ASSESSMENT OF MAXILLARY SINUS MEMBRANE TEARING AFTER SINUS LIFT SIMULTANEOUSLY WITH IMPLANT PLACEMENT USING HYDRAULIC LIFT TECHNIQUE VERSUS SUMMERS' OSTEOTOME TECHNIQUE IN POSTERIOR EDENTULOUS MAXILLA(A Randomized Clinical Trial)

Jamal S. Lashhab*, Hassen Abdelghany Osman, Omniya M Abdelaziz*****

Abstract

Aim: The aim of this study is to assess the incidence rate of sinus membrane tearing after sinus lift using both hydraulic and osteotome techniques in posteriorly edentulous maxilla.

Methodology: Twenty-six patients with edentulous posterior maxilla with limited residual bone height, seeking for fixed restoration, were enrolled in this study. The residual bone height ranged from 6 mm to 8mm. All patients were randomly divided into two groups according to technique used for closed sinus lifting. The control group utilized Summers` osteotome technique and the study group utilized Hydraulic lift technique. Bone graft was placed in the osteotomy site with simultaneous implant placement for both groups. Incidence of sinus membrane tearing evaluated clinically by (valvalsa maneuver). Bone height gain was measured using CBCT immediately and 6 months post-operatively for both groups.

Results: The study group achieved more patient satisfaction with a mean value of 92.77±1.79% than controlled group that had a mean value of 86.15±3.72% mm which was statistically significant difference.

Conclusions: The use of the hydraulic lift technique for elevation of maxillary sinus membrane through crestal approach a safe and effective technique to prevent membrane tearing during the surgery. It also achieved more bone height gain initially and after 6 months follow up as well as more patient satisfaction than Summers` osteotome technique

Keywords: Sinus Membrane Tearing ,Hydraulic and Summers` technique, valvalsa maneuver

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* Researcher, Department of oral Implantology, Cairo University, Cairo, Egypt.
**.DDS, Assistant professor, Department of Oral Surgery, Cairo University, Cairo, Po box 12613, Egypt; Email: Hassan_ao@yahoo.com
*** DDS, Lecturer, Department of Oral Surgery, Cairo University, Cairo, Po box 12613, Egypt; Email: Omniya.abdelaziz@gmail.com

Introduction:

Implant therapy has been proposed in the treatment plan for restoring missing teeth nowadays more routinely because of its high success rates. Dental implant insertion in the posterior maxilla is a challenging treatment because of the ridge resorption as well as the maxillary sinus pneumatization following teeth loss. As a result, there is a significant decrease in the residual bone height. This lack of available bone is often a major hindrance to the placement of dental implants in the posterior maxilla. **(Adell, 1981)**

Maxillary sinus augmentation through Schneiderian membrane (SM) elevation is one of the most predictable surgical procedures to reconstruct the atrophic posterior maxillary alveolar ridge. Schneiderian membrane lifting has been performed through creation of an osteotomy either in lateral sinus wall as developed by **(Tatum and Boyne, 1960)** or via transalveolar approaches as described by **(Summers, 1994)**.

Maxillary sinus floor elevation (SFE) has been the most common widely used augmentation method, because it has become a reliable and acceptable rehabilitation method for atrophic posterior maxilla. However, intraoperative complications have been documented, including devitalization of adjacent teeth, bleeding and perforation of the maxillary sinus membrane. Iatrogenic SM perforation is the most widely occurring intraoperative complication during maxillary sinus augmentations surgeries. The integrity of the sinus membrane, along with the patency of the nasal osteum is essential for the health and normal function of the maxillary sinus. **(Alfaro F et al., 2008)**

The water lift system is a sinus surgical device designed specifically for the safe operation of sinus lifting. It is comprised of an aqua system, a sinus membrane elevation apparatus capable of distributing hydraulic pressure equally all over the Schneiderian membrane elevation.

The goal of this prospective randomized clinical trial was to see how successful the hydraulic lift

technique was at safely elevating the maxillary sinus membrane via the crestal technique in the vertically deficient posterior maxillary ridge with simultaneous implant placement.

Materials and methods:

This study comprised 26 patients seeking for fixed prosthetic restorations for their lost posterior maxillary teeth, however due to sinus pneumatization, they had restricted bone height below the floor of the maxillary sinus that limit dental implant placement. Closed sinus lifting with simultaneous implant placement was carried out for all patients as a treatment plan for fixed rehabilitation of their edentulous posterior maxilla.

Under infiltration local anesthesia using 4% Articaine with 1:100 000 epinephrine vasoconstrictor, a crestal incision was traced 1 cm distal to the pre-planned fixture and a full thickness mucoperiosteal flap was raised using mucoperiosteal elevator to fully expose the alveolar ridge then a sequence of drilling was operated at the proper implant site (based on a pre-planned surgical stent with radio-opaque marker) till the final drilling according to implant diameter. The osteotomy site was prepared to a depth 1 mm below the sinus floor according to the measured bone height in x-ray.

- Sinus lifting technique in the control group (group A):

Using Summers` osteotome technique for sinus membrane elevation by advancing the osteotome with the appropriate osteotome tip size into the prepared osteotomy site with light tapping the osteotome with the surgical mallet to fracture the 1 mm of remaining bone height. Sinus lift was ensured when the correct marking on the osteotome was flushed with the bone crest.

-Sinus lifting technique in the study group (Group B):

Using Hydraulic lift technique for sinus membrane elevation by using a diamond coated special dask drill* (size 2) to mechanically drill and thin out the cortical bone of sinus floor with stopper and copious irrigation. The sinus floor was carefully approached under light apical pressure till the floor was felt to be yielding. By application of the hydro-lift system, the disposable syringe was filled by 5 cc saline and then a 3cc saline was pushed into the hose. The syringe was then adapted to the metallic roller.

The aqua tip was then connected to the osteotomy drilled hole site (Figure 1) and was perfectly adapted by the adaptor. The saline hose was connected to the fitted aqua tip from one end and to the 5cc disposable syringe from the other end. The metallic roller controlled the hydraulic saline pressure into the Schneiderian membrane by rolling the disposable syringe to push the saline steadily through the hose to the aqua tip to elevate the sinus membrane. By application of slow injection of saline solution under pressure (1cc per 20 seconds) to raise the sinus membrane, the hydraulic detachment of the maxillary sinus membrane could be achieved to give more space at this area for bone graft placement.

Figure (1): The metallic roller with adapted 5cc disposable syringe and saline hose to control the hydraulic pressure to the sinus membrane and the aqua tip hydraulic lifter that has been placed into the osteotomy site and saline was being slowly infused to hydraulically lift the sinus membrane.

* Diamond dask drill, Dentium company, Korea.

,5 cc which equal to ,25 gm xenograft (Med-Park Bone D ®*) with ,2 to 1 mm particle size was used for each group. The bone graft was then mixed with blood and a special bone carrier was then used to carry the bone graft to the osteotomy site in increments (Figure 2). Each increment was gently packed into the osteotomy site to mechanically elevate the membrane by condensation of the bone material using a special bone condenser.

Finally, the implant (JD evolution implant ®) of the proper size was removed from its sterile package and handled to its position inside the osteotomy site. The flap was then closed using 4/0 non-resorbable silk ®** suture with 3/8 reverse cutting needle. Before dismissing the patient, a CBCT x-ray was taken to determine the amount of bone height gain immediately after surgery.

Figure (2): A bone graft mixed with blood then applied in the osteotomy site by bone carrier.

Results :

Mean value of patient satisfaction score of the study group (92.77±1.79) was significantly higher than mean value of the control group (86.15±3.72) ($p<0.001$).

Discussion:

The sinus elevation procedure is frequently regarded as the gold standard for generating enough bone volume in the posterior edentulous maxilla to support endosseous implants. The quantity of residual bone in the upper posterior maxilla is reduced as a result of the maxillary sinus pneumatization's significant direct impact on accessible bone height. By using bone grafts and/or other biomaterials to enhance the maxillary sinus, this problem can be resolved. (**Kumar A et al., 2015).**

The maxillary sinus closure, the condition of the residual tissues, and the successful osseointegration of the implants were all taken into consideration when designing this study. As a result, from the outset of the treatment plan, all factors that could have an influence on osseointegration, whether systemically or locally, should be taken into account, including patient selection, implant selection and insertion, sinus lift techniques, and superstructure design. To prevent placing unnecessary pressure on the implants and affecting the validity of the data, patients exhibiting para-functional habits like clenching, bruxism, or a significant overbite were also excluded from the research.

The present study was designed to compare between the effectiveness of Aqua water lift system and conventional system in maxillary sinus membrane elevation during the closed sinus lifting technique, by assessing bone formation around the implant in the sinus cavity and after completion of prosthetic part of the implant using CBCT. In sinus grafting, membrane integrity

is a primary condition for and measure of success. Aqua water lift system effectively preserves the sinus membrane while taking advantage of anatomical features that, in conventional techniques, necessitate a more invasive approach or compromise the clinician's ability to position implants accurately. (**Vitkov L et al, 2005).**

The osteotome sinus floor elevation method (O.S.F.E.) was first reported by Summers in 1994 as a strategy to increase the last 5–6 millimetres of bone height under the sinus to enable a 10 millimetre implant insertion. Indirect osteotome maxillary sinus floor elevation (OMSFE) is utilised when the residual bone height between the floor of the sinus and the crest of the ridge is equivalent to or greater than 6mm, whereas direct one is used in situations of significant resorption, according to **Emmerich D et al., (2005).**

In comparison to open sinus technique, **Coatoam et al. (1997)** found that the closed sinus approach was preferred in sinus lift because it is a less invasive technique that permits the simultaneous placement of implants of 10mm or longer with a reduction in operational time, improved postoperative comfort, and preservation of sinus cavity integrity. Additionally, the indirect strategy may load implants more quickly than the direct way and has high survival rates of about 90%.

According to **Srouji et al. (2009),** the indirect osteotome technique offers a number of benefits over the direct approach, including being less intrusive, controlling sinus augmentation, reducing postoperative morbidity, loading implants more quickly, and achieving good survival rates of 90% or higher. Numerous sources have reported on the elevation that is kept using the osteotome technique. Although **Mardinger et al. in 2007** reported up to 13mm of sinus augmentation, **Nkenke et al. in 2002** recommended the osteotomes only to induce small

elevations.

The most frequent side effect of the indirect Summers' osteotome approach is paroxysmal positional vertigo (Kaplan et al., 2003), which has a significant impact on postoperative patient satisfaction. On the other hand, the hydro lift method, as described by **Vitkov L et al., (2005),** uses the advancement of a dask drill to remove the cortical bone of the sinus floor and create a hole through which a hydraulic pressure may be applied. Because the cortical bone was drilled as opposed to fractured, the procedure was painless. The dask drill is made to only remove bone, not to penetrate soft tissue, hence this effectively avoids sinus membrane perforations.

The hydraulic lift strategy, according to **Vitkov L et al. (2005),** focuses on the hydraulic elevation of the Schneiderian membrane using a special hydro lift system that can produce a uniformly distributed hydraulic pressure during sinus membrane elevation, insuring the safety of the surgery. This method comprises securing an aqua tip to the osteotomy hole site without allowing it to leak, then attaching a saline hose to the fitting aqua tip from one end and to a single-use, 5 cc disposable syringe that is connected with a regulating roller from the other. By gradually injecting the saline solution under pressure (1cc every 20 seconds), the roller controls the hydraulic pressure of the saline into the Schneiderian membrane of the maxillary sinus, creating greater space for new bone growth in this location. Since no hammering or malleting is done via the maxilla, this technique can result in a more comfortable process and higher patient satisfaction. As a result, there is a decreased incidence of the benign paroxysmal positional vertigo that is frequently linked to Summers' osteotome procedure.

Prior to sinus floor elevation, a CBCT was performed on each patient to enable three-dimensional treatment planning and to evaluate the sinus conditions and remaining alveolar bone

height. In order to ensure proper implant and prosthetic placement with favourable force direction on the implants and prosthetic components as well as to facilitate the comparison on the same cut pre and post operatively, **Kahnberg KE et al. (2008)** used a presurgical stent for the patients with gutta percha markers. With CBCT, 3-D reconstructions and cross-sectional imaging are both feasible at possibly lower radiation doses than with medical multislice CT. There is a chance that using panoramic images of the posterior maxilla will result in an underestimation of the amount of bone height available for implant insertion.The accessible bone volume may be assessed more precisely using CBCT. According to **Fortin T et al. (2011),** a CBCT can also detect septa and illnesses in the maxillary sinus as well as artery channels in the lateral sinus wall.

This study employed xenograft, which is animal bone matrix that has been mineralized. The most common source is bovine, and they are osteoconductive transplants with physiological compatibility. According to **Shaifulizan et al. (2014),** there is a clear correlation between the high success rate of sinus augmentation surgeries and the use of xenograft as a reliable grafting material.Clinical stability in their investigation was enhanced by the introduction of xenograft.Because there are no symptoms of grafting material rejection, such as pain, edoema, or bleeding from the surrounding tissue, it is also biocompatible. Additionally, it has a fantastic osteo-conductivity. Radiographs showing no vertical bone loss add to the validity of this investigation.

There are several issues to consider when comparing conventional techniques to the method discussed here. We should state that the traumas and failures associated with implants placed in aggressively drilled and overheated bone are, categorically, not an issue with our

patients. Our patients are generally referred to us because they have deficient alveolar bone to begin with; thus, drilling is minimized or unnecessary and no overheating of bone occurs. This factor contributes to our near 100% success rate for implantation.

Following sinus lifting, complete membrane integrity provides a conducive environment for bone development. According to **Del Fabbro et al.(2008)** the gradual increase in bone density beneath the lining in the grafted area may be caused by the osteogenic activity of the periosteal layer of the sinus lining in response to the stimuli induced by closed sinus lift with simultaneous bone graft placement and implantation.

The hydraulic lift technique in this study had no membrane tearing with more patient satisfaction than Summers` osteotome technique and all implants on both groups have been succeeded and completely osseo-integrated.

Conclusion:

From the result of the current study we conclude that: the use of hydraulic sinus floor elevation through the crestal approach a safe and effective technique to prevent membrane perforation during the surgery. It also produced equal bone distribution around the implant with more bone height and width gain.

Hydraulic lift technique is a valuable alternative technique that combined minimal invasive surgery with more patient comfort.

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