus. Therefore, careful consideration of these factors is essential for successful maxillary sinus procedures.

Vascularization: FIG. C

The blood supply to the maxillary sinus is facilitated through maxillary artery branches, specifically the infraorbital, posterior lateral nasal, and posterior superior alveolar arteries. Additionally, the greater palatine artery may supply blood to the inferior part of the sinus.

The lateral wall of the maxillary sinus is supplied by the infraorbital artery and the posterior superior alveolar artery, while the medial wall is served by the posterior lateral nasal artery. In the lateral wall, both extraosseous (in the buccal tissues) and intraosseous (within the buccal plate of bone) anastomoses occur between the infraorbital and posterior superior alveolar arteries.

The extraosseous anastomosis is situated approximately 23–26 mm from the ridge, posing a risk of hemorrhage during flapping. The intraosseous anastomosis is positioned around 16–19 mm from the ridge, and the detection of radiolucency in the buccal plate on the CBCT scans indicates the presence of an intraosseous blood vessel. This may require careful handling during lateral window preparation.

Indications and Contraindications of Sinus Lifts

Indications

- Insufficient remaining bone (i.e. vertical bone height of less than 10 mm)
- Resorption in the posterior maxillary alveolar bone [4].

Contraindications

- Acute or chronic sinus sinusitis
- Severe allergic rhinitis and usage of topical decongestant and vasoconstrictor medications such as Oxymetazoline
- Neoplasm or large cyst of the sinus
- Previous sinus surgery (e.g. Caldwell–Luc operation)
- History of radiation therapy to maxilla

- Presence of septa
- Uncontrolled diabetes mellitus
- Alcoholism or heavy smoking
- Psychosis (4,5)

Sinus Lifting Techniques

The choice of maxillary sinus elevation and augmentation method is determined by both your preference as a clinician and your patient's anatomy. Patient-specific anatomical factors, such as residual bone height and the desired amount of lift, play a crucial role in this decision-making process.

There are two primary approaches for maxillary sinus floor elevation: the *direct approach*, which includes the lateral window technique, and the *indirect approaches*, encompassing osteotome sinus floor elevation, bone-added sinus floor elevation, minimally invasive transalveolar sinus approach, and antral membrane balloon elevation. For the purposes of this article, we will focus on the lateral window and trans crestal sinus floor elevation techniques.

Lateral Window Technique

The sinus membrane is exposed and operated on through the window created in the lateral wall of maxillary sinus.

Surgical Steps

1. **Local anesthesia**: infraorbital, posterior superior alveolar, greater palatine nerve block; subperiosteal anesthesia through slow infiltration.
2. **Incision**: to create the lateral window, it is essential that soft-tissue incisions allow sufficient space. An anterior vertical incision should be positioned in front of the sinus wall to ensure soft tissue coverage over the bone. Then, a connecting mid-crestal ridge/palatal incision is made (preferably in keratinized tissue to facilitate suturing). A full-thickness flap is then reflected to access the posterior lateral maxillary wall.
3. **Lateral wall**: the outline of the lateral wall window on the buccal plate of the bone is drawn. The length of the to-be-placed implant, and the location of the posterior superior alveolar artery. The size of the window should be adequate to achieve easy surgical access. With experience, membrane elevation can be achieved using a smaller (i.e. more conservative) window. The antrostomy can be either elevated (if surgical access is adequate and the cortical wall is less than 2 mm

thick), or completely removed (in cases of inadequate surgical access, presence of septa, and sinus shallowness).

4. **Membrane elevation**: the sinus membrane is detached and only then it can be elevated with care starting on the floor of the sinus and then extending to the anterior and posterior walls. Do use special sinus membrane curettes to elevate the sinus membrane. To test membrane integrity, you can ask the patient to breathe in deeply while you observe the membrane. Do Valsalva manoeuvre.

5. **Implant placement**: immediate implant placement can be done if there's a minimum of 3-4 mm of residual crestal bone of good quality, otherwise, implants can be placed after 4-6 months. Guided placement of the implant through the surgical guide's sleeve protects the membrane from the drills and minimizes the risk of perforation.

6. **Bone grafting**: bone grafts are placed in the least accessible area first followed by the area along the medial sinus wall. In order not to limit vascularization, bone graft material shouldn't be condensed too tightly.

7. **Membrane placement**: Resorbable membrane is placed over the window. Collagen membrane adheres to the bone and does not require fixation screws or removal.

8. **Suturing**: non resorbable monofilament suture and horizontal mattress sutures are recommended.

A significant disadvantage of the lateral window technique is that it requires a large flap to be raised in order to gain surgical access. It's a technique-sensitive and time-consuming approach, and the success thereof is determined by the amount of available bone.

Case report 1

A female patient of 60 years age reported to our department of prosthodontics and crown & bridge, Dental College Azamgarh, Uttar Pradesh with missing 16 and 17. She wanted a fixed prosthesis for the missing teeth. The patient has been sent for CBCT evaluation. After evaluation the CBCT report of the patient we have found there was only 2mm residual bone height in 16 site (fig E). We have planned a direct sinus lift/ lateral window approach in this case because RBH was 2 mm (fig F). After taking the proper history, The patient has

been sent for routine blood investigation and this case has been planned for DSL followed by implant placement. After explaining the treatment procedure and complications associated with the surgery a written consent has been taken from the patient.

Before starting the surgery local anaesthesia was administered, after securing the anaesthesia a supra crestal incision with releasing incision mesially given and full thickness muco-periosteal flap has been raised to expose the buccal wall of the right maxillary sinus over 16 region. DASK drill (Dentium, south Korea) no 6 with external irrigation is used at the speed of 800 rpm to make a lateral window (fig g) on buccal bony wall of sinus 3 mm above the floor of the maxillary sinus [6]. The detached bony segment has been removed and sinus membraned has been detached by using sinus membrane elevation curettes XSE1L, XSE2L, XSE3L, XSE4L respectively. After detaching the schneiderian membrane a bone graft mix of xenograft + alloplastic graft (fig I) is used the make a scaffold around the implants placed. Both the implants were placed simultaneously (fig M) with DSL. The bony window has been closed by novaplug collagen (novabone USA). Flap is closed by interrupted sutures (fig M) and patient was released after explaining the post operative care.

Trans crestal Sinus Floor Elevation Technique

Also known as trans alveolar or crestal approach, this technique is generally indicated if the residual bone is 6 mm or more in height [7]. Trans crestal drills with hydraulic pressure with increasing diameters are used to indirectly lift the maxillary sinus.

Surgical Steps

1. **Anesthesia**
2. **Incision**: if autogenous bone is needed, you should extend the incision distally to the tuberosity to harvest bone from the area.
3. **Flapping**: full-thickness muco periosteal flap is reflected to expose the crest of the ridge.
4. **Drilling**: use a pilot drill to prepare the osteotomy stopping 2 mm short of the sinus floor. Continue using progressively wide drills of internal irrigation hydraulic lift system (DASK, SYSTEM DENTIUM SOUTH KOREA)
5. **Bone grafting**: after the widest drill and hydraulic sinus floor elevation,

bone grafting material of choice is applied

Sinus floor elevation:

6. reintroduce the largest drill into the osteotomy site with the graft material in place use special dome shape hand sinus floor elevators
7. elevate the sinus floor. The bone graft pushes into the sinus membrane further elevating it. You can add and tap the bone grafting material to reach the optimal sinus membrane elevation level without overstretching the membrane.
8. **Implant placement**: Implant diameter has to be slightly larger than that of the last drill/ osteotome used.

Case report 2

A male patient age 42 reported to our department of prosthodontics and crown & bridge, dental college Azamgarh. With a missing 26,27 (fig N & fig O). The patient wanted a fixed prosthesis for the same. After taking the proper medical history and intra oral evaluation the patient has been sent for CBCT evaluation. On evaluation of CBCT report we have found low residual bone height. For 26 height was – 4.2mm and for 27 height was 3mm (fig P)

So after examining the radiograph and CBCT we have planned this case for trans-crestal / indirect sinus lift technique. For this we had planned to use DASK kit from Dentium (south korea). This kit consists round ended diamond coated drill with internal (fig Q) [8]. The internal irrigation helps in hydraulic lift of the schneiderian membrane when drill enters the sinus cavity. It creates hydraulic pressure on schneiderian membrane that results in membrane elevation and we used stoppers (fig R) to prevent accidental pushing of drill inside maxillary sinus and perforation of membrane. After using Dask drill 1# and drill 2# i.e diamond coated we used Dask drill no 3# which is umbrella shaped smooth surface internally irrigated which is used to elevate the schneiderian membrane without perforating it. Novabone putty [9,10] (alloplastic graft) has been placed inside sinus through crestal osteotomy followed by simultaneous implant placement (fig S). Gingival formers were placed and sutured (fig S & T). Sutures were removed 10 days post operative and final prosthesis were delivered 4 months post operative (fig U).

CONCLUSION:

Maxillary sinus pneumatization occurring after posterior tooth loss in the maxilla complicates implant placement in this area. Reconstructing lost bone through sinus lifting and bone augmentation offers

consistently predictable treatment outcomes. This enhances the long-term implant treatment success for many patients. Minimally invasive trans crestal sinus lift technique and direct sinus lift technique both have shown a high degree of success rate.

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FIGURES:

Sinus septa:

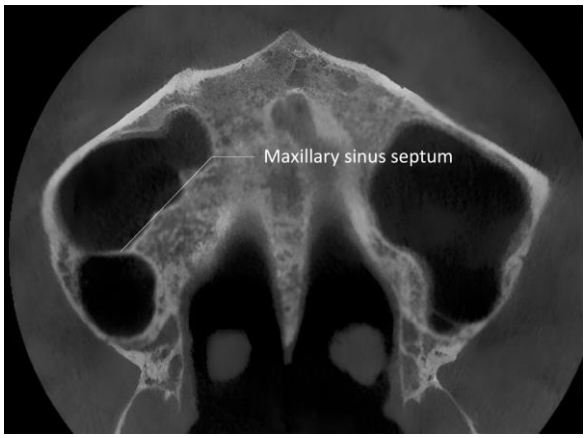

FIG. A– Maxillary sinus septa.

Schneiderian Membrane

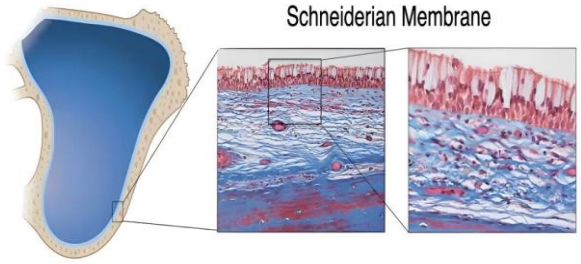

FIG. B – Schneiderian membrane.

Vascularization:

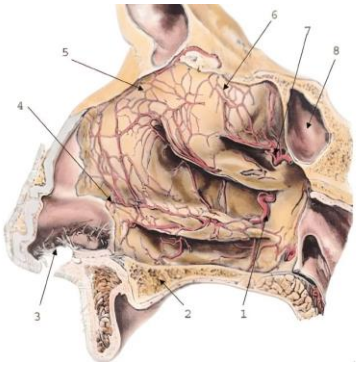

FIG. C – vascularization of maxillary sinus.

Fig. D – Pre operative 16, 17 region.

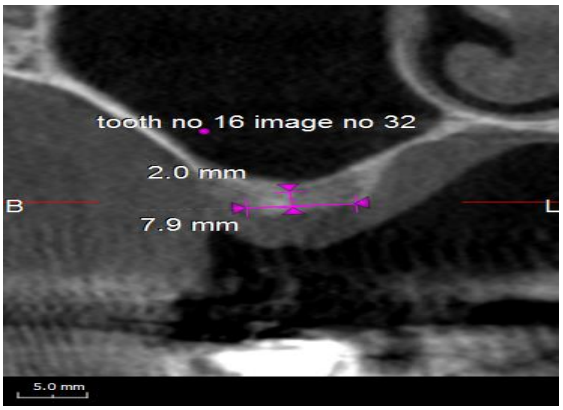

Fig. E - CBCT of 16.

Fig. F – Pre operative IOPAR of 16 and 17 region.

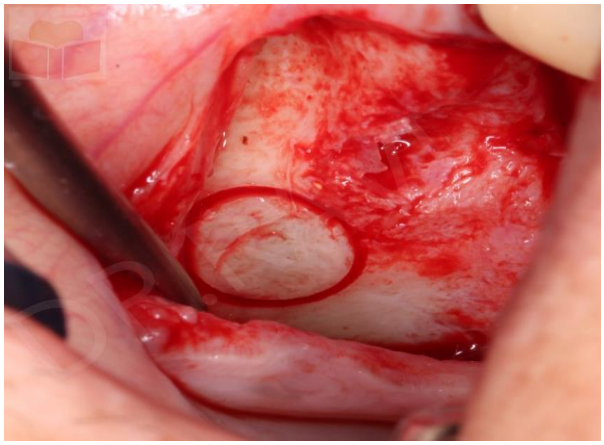

Fig. G – Lateral window created by DASK drill no 6.

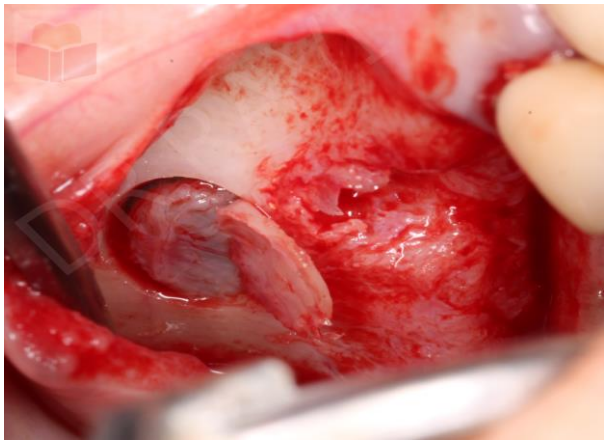

Fig. H – The bony window is detached.

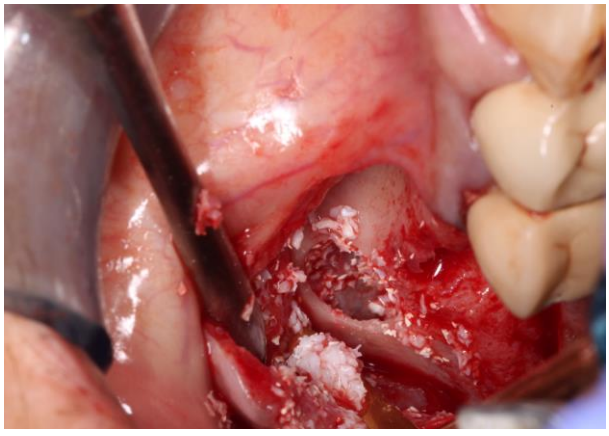

Fig. I – Bone graft insertion through lateral window.

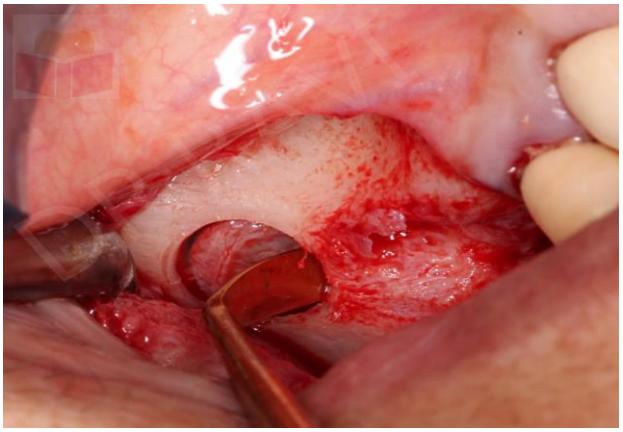

Fig. J – Sinus curette detaching membrane from lateral wall.

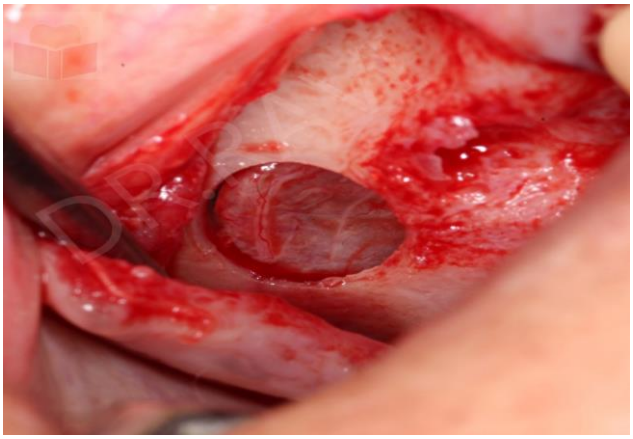

Fig. K – The lateral window.

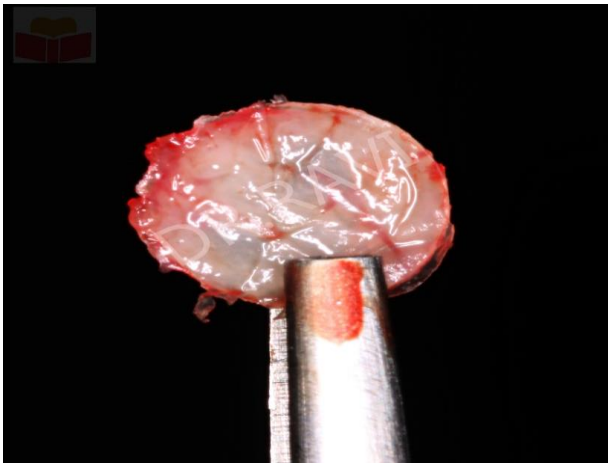

Fig. L – Detached portion of bone from outer wall.

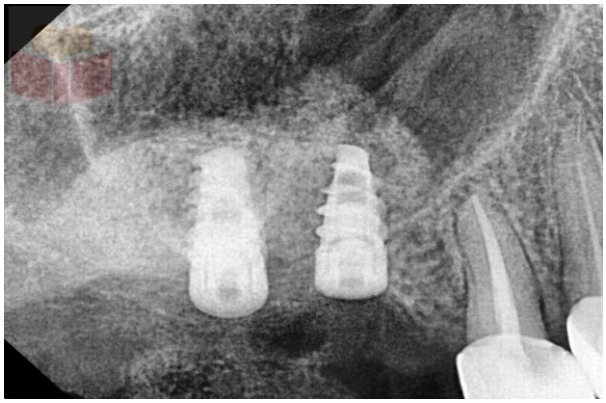

Fig. M – IOPAR showing implant placed and graft material inside maxillary sinus.

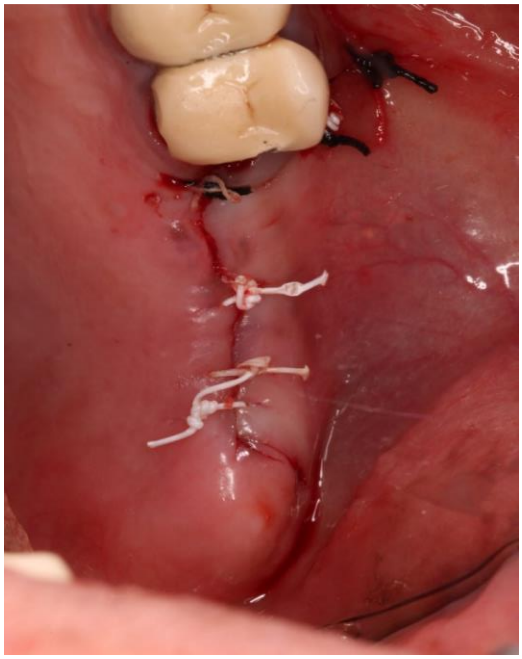

Fig. M – Sutured post operative view.

Fig. N – IOPAR showing deficient bone height in 26, 27 region

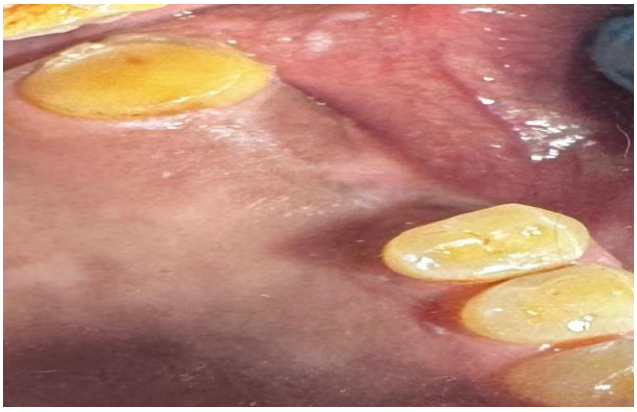

Fig. O – Pre operative picture of 26, 27 region.

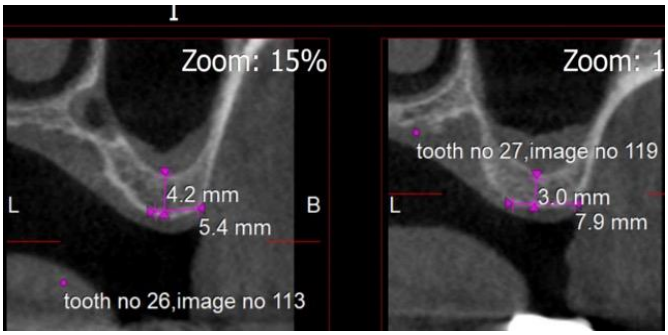

Fig. P – CBCT of 26, 27 region.

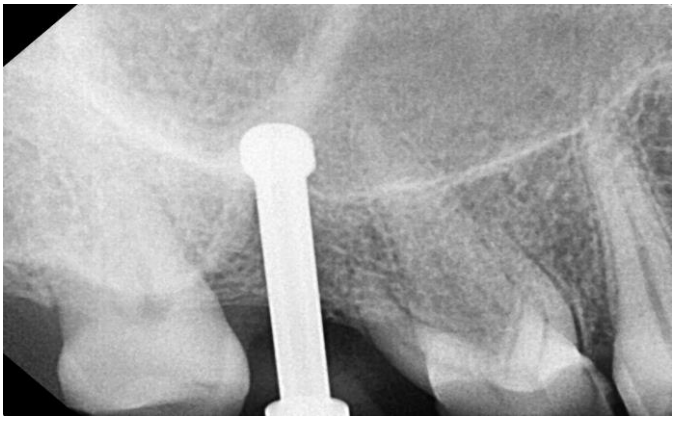

Fig. Q – Diamond coated drill inside the maxillary sinus.

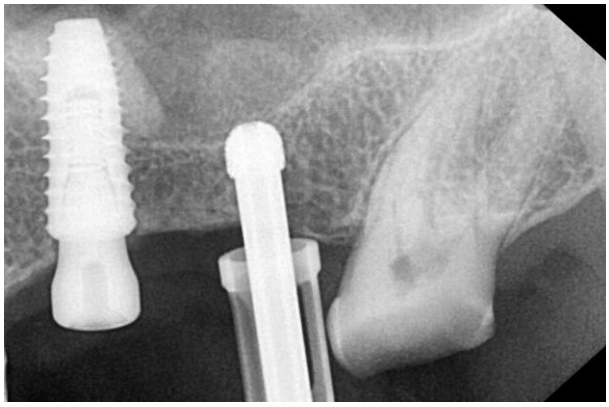

Fig. R – Diamond coated drill with stopper.

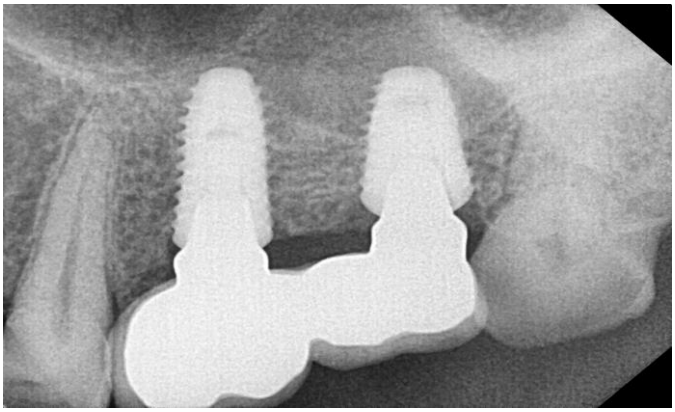

Fig. U – Final prosthesis.

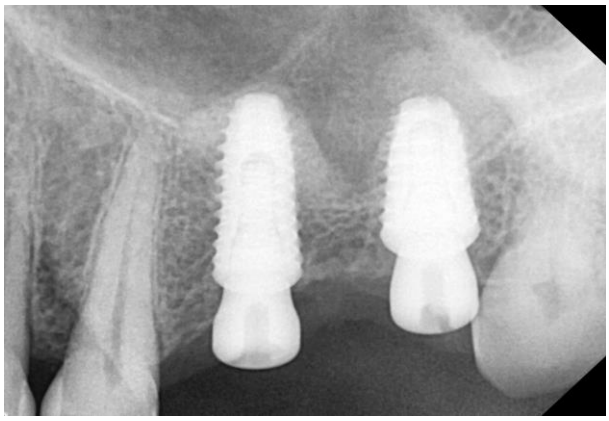

Fig. S – 26, 27 implants with dome shape bone grafts in maxillary sinus.

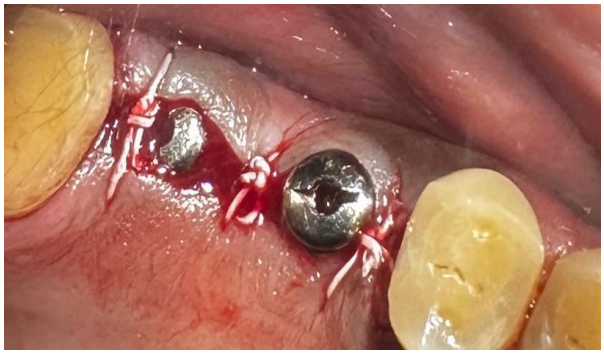

Fig. T – Suturing.