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"SINUS LIFT BY CRESTAL APPROACH"

Periodontology

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ABSTRACT

The posterior maxilla is a challenging site for dental implant rehabilitation. Bone quantity in the maxillary posterior edentulous area may be insufficient for dental implant placement because of the presence of the maxillary sinus. several techniques have been proposed to lift the maxillary sinus and augment with bone graft. The bone volume augmentation is expected to result in primary implant stability, promote osseointegration, prevent overloading, and provide long-term implant success. These techniques are called sinus lift procedures. The commonly used sinus lift techniques are lateral and crestal sinus lift. This review aims to focus on crestal sinus lift procedure.

KEYWORDS

Sinus Lift, Crestal, Lateral

INTRODUCTION

The ideal placement and restoration of dental implants are dependent on the presence of adequate bone volume and quality at the edentulous site. The posterior maxilla is a challenging site for dental implant rehabilitation. Bone quantity in the maxillary posterior edentulous area may be insufficient for dental implant placement because of the presence of the maxillary sinus. When teeth are extracted in the posterior maxilla, bone in that area is lost due to inferior expansion of the sinus involving the residual ridge area.[1] This process is known as pneumatization of the maxillary sinus. Moreover, bone density in this area also decreases rapidly and is the least dense area of the maxilla. To obviate these problems, several techniques have been proposed to lift the maxillary sinus and augment with bone graft. The bone volume augmentation is expected to result in primary implant stability, promote osseointegration, prevent overloading, and provide long-term implant success. [2] These techniques are called sinus lift procedures.

Elevation of the sinus floor can be performed through a lateral window [3], or via a crestal access.[4] The most commonly used technique for sinus floor elevation is through a lateral window, which was first presented by Tatum in 1977 [5] and was first published by Boyne and James in 1980 [3]. The use of this procedure is recommended to treat the posterior maxilla, when the residual bone height (RBH) varies between 1 and 6 mm.[3] It offers an average implant survival of 91.8% (ranging from 61.7% - 100%)[6]. However, this technique has several shortcomings. The lateral window approach is an extensive, invasive and technique sensitive procedure. Postoperative complications such as membrane perforation, discomfort and morbidity are common after this type of surgery. [7]

Summers in 1994 introduced elevation of the sinus membrane through a crestal approach using osteotome technique to overcome the limitations of the lateral window apprpoach. In crestal approach, the sinus membrane is lifted through the crestal bone using osteotomes, and implants are inserted directly in the sites prepared with the osteotomes of increasing diameters [8]. If the preoperative bone height is at least 4mm, there is adequate primary stability for an implant to permit simultaneous augmentation and implant placement. If less than 4mm of preoperative bone is present, Summers proposed a two stage osteotome procedure. The first stage procedure elevates the membrane so that at least 4mm of alveolar bone is present after healing [9]. A second osteotome procedure elevates the membrane, as necessary, to insert the selected implant. When compared with the lateral window approach, the crestal approach offers the advantages of a more conservative surgical entry, more localized augmentation of the sinus, less operative time and minimal postoperative discomfort.[8] The crestal approach technique has then been modified by Cosci. [10]who introduced a series of atraumatic lifting drills of varying lengths to avoid the perforation of the sinus during drilling of the implant site. Therefore, recently clinical research is focusing on elevation of sinus using crestal approach to facilitate the implant in adequate bone housing.

HISTORICAL BACKGROUND

The osteotome technique was first developed to compress soft, type III and IV maxillary bone. The concept is intended to increase the density of bone in the maxilla leading to better primary stability of inserted dental implants. Tatum (1986)[5] described the crestal approach to elevate the sinus floor. In the original approach, implants were placed after the controlled fracture of sinus floor and were submerged during the healing phase. The osteotome technique for sinus floor elevation, using a set of osteotomes of varying diameters to prepare the implant site, was first presented by Summers (1994)[4]. In this technique, the sinus membrane is lifted through the crestal bone using osteotomes, and implants are inserted directly in the sites prepared with the osteotomes of increasing diameters [8]. The bone-added osteotome sinus floor elevation (BAOSFE), today referred to as the *Summers technique*, may be considered to be a more conservative and less invasive approach than the conventional lateral approach of sinus floor elevation. Summers supported a small osteotomy through the crest of the edentulous ridge, at the inferior region of the maxillary sinus. This intrusion osteotomy procedure elevates the sinus membrane, thus creating a "tent". This creates a space for bone graft placement. It should be noted that the bone grafts are placed blindly into the space below the sinus membrane. Although there is uncertainty of possible perforation of the sinus membrane with this technique, an endoscopic study has shown that the sinus floor can be elevated up to 5 mm without perforating the membrane [11]. The crestal approach technique of Summer has then been modified by Cosci [10] who introduced a series of atraumatic lifting drills of varying lengths to avoid the perforation of the sinus during drilling of the implant site.

SURGICAL PROCEDURE

The transalveolar osteotome technique (crestal approach) has been suggested in case of a flat sinus floor with a residual bone height of at least 5 mm and adequate crestal bone width for implant installation. However, patients with a history of inner ear complications and positional vertigo are not suitable for the osteotome technique. In addition, local contraindications like an oblique sinus floor (>45º inclination) are not suitable for the osteotome technique because the osteotomes first enter the sinus cavity at the lower level of an oblique sinus floor, while still having bone resistance at the higher level. In such situation, there is a high risk of perforating the sinus membrane with the sharp margin of the osteotome.

Prior to the surgical procedure, the patient was advocated to rinse with 0.1% chlorhexidine for a period of 1 minute. After this, local anesthesia was administered into the buccal and palatal regions of the surgical area. A mid-crestal incision with or without releasing incision was made and a full-thickness mucoperiosteal flap was raised. The distance from the crestal floor of the ridge to the floor of the maxillary sinus was measured prior to implant site preparation on the pre-operative radiographs. With a surgical stent or a distance indicator, the implant positions were marked on the alveolar crest with a 2.0 mm small round bur. After confirming the distance to the sinus floor, pilot drills with

small diameters (1–1.5 mm smaller than the implant diameter) were used to prepare the implant site to a distance of approximately 1 - 2 mm from the sinus floor.

SUMMERS OSTEOTOME TECHNIQUE

The implant osteotomy was prepared to the appropriate final diameter, 1 - 2 mm short of the antral floor. The first osteotome used at the implant site was a flat ended small diameter tapered osteotome. With light malleting, the osteotome was pushed towards the compact bone of the sinus floor. By this tapping motion, with 0.5 to 1.0 mm increments, the osteotomy sites was prepared to a vertical distance of up to 2 mm beyond the initial prepared implant site. After reaching the sinus floor, the osteotome was pushed about 1 mm further with the help of a mallet using light force, in order to create a "greenstick" fracture on the compact bone of the sinus floor. A tapered osteotome of small diameter was chosen to minimize the force needed to fracture the compact bone. The second tapered osteotome, with a diameter slightly larger then the first one, was used with the same length as the first osteotome and was used to increase the fracture area of the sinus floor. The third osteotome used was a straight osteotome with a diameter about 1–1.5 mm smaller than the implant to be placed. The last osteotome to be used must have a form and diameter suitable for the implant to be placed. It was important that the last osteotome only entered the preparation site once. If several attempts were made in sites with soft bone (type III or IV), there was a risk of increasing the diameter of the preparation that might jeopardize achieving good primary stability. On the other hand, if the last osteotome diameter was too small compared to the implant diameter, too much force was used to insert the implant which resulted in more bone trauma and, hence, greater bone resorption, thus delaying the osseointegration process [12].

During the entire preparation, it was crucial that precise control of the penetration length was maintained. Before placement of grafting materials, the sinus membrane was tested for any perforations. This was tested with the Valsalva maneuver (nose blowing). The nostrils of the patients were compressed, and the patient was asked to blow against the resistance. If air leaked out of the implant site, the sinus membrane was perforated, and no grafting material was to be placed into the sinus cavity. If the sinus membrane was judged to be intact, the preparation was filled with grafting material. The grafting material was then slowly pushed into the sinus cavity with the same straight third osteotome. This procedure was repeated four to five times until about 0.2–0.3 g of grafting material had been pushed into the sinus cavity below the sinus membrane. Finally, before implant placement, the preparation was again checked for patency, and the Valsalva maneuver was repeated. The implant was then slowly threaded into position so that the membrane was less likely to tear as it was elevated. Ideally, the apical portion of the implant should engage dense bone on the cortical floor, bone over the apex, with an intact sinus membrane. The implant should extend 0-2 mm beyond the sinus floor, with 1mm of compressed bone over the implant apex which results in as much as a 3mm elevation of the sinus mucosa.

COSCI'S OSTEOTOME TECHNIQUE

The crestal approach technique by Summers was modified by Cosci [10]. Cosci advocated the use of a series of atraumatic lifting drills of varying lengths to avoid the perforation of the sinus during drilling of the implant site. In the Cosci technique, when the bone height was 6-7 mm then a trephine drill was used, otherwise the standard 3mm long pilot drill was initially used followed by the 3 mm long intermediate drill and by the atraumatic lifting drill of the actual height of the ridge as measured on the radiograph. Osteotomes were not used. The site was then probed to confirm the integrity of the Schneider membrane and the bone graft was gradually inserted in the osteotomy site to lift the membrane to the desired height and then implants were placed.

POST-SURGICAL CARE

The post-surgical care after placing implants with the osteotome technique was similar to that after standard implant placement. In addition to the standard oral home care, antiseptic rinsing with 0.1–0.2% chlorhexidine twice daily for the first 3 weeks after surgery was highly recommended. However, if bone substitutes were used, the patients are placed on antibiotic prophylaxis for a period of 1 week.

CLINICAL RESEARCH ON CRESTAL APPROACH

Osteotome-mediated transcrestal sinus lift approach was first proposed by Tatum in 1986 [5]. In 1994, Summers described the osteotome technique [4], where the author proposed the preparation of implant site through the use of conical osteotomes which allows the compression through lateral force application of the bone in the posterior maxilla. The author stated that these maneuvers allow increase in the lateral bone density, preserving bone because drilling is avoided. Cosci and Luccioli (2000)[10] modified the Summers technique by using atraumatic lifting drills instead of osteotomes.

Transcrestal, osteotome-mediated sinus lift surgery may be performed with or without the use of bone grafting materials like allograft, autogenous bone, or heterologous bone material. No significant differences in terms of implant survival and success rates were observed comparing the two methods [12]. Two systematic reviews recently reported high survival rates after implant placement in conjunction with a transcrestal sinus floor elevation: 90.9% (Emmerich et al 2005)[8] and 92.8% (Tan et al 2008)[13]. In addition, a transcrestal sinus floor elevation typically results in less morbidity, cost, and time needed for healing than a lateral wall sinus lift [14].

Several modifications of the Summers technique have been proposed. These include the use of nasal suction technique, piezoelectric ultrasonic osteotome, minimally invasive antral memebrane ballon elevation (MIAMBE), rotatory instruments, hydraulic sinus elevation system and electric mallet for osteotome sinus elevation surgeries. Hence, several clinical studies have been conducted in order to evaluate the efficacy of modification of surgical procedures used for sinus lift via crestal approach.

COMPLICATIONS ASSOCIATED WITH CRESTAL APPROACH

The "Summers technique," often referred to "osteotome/crestal sinus membrane elevation," or OCSME, is recommended for patients with at least 5.0 to 6.0 mm of alveolar bone below the sinus floor [4]. During the surgery, the sinus membrane is elevated with osteotomes from a crestal approach through the osteotomy prepared for dental implant placement, thereby avoiding surgical access through the zygomatic buttress of the maxilla. The transcrestal approach is preferred over the lateral window technique when limited additional vertical bone height is needed because of the less extensive surgery and lower morbidity [13]. However, OCSME is a visually restrictive procedure and is considered to be a sensitive technique with inherent limitations, especially when direct visual examination of the maxillary sinus membrane is desired or required. Despite the widespread clinical application of this surgical technique, along with the advent of multiple surgical variations, few studies have evaluated the incidence of maxillary sinus membrane perforations using crestal sinus elevation procedure.

When considering the best approach for augmentation, the osteotome technique can create ample sinus augmentation to insert whatever length of implant is functionally required for virtually every case and takes less time to perform, needs a relatively small access, requires minimal material cost, may have better primary implant stability due to more compact bone, may expand the ridge width and has minimal postoperative discomfort or other healing complications as compared to lateral approach. Thus perhaps it should be considered the gold standard for sinus augmentation. However, the major disadvantage of osteotome technique is that it is a blind procedure and can only be performed in cases having more than 5mm of residual bone height, requiring not more than 2mm of bone above the sinus floor. Schneiderian membrane perforation has been identified as the most frequently encountered complication (3.8%). and infections were rare (0.8 %). If the osteotome technique requires extensive malleting during the sinus floor elevation, it may cause postsurgery sequelae such as a headache or benign paroxysmal positional vertigo (BPPV). Therefore despite its many advantages, the osteotome technique is used only in a restricted number of cases for sinus lifting and augmentation.

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