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Techniques of Maxillary Sinus Floor Elevation

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Abstract

Posterior maxillary region is often limited for standard implant placement because of reduced residual vertical bone height. An elevation of the maxillary sinus floor is one option in solving this problem. This article describes the various surgical techniques that can be used to enter the sinus cavity, elevating the sinus membrane and placing the bone grafts for placement of dental implants in the resorbed posterior maxillary region.

Keywords:- Maxillary sinus, Dental implants, Direct sinus floor elevation, Indirect sinus floor elevation, Lateral antrostomy, Crestal approach.

INTRODUCTION

Restoration of the normal function, esthetics, contour, speech and health of the stomatognathic system is the goal of modern dentistry .Use of dental implants for the prosthetic rehabilitation of edentulous areas of mouth have shown a remarkable success over the decades. Placement of dental implants in the resorbed posterior maxillary region is challenging owing to advanced resorption of alveolar bone combined with an increase in pneumatization of maxillary sinus because of higher air pressure in the pneumatized sinus cavities.[1,2] In addition, the bone found in the posterior maxilla consists mostly of thin cortices and spongy cancellous compartments. All these factors combined together make the placement of dental implants difficult in posterior maxillary region. Jaffin and Bermann investigated the success rate of implants in different bone qualities and explained the high failure rate of 44% in maxillary type IV bone as a result of the poorer bone quality or overloading of short implants in cases of inadequate implant-crown ratio.[1,2,3,4,5]

Posterior maxillary region is often limited for standard implant placement because of reduced residual vertical bone height. Ridge augmentation with onlay or inlay bone graft or use of small length dental implant have been suggested in the past with limited success. An elevation of the maxillary sinus floor is one option in solving this problem. Several surgical techniques have been presented to enter the sinus cavity, elevating the sinus membrane and placing the bone grafts. Sound knowledge of anatomy of maxillary sinus and its possible variations is vital for selecting an appropriate technique for maxillary sinus membrane

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augmentation for successful implant placement.[3,6,7,8,9]

Different Techniques For Maxillary Sinus Elevation

There are two main approaches for maxillary sinus floor elevation: Direct and Indirect approach. Direct or Lateral antrostomy technique and Indirect or Crestal approach which includes osteotome sinus floor elevation, bone added sinus floor elevation, minimally invasive transalveolar sinus approach, and antral membrane balloon elevation.The lateral window technique was first conceived and demonstrated by Tatum in 1976 by using a modified Caldwell-Luc approach. The surgical technique consists of osteotomy to form a bony window and medial rotation of this window without perforating the sinus membrane and placement of auotogenous bone graft. Boyne and James in 1980 published their technique of maxillary sinus augmentation as a possible way of restoring this problematic region by using 2 step maxillary sinus augmentation procedure. With a round bur, an antrostomy approximately 10 mm in diameter was made in the lateral antral wall. The membrane was then dissected and elevated from the entire floor of the maxillary sinus. The bone window was intruded into the sinus like a trapdoor, and the space underneath was filled with an autogenous bone graft taken from the lateral iliac crest. Bladed implants were inserted after 3 months .Tatum in 1986 published his techniques of 1 step lateral antrostomy and crestal approach using 'socket formers' a greenstick fracture of the sinus floor was accomplished by tapping these hand instruments, which were formed as chisels, in a vertical direction. If the floor had been detached, small curettes were inserted into this crestal approach and used as elevators for the antral membrane. Summers in 1994 introduced a technique using round, tapered 3I osteotomes with diameters increasing from 1 to 4 ram. By means of gentle pushing and tapping of the instruments, the adjacent bone layer can be compressed and the schneiderian membrane elevated; bone is conserved because no drilling takes place. Summers modified the osteotome technique by adding small particles of autogenous bone or bone allografts or xenografts, which were placed in the bony orifice and compacted by the osteotomes. The bone graft was intended to support the raising of the membrane and fill up the space underneath it; the term "bone-added osteotome sinus floor elevation" (BAOSFE) was coined to denote the procedure. An elevation of about 4 to 5 mm in sites with a minimal initial bone height of 6 mm was reported for this "one-step" technique of placing implants simultaneously.[1,2,3,4]

Ellegaard et al in 1997 performed maxillary sinus augmentation without the use of bone graft material where sinus membrane is directly tented over dental implant with the void being filled with coagulum.[10]

Cosci and Luccioli in 2000 described a method with a crestal approach using special lifting drills with a small cutting angle of 30 degree and built in water flow system in specific sequence of increasing length in which floor of maxillary sinus was perforated rather than fractured without perforating the sinus membrane.[11]

In 2001, Vercellotti et al. introduced the Piezoelectric technique. The advantage of

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piezoelectric osteotomy lies in being able to cut the bony window with great simplicity and precision while ensuring the membrane's integrity. This is due to the termination of the surgical action when the piezosurgery tips come in contact with non-mineralized tissue.[12]

Fugazzotto in 2002 presented a technique which utilizes trephine burs with 3 mm diameter followed by an osteotome in crestal maxillary sinus augmentation procedure. The implant site is prepared using a 3 mm exterior diameter trephine bur at a distance of 1–2 mm from the sinus floor. Bone cylinder is then pushed apically to a depth of 1 mm less than the one made with the bur, using an osteotome of the same diameter as the trephine bur. The final preparation of the implant site is carried out using osteotomes of increasing diameters, always inserting them to the same depth. The implants are inserted at a speed of 30 rpm, causing controlled lateral movement of the bone cylinder inside the space created by the movement of the sinus membrane.[13]

Lundgren et al in 2004 presented techniques without the use of bone graft.[14] Soltan et al. introduced the technique of Antral membrane balloon elevation. This technique uses inflatable balloon to elevate the sinus membrane. The Zimmer sinus lift balloon was designed to lift the sinus membrane gently and evenly. This technique has been shown to reduce the chance of sinus membrane perforation. There is a metal shaft with a tip connected to a latex balloon which has the inflation capacity of approximately 4 ml. For lateral window approach, angled design of balloon and for a crestal approach, the straight design balloon is used. Before the balloon is inserted, the osteotomy is enlarged to 5 mm. Osteotome of 5 mm is used to break the sinus floor after the addition of bone. The sleeve of the balloon is then inserted 1 mm beyond the sinus floor. The saline is injected slowly from the syringe into the balloon so that the balloon would inflate progressively. The desired elevation is determined by deflating the balloon and the process is again repeated till the desired sinus elevation. One cubic centimeter of saline is expected to raise 6 mm of the membrane.[15,16]

Lozada et al in 2011 introduced a technique which is a modification of conventional lateral and crestal approaches by using specially designed DASK surgical drills with a feature of internal irrigation system and sinus membrane elevating curettes to perform maxillary sinus augmentation which was described by the authors as lateral/crestal bone planning antrostomy.[17]

Minimally invasive trans-crestal guided sinus lift technique was given by Pozzi and Moy in 2013. This is a new procedure with computer-guided planning and a guided surgical approach to elevate the maxillary sinus. The use of computer-aided design/computer-aided manufacturing generated surgical template in combination with expander-condensing osteotomes, make this surgical technique minimally invasive.[18]

Minimally invasive trans-alveolar sinus approach (MITSA) elevation technique was given by Kher et al. 2014. In this procedure, calcium phosphosilicate putty is used for hydraulic sinus membrane elevation. Drilling is done 1 mm short of the sinus floor and osteotomy completes till the last drill. Concave 3 mm osteotome is used to in-fracture sinus floor. Novabone gun cannula fits snugly in

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prepared osteotomy. The material gently lifts membrane due to its consistency. Thereafter, implant is placed. MITSA technique is minimally invasive as this technique uses osteotome only once so is less traumatic to the patient.[19]

CONCLUSIONS

Selection of an appropriate technique for maxillary sinus membrane augmentation for successful implant placement is vital based on the clinical features and available resources.

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