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NEOTERIC SINUS ELEVATION : A SMART LIFT – DIVA IMPLANTS

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ABSTRACT

Contemporary dentistry started appreciating the importance of anatomy of the maxillary sinus and the bone quality of maxillary bone when the restorations began shifting from tooth supported fixed prosthesis to the implant supported prosthesis. The low position of floor of sinus posed problems for the implant placement, literature suggesting many procedures for sinus floor lifting with different augmentation substitutes. Complications are still unavoidable and may lead to implant failure. The main goal of the implantology is to increase the longevity of implants by exact implant placement into bone of sufficient density. It is known that maxillary bone exhibits significantly lower bone mineral density than the mandible. Bone augmentation with bone substitutes has become the common procedure in increasing the density of the maxillary bone. New stimulus has been gained by the dental implantology by the introduction of the Dynamic Implant Valve Approach (DIVA) implants.

INTRODUCTION

The maxillary sinus, largest of paranasal sinuses is pyramidal in shape with its base parallel to lateral nasal wall and apex pointing towards zygoma. The size of the maxillary sinus remains insignificant until the permanent dentition fully erupts. The average dimensions of adult sinus are 2.5 to 3.5 cm in width, 3.6 to 4.5 cm in length and 3.8 to 4.5 cm in depth. The size of sinus will increase with age if the area is edentulous. Also, pneumatization varies from person to person. It has an estimated volume of approximately 12 to 15 cm 3. The inner lining of the maxillary sinus is lined by pseudo-stratified ciliated epithelium known as Schneiderian membrane with an average thickness of 0.8mm and is continuous with nasal epithelium through the ostium in middle meatus. The superior wall is formed by the floor of the orbit, anterior wall constituted by facial portion of maxillary bone, posterolateral wall constituted by zygomatic bone and greater wing of sphenoid and floor is constituted by the alveolar process and the palatal process of maxilla. It extends between adjacent teeth or individual roots, creating elevations of the antral surface, commonly referred to as `hillocks`[1]. Because of the implications, this can have on surgical procedures; it is essential for the clinicians to be aware of the exact relationship between the roots of the maxillary teeth and the maxillary sinus floor[2,3,4].

When patients present with advanced ridge resorption, it could complicate the procedure of implant surgery. This problem is magnified in the posterior maxilla where ridge resorption and sinus pneumatization, compounded with a poor quality of bone, are often encountered[4,5]. The procedure of choice to restore this anatomic deficiency is maxillary sinus floor elevation. Maxillary sinus floor elevation (SFE) was initially described by Tatum at an Alabama implant conference in 1976 and subsequently published by Boyne in 1980. The procedure is one of the most common pre-prosthetic surgeries performed in dentistry today. Numerous articles have been published in this field regarding different grafting materials and modification to the classic technique[6]. Field of implantology always haunts for the new technique and the new material to overcome the demerits of the techniques that are already present. Keeping this in mind through this review, we would like to bring up the new technique for sinus floor lifting and implant placement using DIVA implants.

SINUS LIFT PROCEDURE:-

The insertion of the implants in posterior Maxilla is often complicated due to the inadequate bone quantity and quality.

- For the placement of an implant the height of the ridge should be atleast 5-6mm(summers 1994)[6]
- If it is less than 5mm then the sinus floor is elevated and grafting is performed to maintain the height[6].
- It is performed mainly by 2 techniques[6]:-

a) direct sinus lift
b) indirect sinus lift Based on the implant placement after sinus lift[6]:-

a) immediate placement of an implant
b) delayed placement of an implant

SINUS LIFT PROCEDURES

There are many procedures available in the literature on sinus lift. Some of them are[6]:

1. Transcrestal Approach (tSFE):
2. Lateral Window Approach (LatW)
3. Piezoelectric Surgery (PS)
4. Balloon elevation technique
5. Hydraulic Sinus Lift Technique (HySiLift)
6. Osteotome Technique (OstSFE)
7. Nasal suction technique

OMPLICATIONS:

The surgical procedures may have some of the following complications[6,7]:-

IMMEDIATE INTRA OPERATIVE:

- Membrane perforation
- Haemorrhage from vessels
- Mechanical obstruction to the ostium
- Infraorbital nerve injury

EARLY POST OPERATIVE:

- Wound dehiscence
- Acute graft infection
- Haemorrhage
- Exposure to the bone graft

DELAYED POST OPRATIVE:

- Chronic sinusitis
- Exposure to the bone graft

LATE COMPLICATION:

- Intra cranial abscess
- Blindness

DIVA IMPLANTS:

Until recently, most of the sinus lift procedures performed by the surgeons are cumbersome and carried the high risk of possible complications including infection, bleeding, etc., DIVA, a new sinus elevation technology, delivers an innovative solution that enables sinus lift implants to be carried our using a simple, relatively short procedure, with significantly lower risk of complicatons and patient discomfort[7,8,9].

DIVA technology is gentle and minimally invasive, significantly reducing the risk of membrane damage. The procedure's simplicity also carries additional benefits – a shorter chair time, no or few postoperative complications. The unique technology enables sinus lift procedures to be performed even in cases of minimal residual bone[7,8,9].

UNIQUE QUALITIES OF DIVA:

DIVA sinus lift technology possesses four unique features[7,8,9]:

1. Use of implant itself to elevate the sinus membrane without risk of perforation
2. Its configuration allowing injection of bone substitute directly through the implant
3. Absolute sealing of the implant against oral flora and
4. Its strength is greater than or equal to the regular dental implants

DIVA IMPLANT KIT:

A. DIVA Implant
B. Internal Screw Driver (optional)
C. Syringe
D. IV Cannula
E. Synthetic Bone Paste (-TCP in hyaluronic acid)
F. DIVA osteotome

DIVA IMPLANT:

The Titanium-Aluminum-Vanadium implant (Ti-6Al4V ELI) (fig 1a) has an internal sealing screw that serve for endoscopic direct observation and as a drug delivery system via its channel

DIMENSIONS:

DIAMETER	HEIGHT	
3.75 mm	11.5 mm	13 mm
4.2 mm	11.5mm	13mm
5.0mm	11.5mm	13mm

INNER SCREWS:

Initial screw(fig1c) is removed after the placement of implant for providing the channel for delivery of saline and bone substitute Final inner valve screw(fig1d) is used to seal the implant after the bone substitute

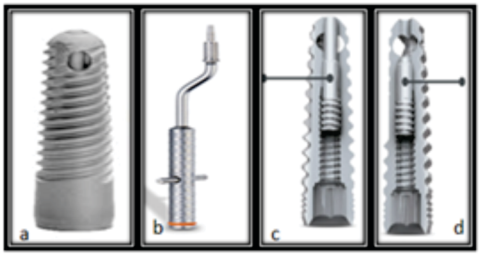

Fig 1: a. DIVA implant, b. Osteotome, c. initial inner screw valve, d. final inner screw valve

STEP BY STEP PROCEDURE:

- After review of the CT scan, use a round bur to indicate the implant's exact location. Start initial drilling beneath the sinus floor with a standard 2mm pilot drill until a depth of 1mm beneath the sinus floor (fig 2a). Use a drill stopper to achieve the correct depth.
- Insert the special concave Osteotome (fig 1b) with a stopper into space created by the pilot drill. Gently apply pressure until the first crack of the sinus floor cortical bone is detected (fig 2b).
- Insert the DIVA device using controlled rotation until initial primary stability is obtained(fig 2c).
- With the attached special driver, unscrew and remove the first valve screw (the long one) located within the device (fig2d). The bleeding that is observed from the DIVA channel indicates the sinus floor fracture.
- Attach a filled saline syringe to the IV Cannula (fig2e). Use this apparatus to gently introduce 1cc of saline via the implant to rinse the sinus membrane. Remove the syringe and cannula, attach the ratchet to the implant, and carefully screw it in by 1mm. repeat this rinse and ratcheting procedure until a counter sink for the DIVA device is attained (fig2f). With this procedure, the membrane elevates, yet remains intact.
- Detach the saline syringe from the IV Cannula, and then attach the bone substitute syringe (fig2g). Use this apparatus to inject substitute via the implant until the excess bone substitute overflows the implant.
- Use the attached driver and screw in the first valve screw to expel the remaining bone substitute from the inner tunnel of the implant, and then rinse the implant with saline and remove the valve screw.
- Screw in the secondary valve screw (the shorter one) (fig2h) to achieve absolute sealing, and cap the DIVA implant with a cover screw.
- After a 6-8 month osseo-integration period,(fig3) remove the cover screw to expose the implant and confirm that the inner valve screw has remained tight. Then, cap the DIVA implant with the healing screw. The implant is now ready for permanent prosthetic restoration.

ADVANTAGES:

- DIVA sinus lift technology is simple and easy –to- use.
- The less invasive technology significantly lowers the risk of membrane rupture.
- The DIVA device specially designed to make sinus lift procedures possible even in cases of minimal residual bone (3mm).
- DIVA's minimally invasive sinus lift procedure leads to far lower risk of infection and other post –op complications, both during and after the procedure.
- DIVA's shorter, more efficient procedure compared to other sinus lift procedures results in decreased chair time.

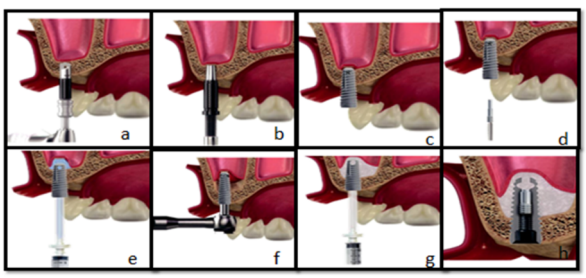

Fig 2: step by step procedure. a. Initial drill, b. Use of osteotome, c. Insertion of diva implant, d. Long screw valve removal, e. Attach saline syringe cannula, f. Racheting by 1mm, g. Attachment of bone graft material syringe, h. Placement of second screw valve

Fig3:Osseo-integration of implant

DISCUSSION:

According to Nahlieli O etal.,7 DIVA implants were mechanically comparable to other commercially available implant systems, showing that inner screw doesn't effect the structural integrity of the implant, and inner sealing screw was tight and provides hermetic closure of the implant satisfying the basic and crucial requirement. Nahlieli O8, reported the first results of DIVA

implants in humans stating that this procedure is minimally invasive, easy, and rarely requires the lateral open approach and leads to immediate expansion of the sinus membrane. Nahlieli O etal.,9 in 2016, stated that the implantation procedure using DIVA implants reduced complications due to intraoperative sinus membrane perforation, and complications in the sinus elevation surgery. The option of endoscopic observation of the bone condition, irrigation, drug delivery during the follow-up period for the maintenance of the implants can be performed via the internal port of the implant.

CONCLUSION

DIVA implant technique definitely simplifies the implant placement especially in the maxilla and post-operative treatment. Further research is required to assess the long term success of the DIVA implants.

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