An Assessment of the Efficacy of Sinus Balloon Technique on Transcrestal Maxillary Sinus Floor Elevation Surgery

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ABSTRACT

Background: A minimally invasive antral membrane balloon elevation (MIAMBE) has been introduced to overcome the invasiveness of modified Caldwell-Luc (lateral approach) and the drawbacks of the osteotome (summers' technique) in maxillary sinus floor elevation surgery.

Materials and methods: A total of 13 adult Iraqi patients aged 28-55 years, 4 males and 9 females underwent sinus floor elevation surgery via crestal approach by using sinus balloon technique. A panoramic radiograph and (Cone beam computed tomography (CBCT)/or medical CT scan) were obtained before and after surgery. Postoperative gained bone was assessed and the patient reactions including pain, nasal bleeding, and ecchymosis were recorded. The whole follow up period was 1year following the sinus lift surgery.

Results:The total performed sinus floor elevation cases were 17 with a total of 27 sinus floor elevation sites. The maximum gained bone with sinus balloon technique was 10.6 mm. Twenty three dental implants placed in augmented maxillary sinuses, two implants early failed 8.70 % and the survival rate of the dental implants was (91.30 %). Schneider's membrane perforation didn't occur in any case of this study 0%.

Conclusion: Sinus floor elevation via crestal approach using the balloon technique solve the limitations for original osteotome technique (summers' technique) for cases even when the subantral bone height is less than 3 mm. The utilization of hydraulic pressure in combination with balloon technique also shows a great role in both sinus membrane elevation and as a diagnostic aid of Schneider's membrane perforation.

Key words: Sinus lift surgery, antral membrane balloon elevation, Schneiderian membrane perforation. (J Bagh Coll Dentistry 2016; 28(1):109-113).

INTRODUCTION

The new advances and devices simplified the original techniques used in sinus floor elevation surgery. The sinus membrane elevation conventionally established through two main approaches the modified (Caldwell-Luc) lateral approach (Tatum 1976) [(1)], or by a more conservative transcrestal approach (summers' technique) 1994[(2)]. Lateral window technique can be applied when the subantral bone height is less than 5 mm[(3)].It is predictable and allow for greater amount of bone augmentation but it need larger surgical access[(4)],with high risk of *Schneiderian membrane* perforation and possible trauma to intraosseous arterial supply[(5,6)].On the other hand the osteotome technique is less invasive[(7)],and associated with less post-operative morbidity[(8)].However, this technique has several limitations included restricted indications and allow for only minimal amount of bone gain which is 3-4mm[(9)].Later, many modifications established to facilitate and optimize the results achieved with original approaches, among these modifications Antral Membrane Balloon Elevation (AMBE)via crestal approach has been introduced whichmay extend the indication for transcrestalsinus lift surgery for membrane elevation of up to 10 mm[(10)].

The purpose of this study was to evaluate the efficacy of the balloon technique in sinus elevation surgery and the short term survival rate of the dental implants during the 1st year after placement.

MATERIALS AND METHODS

The present study continued from December 2013 to June 2015in Dental College Teaching Hospital, Department of Oral and Maxillofacial Surgery /Baghdad University. It based on clinical and radiographical data.

The sample included patients with single or multiple missing teeth in the sinus zone of atrophied maxilla in which the subantral bone heightwas ≤ 4 mm for the two stage sinus floor elevation surgery and > 4mm for one-stage sinus floor elevation surgery.

Inclusion Criteria

1. The patient' age ranged from 20 –70 years.
2. Missing tooth (teeth) in the sinus zone of atrophied maxilla in which the subantral distance < 8 mm.
3. Healed planned implant site at least 6 months after extraction.
4. Healthy person with no history or clinical evidence of specific systemic diseases that may affect the bone healing, dental implant osseointegration and the maxillary sinus health.

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Exclusion Criteria

1. Any local or systemic disease that may affect the bone healing potential, dental implant osseointegration and maxillary sinus condition such as (diabetes, osteoporosis, others).
2. Sinusdisease (sinusitis, mucomycosis, retention cyst, mucocele,tumor,polyp,others).The presence or absence of maxillary sinus disease confirmed by preoperative cone beam computed tomography (CBCT) scan.
3. History of previous sinus surgery.
4. Presence of septa in the planned site for maxillary sinus floor elevation as confirmed by preoperative radiograph (CBCT scan).
5. Head and neck radiotherapy.

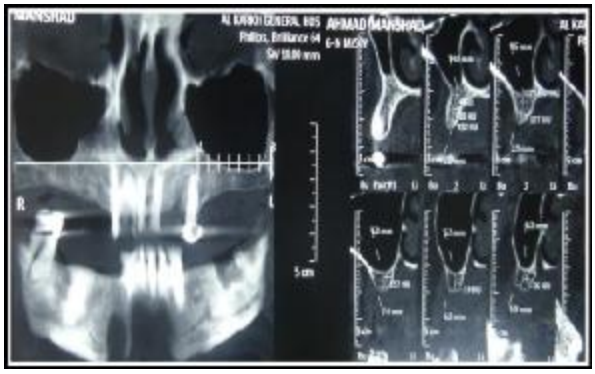

Figure 1: Pre-Operative Medical CT Scan Measurements Show the Height and Width of the Planned Implant Site.

Surgical Procedure

All the patients rinsed with chlorhexidine 0.2% for 1 min preoperatively.The procedure was performed under local anesthesia (2% lidocaine with 1:100,000 adrenalin as vasoconstrictor, 2.2 ml cartridge). A crestal incision is made slightly with palatal bias and a full thickness flap (extensive flap design) was raised.The drilling site was marked initially by the pilot bur in the center of the alveolar crest and stopped 1 mm below the sinus floor. Drilling was done using the Dentium (Korea) or Nucleoss (Turkey) implant systems.Dental implant bed was enlarged to at least 4.2 mm to allow entry of balloon and the bed was then enlarged until reaching to the final drill determined diameter, as shown in figure 2.

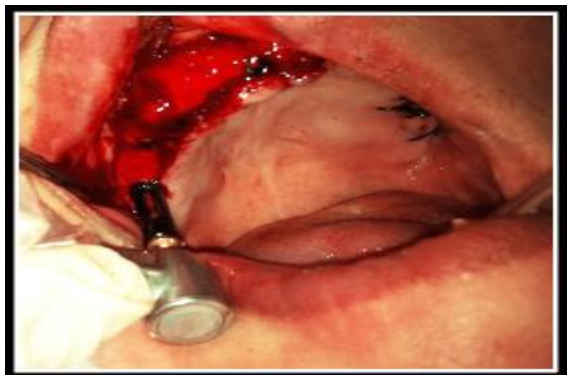

Figure 2: Preparing Implant Bed by Drilling with Sequential Larger Drills.

Anosteotome tip No D2.0 mm, No D3.0 mm and/or No D3.8 mm from osteotome kit *(Friadent, company)*was inserted and gentle tapping applied by surgical mallet to allow for controlled green-stick fracture of the sinus floor, as in figure (3). Entrance into the sinus membrane space (SMS)was manifested by changing in the voice resonance and tactile sense of the surgeon.

Figure 3: Controlled Green Stick Fracturing of the Sinus Floor with Osteotome.

Depending on the residual alveolar bone height, the integrity of the Schneiderian membrane can be assessed clinically either by direct vision or by using hydraulic pressure test to elevate and detect the sinus membrane patency, seefigure4.

Figure 4: Schneiderian Membrane Clinically Visible of Two-Stage Sinus Lift Surgery with Subantral Bone Height of 3 mm.

Hydraulic pressure test was performed by using 50cc disposablesyringe then by introducing the normal saline in each bed with gentle pressure, if there is no evidence of coughing reflex or discharge of saline from the nose, this will confirm theintegrity of the membrane clinically as shown in figure 5.

Figure 5: Initial Elevation and Assessment of Sinus Membrane Integrity via Hydraulic Pressure Test with Injection of 20 cc Normal Saline.

Figure 6: The Sinus Lift Balloon was Introduced beneath the Schneiderian Membrane within the SMS (Sinus Membrane Space) and Inflated.

The balloon (*Genoss Company, Korea)* inserted in the subantral space "beneath the sinus membrane" and then inflated. This procedure was repeated 3-4 times as in figure (6).After the desired sinus membrane elevation was achieved, the GBR barrier membrane inserted in the bed and pushed apically with an osteotome beneath the elevated *Schneiderian membrane.*

The Particulate bone grafts {βTricalcium phosphate sterile resorbablebone substitute} was then injected in the prepared bed and guided gently beyond the fractured sinus floor beneath the *Schneiderian membrane* with an osteotome.

After placement of the required amount of bone substitute for elevation, the dental implants were placed. The length of the placed dental implants were (10 and 12 mm) and diameter were(4.2, 4.3, 4.8, and 5 mm).Wound closure was performed utilizing non-absorbable black silk suture gauge 3/0. Immediate post-operative periapical radiograph was obtained for immediate assessment of sinus lift surgery as shown in figure 7.

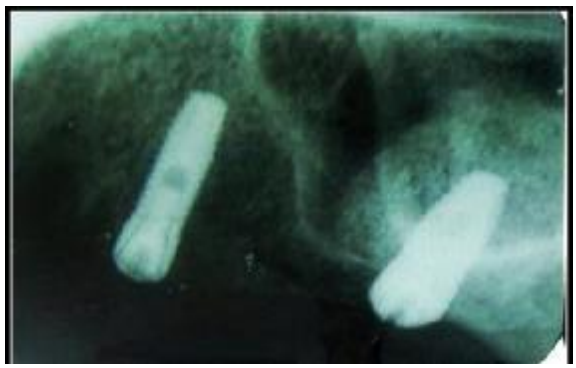

Figure 7: Immediate Post-Operative Periapical Radiographs Show the Amount of Bone Graft and Implants inside the Augmented Lift Maxillary Sinus.

The post-operative bone gain was measured in the axial view of CBCT scan.Post-operative OPG was taken to all patients 6 months after surgery as in figure 8.Follow-up period after treatment was 1 year.

Figure 8: Post-Operative OPG Show Distribution of Dental Implants and the Augmented (R and L) Maxillary Sinuses.

Figure 9: Healing Abutments in the 2nd Stage Surgery.

Figure 10: Final Prosthesisinside the Patient's Mouth.

RESULTS

A total of 13 adult Iraqi patients aged 28-57 years, 4 males and 9 females were participated in this study. Nine patients underwent unilateral sinus floor elevation surgery and 4patients underwent bilateral procedures. The total performed sinus floor elevation cases were 17 with a total of 27 sinus floor elevation sites.

Fifteen cases were performed in a single-stage surgery (simultaneous sinus floor elevation and dental implant placement) and 2 cases were performed in a two-stage surgery (sinus floor elevation and delayed dental implant placement 6 months later).The mean bone gain in this study was 6.70 mm and the mean utilized non autogenous bone graft material was 0.74 ccresulting in p value of 0.027 which is significant. The maximum gained bone with sinus balloon technique was 10.6 mm and the minimum of gained bone was 4.9 mm.The mean initial subantral bone height was 5.56 mm (SD = 1.18), while the mean gained bone height 6 months after operation was 6.7 mm (SD = 1.56) with P value of 0.004 which is highly significant.

A total of 23 dental implants placed in the augmented maxillary sinus, two implants early failed 8.70 % and the survival rate of the dental implants inside the sinus was 91.30 %.

Twenty eight dental implants were placed outside the sinus in the same patients, 1 implant early failed 3.57% and 27 dental implants survived with a survival rate of96.42%. The cumulative survival rate of dental implants inside and outside sinus was94.12%.*Schneiderian membrane* perforation didn't occur in any case of this study 0%. Minor post-operative complications were registered involving mild nasal bleeding in one patient and infraorbital ecchymosis in another patient which resolved spontaneously and needed no intervention.

DISCUSSION

Schneiderian membrane perforation didn't occur in any case of this study 0% and this was confirmed clinically in all cases before insertion of (GBR) barrier membrane by direct vision if the subantral bone height was less than 4 mm or by normal saline irrigation test which show absence of coughing reflex and nasal saline discharge. Radiographically, CBCT scan showed uniform distribution of the bone substitute material around the dental implants, identical consistent dome shape of the bone substitute and no leakage of bone particles from sinus membrane space into the sinus cavity space.

Absence of *Schneiderian membrane* perforation in all cases could be attributed to the non-traumatic surface of the balloon and gentle slow inflation of sinus balloon. Utilization of the hydraulic pressure isthought to be the goldstone in the procedure since it was quite helpful in both simple non-invasive elevation of the sinus membrane and as a diagnostic test for *Schneiderian membrane*perforation.With MIAMBE, the maximum gain in bone height was 10.6 mm which achieved the results obtained with the lateral window approach in a minimally invasive manner. The majority of the patients experienced mild pain after sinus floor elevation surgery and this was due to non-invasive nature of the procedure. The minor post-operative complications included infraorbital ecchymosis in one case 5.88%. This could be attributed to the injury of the posterior superior alveolar artery during sinus floor elevation surgery due to the anatomical variations of Posterior superior alveolar artery location which could be located even in the floor of maxillary sinus. Bleeding from the nose occurred in one case5.88%, which arise12 hours after surgery according to the patient description. It was mild and stopped without any intervention.

As a conclusion, utilization of hydraulic pressure in combination with sinus balloon technique is of great value in both sinus

membrane elevation and as a diagnostic tool of *Schneiderian membrane* perforation. The crestal sinus balloon techniqueproduce the same elevation achieved by lateral approach which is ≥10 mm in a less invasive manner. It solves the limitations for original transcrestal osteotome technique for cases even when the subantral bone height is less than 3 mm. Also it reduces the risk of sinus membrane perforation and reduces the postoperative pain, infection, and other symptoms usuallyoccurred with sinus lift procedures.

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