Placement of dental implant into posterior maxilla of deficient height applying different techniques

A protocol submitted in Partial fulfillments of the requirements for Doctor Degree in Oral Medicine, Periodontology, Oral Diagnosis and Oral Radiology

BY

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Introduction

Treatment for edentulous patients is either removable complete or partial dentures. However, the use of removable dentures reduces taste perception and chewing capacity. [1] Dental implants have become a predictable treatment option for applicable patients. [2] The success rate of dental implants is associated with bone quality and quantity. [3]

Most implant failures occur in the maxillary molar region with poor bone quality. [4,5] Other factors that may cause failure and difficulty in implant placement in the posterior maxilla are limited visibility, reduced inter-arch space, and sinus pneumatization due to atrophy of the alveolar ridge. In such cases, sinus augmentation is required to create sufficient vertical bone volume for implant placement with adequate stability. [6]

Numerous methods have been proposed to treat a vertically deficient, edentulous, posterior maxillary ridge of poor bone quality. Traditionally, two techniques are employed, namely, the direct sinus elevation procedure using a lateral window approach and the indirect sinus elevation procedure using a crestal approach.[7] The lateral window approach has been reported to yield predictably favorable clinical results.[8] Nonetheless, the degree of invasiveness and patient morbidity, risk of severing the alveolar antral artery, risk of perforating the sinus membrane, delay in healing, and increased risk of postsurgical infection are major drawbacks of this procedure.[9] Conversely, the transcrestal indirect sinus elevation techniques are less invasive, less time-consuming, and reduce patient morbidity. However, the risk of membrane perforation may be as high as 24% due to lack of direct visibility and access. [10]

Many surgical techniques have been developed to lift the sinus membrane indirectly, Summers in 1994 had described a technique; the Osteotome sinus Floor Elevation (OSFE) wherein an osteotome is used to fracture the sinus floor and to lift the sinus membrane, then grafting materials and implants can be inserted in the subantral space through the osteotomy site. [11] This technique also is not without its drawbacks, namely, explosive force to the maxilla with poor control, unintentional displacement or fracture, membrane perforation, benign paroxysmal positional vertigo and patient discomfort. [12]

Vercellotti et al presented the use of piezoelectric ultrasound as a new alternative in performing osteotomies in maxillary sinus lifting surgeries. [13] An important feature of the piezoelectric device is the selective cutting of only mineralized structures, without damaging soft tissues. [13, 14] No perforations of the Schneiderian membrane occurred during the piezoelectric preparation of the lateral antrostomies.[15] Piezosurgery was used to expose the maxillary sinus mucosa through the alveolar crest pathway in maxillary sinus floor elevation with hydraulic pressure for the graft and simultaneous implant placement. Some potential advantages of the method are reduced trauma and a reduced rate of sinus membrane perforation during surgery, no malleting, and shorter surgery time. Although all of these advantages, membrane perforation by high hydraulic pressure may happens. [16]

An additional technique of bone instrumentation called osseous densification was introduced. It is a biomechanical osteotomy preparation technique that preserves bone through a non-excavating drilling process utilizing specially designed drills with a tapered geometry and specially designed flutes to progressively expand the osteotomy while compacting bone into its walls and apex. In this manner, this bone densification method enhances implant primary

stability due to an elastic “spring-back” effect created in the prepared osteotomy by the compaction autografting.[17]

In view of this, it would be of value to assess the effect of these different techniques which have been used in crestal sinus lifting compared to each other. Such comparison may aid toward further clarification of this, with aspect to overcome one of the most perplexing phenomena which is weak implant stability and low bone level associated with sinus pnuematization.

Aim of study

The aim of the present study is to evaluate and compare the efficacy of different techniques for implant placement in deficient posterior maxilla

Objective

Evaluation of implant primary and secondary stability, bone gain and density using different techniques (Osteotome technique, Densah drills technique, Piezosurgery) in crestal sinus lifting.

Patients and Methods

Study design

Comparative study

Study setting and population

Twenty one patients will be included from those attending at the Department of Oral Medicine, Periodontology, Oral Diagnosis and Oral Radiology, Faculty of Dental Medicine, (Boys ,Cairo) Al-Azhar University.

Eligibility criteria of population:

A. Inclusion criteria:

(1) Young and adult patients of both sexes.

(2) Patients exhibit class C residual bone height according to ABC sinus augmentation classification.[18]

(3) The edentulous ridges are covered with mucoperiosteum free from signs of inflammation, ulceration or scar tissue.

(4) Remaining natural teeth have good periodontal tissue support.

(5) Occlusion showing sufficient inter-arch and intra-arch spaces for future prosthesis.

B. Exclusion criteria:

(1) Patients with systemic conditions that could influence the outcome of the therapy as: Pregnancy and Heavy smokers

(2) Patients with systemic disease that may affect bone quality.

(3) Uncooperative patients

(4) Patients with active periodontal disease.

(5) Patients with neglected oral hygiene.

(6) Patients with limited mouth opening and unfavorable intermaxillary arch space.

(7) Patients with maxillary sinus disease or previous sinus surgery.

C. Ethical consideration:

All participants will be verbally informed about the nature of the study, and written informed consent will be collected for participation in the study.

Sample size calculation

According to analyses of the post- operative bone height [16, 19-20], sample size calculation was undertaken via G power version 3.1 statistical software based on the following pre-established parameters: an alpha-type error of 0.05, a power test of 0.95, a total sample of at least 21 subjects (7 subjects for each group) appeared to be sufficient.

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Intervention

The patients will be randomly divided into 3 equal groups:

1) Group 1(controlled group): 7 patients will be treated by traditional closed sinus lift (osteotome) with bone grafting (xenograft) and implant placement.

2) Group 2: 7 patients will be treated by densah drills(Versah, Jackson, MI, USA) sinus lift with bone grafting (xenograft) and implant placement.

3) Group 3: 7 patients will be treated by piezoelectric (Piezotome; Satelec) crestal sinus lift with bone grafting (xenograft) and implant placement.

Pre-surgical Therapy:

Before the surgery, each patient will be given careful instructions in proper oral hygiene measures. A full mouth supragingival and subgingival scaling and root planning procedure will be performed under local anesthesia using ultrasonic as well as hand instrumentation.

-Cone-beam computed tomography (CBCT) will be taken to estimate the height and width of the bone crest and bone density.

Surgical Procedure:

Patients will be asked to use 0.12% chlorhexidine digluconate rinse, and Povidone iodine solution will be used to perform extraoral antisepsis. After administration of local anesthesia at the implant site, a full thickness flap will be elevated to expose the crest of alveolar ridge. A pilot drill will be used to start the osteotomy preparation, which should be ended 1mm short of sinus floor. **In group 1**; **(closed sinus lifting with Osteotome):** The drills can be sequentially used to widen the osteotomy site to the same level (1 mm short of the sinus floor), an osteotome of diameter a little less than the planned implant body, will be inserted in the prepared osteotomy site and gently tapped to reach the same level, the osteotome will be tapped gently to fracture up the sinus floor.

In group 2; (closed sinus lifting with densah drills): Change the drill motor to reverse-densifying Mode (counterclockwise drill speed 800-1500 rpm with copious irrigation), Begin with the densah bur (2.5mm) until 1 mm short of the sinus floor, use the next wider Densah Bur (3.0mm) in the same mode and advance it into the previously created osteotomy with modulating pressure and a pumping motion. When feeling the haptic feedback of the drill reaching the dense sinus floor,

modulate pressure with a gentle pumping motion to advance past the sinus floor in 1 mm increments, the next wider densah drills advance in the osteotomy.

In group 3: The initial osteotomy will be performed with a 2-mm twist drill to remove the cortical bone, then the intralift tips (Intralift; TKW1, TKW2, TKW3, TKW4, TKW5; Satelec). TKW1 to TKW4 tips have diameters of 1.35 mm, 2.1 mm, 2.35 mm, and 2.8 mm and will be used to gradually widen the access canal to the Schneider membrane, gentle pressure will be applied on the tips to deepen the pathway, and a sterile spray (80 mL/min) cooling the tips to avoid heat injury. The TKW5 tip will be then inserted into the access canal, and the ultrasonic activation for 5 seconds with internal irrigation of 40 mL/min and repeated at 50 mL/min and then 60 mL/min. The sinus membrane will be pushed upward by the hydraulic pressure, the floating of the sinus membrane will be evaluated, and then the TKW4 (Ø 2.8 mm) will be used again to widen the access canal to the sinus membrane before plugging the bone graft.

For all groups: Clinical check for membrane still intact, blocking the patient's nostrils and asking the patient to blow through his or her nose. Xenograft will be added as the grafting material and pushed to the sinus through the osteotomy site until the desired height of sinus elevation will be gained, the implant fixture will be inserted. Smart peg will be placed on implant and Ostell will be used to record ISQ. Cover screw will be placed on implant and flab will be sutured. Sutures will be removed after 10 days.

Evaluation

Patients will be evaluated clinically and radio graphically as follows:

1. Clinical parameter including:
    i. Implant primary stability will be evaluated by resonance frequency analysis (RFA) [21] at base line.
    ii. Implant secondary stability will be evaluated by resonance frequency analysis (RFA) [21] at 6 months (immediately before loading).
2. Radiological assessment:
        i. Preoperative Cone beam computerized tomography (CBCT) will be taken for assessment of bone height and thickness (implant treatment plan) and at time of loading (6 months) to evaluate vertical bone gain, ridge width, crestal bone loss and bone density.

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