

# Sinus membrane lift using water balloon followed by bone graft and implant: 28 cases report

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**Abstract Aim:** The objective of this study was to assess the efficacy and safety of minimally invasive sinus lift using an inflatable water balloon followed by bone graft and implant placement.

**Methods:** A total of 28 cases with single tooth missing in the posterior maxilla underwent water balloon sinus lift followed by bone grafting and implant placement. Baseline bone height was 4.92 ± 1.24 mm. Implant site preparation employed a pilot drill and osteotomy followed by water balloon elevation. The mean inflated balloon volume was 0.670.17 mL. Bio-Oss was infilled with dedicated instrument under the elevated sinus membrane. 28 implants (diameter from 3.8 to 5.0 mm) were totally placed. Pre- and post-operative panoramic films or CT's (optional) were taken for every case to measure and compare the result of sinus membrane lift with water balloon. Postoperative patient reactions including swelling, discoloration, discomfort, hematomas, and disability were also documented. **Results:** Successful sinus membrane water balloon lifting procedure were performed in 26 cases, two procedures were aborted due to sinus membrane perforation. A total of 26 implants were placed. The mean inflated balloon volume was 0.670.17 mL, X-ray examination showed mean elevated height by balloon was 10.92.06 mm. Computed tomography showed the bone graft distributing evenly around implants. Patients were extremely pleased and needed very little medical attention. The mean follow-up was 15.92.94 months. One implant was lost because of infection. Conclusion: The use of water balloon elevating sinus membrane is a truly minimally invasive technique and is associated with very little discomfort. The method has very encouraging results, and is easy to learn and associated with little low complication rates.



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## Materials and Methods

A total of 28 cases with single tooth missing in the posterior maxilla underwent water balloon sinus lift followed by bone grafting and implant treatment in the Department of Implant Dentistry Peking University, School of Stomatology. Each patient received an explanation regarding the procedure and signed a consent form. Pre-operative computerized tomography (optional) and panoramic radiographs were performed to assess mucosa thickness, pathology, bone height, sinus structure. Baseline bone height was 4.92 ± 1.24 mm.

## Surgical technique

A local anesthesia (infiltration of posterior superior alveolar nerve and greater palatine nerve) was executed by Articaine Hydrochloride (Merignac Cedex France). An alveolar horizontal, full-thickness flap was performed. No vertical releasing incision was employed and the flap was reflected not exceeding the alveolar ridge. Implant site preparation employing a pilot drill of 2 mm, 2.8 mm reached about 1 mm short of the sinus floor. Then the sinus floor was gently elevated by osteotome (Alta-tec Biotechnologies, Germany) from 3.8 mm to 4.3 mm or 5.0 mm. After examining the integrity of the sinus membrane by Valsalva maneuver, the dedicated inflatable balloon ((Hager & Meisinger GmbH, Germany) was anchored and the balloon was slowly inflated with the dedicated inflator syringe using 0.9% normal saline with gentle inflating pressure. Once the desired elevation (usually > 10 mm) was obtained, the balloon was deflated and removed. A second test of membrane integrity was done as previously mentioned. A mix of autologous platelet-rich fibrin (obtained by centrifugation of 20 mL of patients' blood divided into 2 test tubes and spun for 10 minutes at 1600 RPM by Hereaus Centrifuge) and Bio-Oss particles (Geistlich Pharma AG) was infilled with dedicated instruments (USTOMED Germany) under the elevated sinus membrane. After bone transplantation, implants (Camlog Biotechnologies, Germany) of 3.8 mm to 5.0 mm diameter were placed and primary closure was performed with 4-0 absorbable sutures in 23 cases. Nonsubmerged technique was used in 3 cases. Prosthetic rehabilitation was delivered 4 weeks after implant exposure.

## Postoperative care

Patients were discharged with a single, 600-mg dose of Ibuprofen for treatment of pain and Vellosof 0.5g TID for 7 days for prophylaxis.

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The widespread use of implants for the replacement of the missing teeth leads to the use of more sophisticated surgical techniques in sites that previously were considered as contraindication for implant therapy. The posterior region of the edentulous maxilla frequently presents insufficient bone for rehabilitation by means of endosseous implants. Maxillary sinus lifting with a bone graft is a procedure first introduced by Boyne & James<sup>1</sup> and Tatum.<sup>2</sup> This technique has been used to permit the placement of endosseous implants in edentulous or excessively pneumatized maxillae. Although the lateral maxillary window approach (Caldwell Luke) could have a very successful clinical results for sinus grafting, this method had many shortcomings.<sup>3</sup> The limitations of lateral maxillary approach include sinus membrane perforation (10%-35%)<sup>4</sup>, bleeding, infection, infraorbital nerve laceration, and requires surgical expertise.<sup>5</sup> The postoperative discomfort including swelling, discoloration, disability, hematoma, pain occurs very often.<sup>5</sup> The other technique is

a limited sinus elevation by osteotome, which yields an average bone height of 3±0.8mm<sup>6</sup>. According to standard protocol, the osteotome technique can only be used when the ridge height is more than 5 mm where implants are placed simultaneously with the elevation of the sinus floor<sup>7</sup>. Moreover, this procedure can also be complicated by membrane perforation and tear.<sup>8</sup> Efraim et al<sup>9</sup> reported a minimally invasive technique for sinus membrane balloon elevation followed by implant placement. This procedure had satisfactory bone augmentation results (usually 10 mm) and good implant durability. For patients, this procedure eliminates the complications, discomfort, disfiguring and disability associated with traditional lateral window approach. The aim of the present study was to evaluate the efficacy and safety of a minimally invasive technique for sinus membrane elevation using water balloon followed by bone graft and implant via the osteotomy site and to report on the preliminary clinical results.

### Clinical evaluation

Postoperative patient reactions were also documented. Surgical complications including severe bleeding, infection, and implant failure were evaluated postoperatively.

### Radiographic evaluation

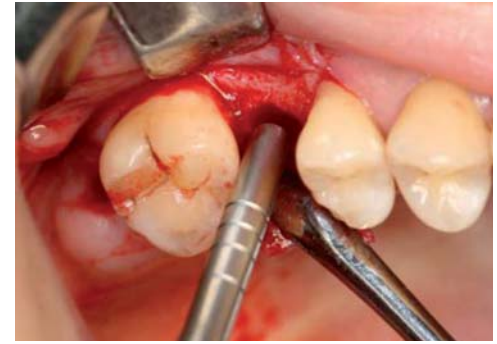
Pre- and post- operation panoramic films or CT's (optional) were taken for every case to measure and compare the result of sinus membrane lift with water balloon. Periapical films were employed to observe the marginal bone resorption and osseointegration after permanent prostheses delivered.

### Results

Between May 2006 and February 2007, we had 28 patients with a mean age of 40.2 (2.35) years. Among them 14 were female. Baseline bone height was 4.92 (1.24) mm. The mean inflated balloon volume was 0.67 mL. Computerized tomography (CT) showed the bone graft distributing evenly around implants, and the shapes of the elevated space were regularly like a hemisphere on panoramic views. X-ray examination showed mean elevated height by balloon was 10.92 (0.6) mm. The bone graft was stable and integrated with implant well after operation. Recorded minor complications included a mild, self-limiting nosebleeding happened right after surgery in one patient. No patient required medication for swelling alleviation and in general they needed little medical attention postoperatively. A total of 26 implants were placed and restored with permanent prostheses. The mean follow-up was 15.92 (9.4) months. Only 3 implants were nonsubmerged in this study. One implant was lost due to infection 2 weeks postoperatively. The implant was placed again 3 months later and healed uneventfully. Two procedures were aborted due to sinus membrane perforation, but sinus graft and implant placement were successfully performed through Caldwell Luke approach 4 weeks later. Two cases were submitted to demonstrate the technique of the procedure step by step and the follow-up results (Cases 1 Figure 1-10) and Case 2 Figure 1-3). **Radiographic evaluation** Pre- and post- operation panoramic films or CT's (optional) were taken for every case to measure and compare the result of sinus membrane lift with water balloon. Periapical films were employed to observe the marginal bone resorption and osseointegration after permanent prostheses delivered.



**Figure 1.**  
I6 was lost with adequate buccal bone.



**Figure 2.**  
Osteotome was used to elevated the sinus floor.



**Figure 3.**  
The inflated balloon was anchored.



**Figure 4.**  
Fine bone instruments to insert the bone graft.



**Figure 5.**  
A mix of Bio-Oss and autologous platelet-rich fibrin was used as bone graft.



**Figure 6.**  
The implant was placed simultaneously.



**Figure 7.**  
Preoperativel panoramic X ray showed the residual bone height was 5.4 mm.



**Figure 8.**  
6 month post operatively panoramic X ray showed bone graft was stable.



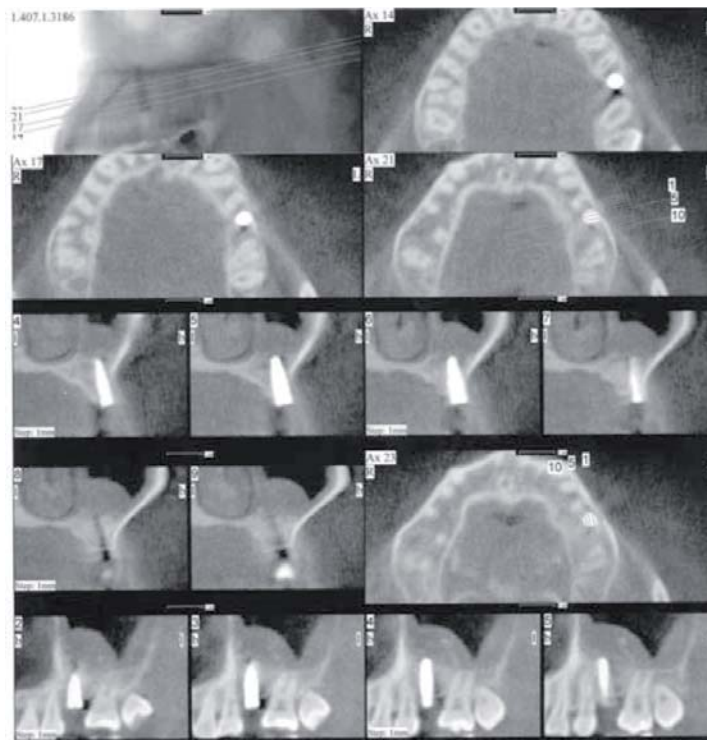
**Figure 9.**  
The periimplant marginal bone was stable 12 months after permanent prostheses delivered.



**Figure 10.**  
The final clinical result showed periimplant soft tissue was healthy.



**Figure 1.**  
Preoperative panoramic X ray film showed the residual bone height was 3.3 mm.



**Figure 2.**  
CT showed bone graft distributed evenly around implant.



**Figure 3.**  
Periapical film showed marginal bone was stable and osseointegration around implant was fine 13 months after prostheses delivered.

## Discussion

Indications selection criteria for water balloon maxillary sinus lifting:

Because this study was planned to evaluate the feasibility and importance of the method for general practitioners and doctors who are not surgical experts, this surgical procedure was randomly performed by doctors in the department including junior doctors, therefore the selection criteria of patient in this study were those with single tooth missing but that had insufficient bone height in posterior maxillary area with adequate bone width. An osteotome was employed to condense the bone and ensured implants initial stability. Only 3 implants were nonsubmerged because the residual bone height was more than 5 mm and with type III bone quality according to the Lekholm and Zarb classification<sup>10</sup>. For a residual bone height less than 3 mm, traditional lateral maxillary approach was executed. The results in this study indicate this sinus membrane water balloon elevation procedure is safe and effective for single tooth missing in posterior maxillary area, which needs sinus bone grafting even performed by junior doctors who are not surgical experts. The procedure is truly minimally invasive. The study of the sinus membrane balloon elevation for multi-teeth missing area is now in the process in the same department.

Key points for the water balloon maxillary elevation technique:

Although every case in this study had preoperative residual bone analysis through orthopantomography or CT examinations, which were very important to plan and evaluate the procedure, the interpreted bone height on the film could not be totally identical with surgical findings and exactly guide surgical procedure. With reference of X-ray bone value, the surgical drill feeling is a key point for a successful sinus membrane lift with the water balloon. During preparing the implant site the drill just reaches the sinus floor cortical bone layer when it felt from soft to hard. Then osteotomes were used step by step to elevate the sinus floor about 1 mm, and the water balloon was inflated to lift the sinus membrane to the desired height. Sinus membrane perforation was observed when using the pilot drill to prepare the sites in 2 cases in this study. No balloon rupture was observed when using the balloon to lift the sinus membrane. Efraim et al<sup>9</sup> reported sinus membrane and balloon rupture in 1 case out of 24 cases. It indicated the force of the water balloon was gentle and spread equally on each direction during sinus membrane elevation.

### **Bone graft selection:**

Xenografts have been very well documented as a sinus grafting material. They have been

used alone or as part of a composite graft combined with autogenous bone, venous blood or platelet rich plasma<sup>11</sup>. In this study it seems that a mix of Bio-Oss and autologous platelet-rich fibrin with a ratio 3:1 could stimulate bone formation. Although the benefit of platelet-rich fibrin to bone formation around implants is still controversial<sup>12-13</sup>, further study is needed to elucidate long-term effects.

### **Implants selection:**

Both Wallace and Del Fabbro reviews show a dramatic difference in implant survival when comparing rough to machined implants<sup>3, 11</sup>. In this study Camlog implants conditioned with a particle-blasted and acid-etched micro-structured surface were used. It maybe results in high implant durability. Future study is needed to show implant bone contact for Camlog surface to confirm it.

### **Safety and efficacy evaluation:**

This study reports a minimally invasive, single-stage procedure of maxillary bone augmentation. There were no major complications, and the procedure yielded satisfactory bone augmentation results and good implant durability as observed in this study. This procedure eliminates the complications, discomfort, disfiguring, and disability associated with traditional lateral maxillary sinus approach and shortens the time to implant exposure and functionality by more than 6 months. This result is similar to Efraim Kfir's report.<sup>9</sup>

### **Conclusion**

The use of balloon elevation sinus membrane could be a truly minimally invasive and is associated with very little discomfort. The method is easy to learn and with excellent procedural success, and low complication rates.

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