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Maxillary sinus floor elevation by the lateral approach with hydraulic pressure: case series

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The insufficient thickness of alveolar bone together with low bone density make difficult to place of dental implants at posterior of the maxilla. To overcome this anatomical restriction, there has been sinus floor elevation (SFE) that can provide sufficient bone volume for implant placement. In the present report, three cases of SFE using hydraulic lift kit to the posterior maxillary site with reduced vertical bone height, and the evaluations of the clinical and radiographic evaluations were completed. Three patients with an insufficient alveolar bone height were treated with sinus augmentation without any complications. A radiographic evaluation showed that augmented bone height was consistently maintained through the follow-up periods and no specific bone resorption was shown. Based on the results in this report, the hydraulic pressure might be an effective procedure to elevate sinus floor with/without implant placement and reduced the risk of membrane perforation in the atrophied posterior maxilla. **(THE JOURNAL OF KOREAN ACADEMY OF OSSEOINTEGRATION 2018;10(1):10-15)**

Key words: Dental implant, Hydraulic lift, Sinus floor elevation, Lateral approach

INTRODUCTION

Following tooth loss, resorption of the alveolar process and reduction of the height in the posterior maxilla begins. Moreover, the osteoclastic capacity of the periosteum adjacent to the sinus membrane is activated, thereby resultant to the pneumatization of the sinus[1]. The insufficient thickness of alveolar bone together with low bone density makes difficult to the place of dental implants at the posterior of maxilla. To overcome this anatomical restriction, there has been sinus floor elevation that can provide sufficient bone volume for implant placement and proven to be a reliable procedure with predictable results[2-4].

There has been two main access to the sinus, the lateral sinus wall osteotomy (the lateral approach) and the passage through the crestal osteotomy (transalveolar approach), to elevate the Schneiderian membrane and augment the bone graft[5,6]. Between them, the lateral approach first introduced by Boyne[2] in 1969 utilized surgical opening at the lateral wall of the maxillary sinus to have good visual and instrumental access during sinus floor elevation (SFE). Today the modified Caldwell-Luc approach is the most generally accepted method, allowing for the benefit of ready access to the sinus, significant elevation of the floor, and thus creation of sufficient bone volume to support the placement of implants. However, since this technique requires a relatively large surgical operation, patient morbidity resulting from bleeding and postoperative swelling and membrane perforation during the surgery have been the common complication of lateral SFE[7].

In the clinical trials to perform SFE with less invasive and effective way, the innovative surgical tools have been developed including the hydraulic sinus lift (hydrodissection), specially designed reamers, drills and piezoelectric devices to minimize the trauma while cutting the sinus floor and decrease patient's discomfort related to the rupture of the Schneiderian membrane[8].

In the present report, three cases of SFE using hydraulic lift kit to the posterior maxillary site with reduced vertical bone height, and the evaluations of the clinical and radio graphic outcomes were done.

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CASE REPORT

1. Case I

A 57-year-old female patient who had missed the first molar in left maxilla was referred to the Department of Oral and Maxillofacial Surgery of Ewha Medical Center in July 2016 for SFE. The patient had an unremarkable medical history. Panoramic radiography and computed tomography (CT) examinations were performed, panoramic view showed deficient residual bone height (RBH) at the first molar in left maxilla with sinus pneumatization (Figure 1A). In computed tomography, the RBH at the first molar in left maxilla was measured to be 2.5 mm and 3.0 mm, respectively, and SFE using hydraulic lift kit was planned (Figure 1B).

The patient rinsed with 0.12% chlorhexidine digluconate solution (Hexamidine, Bukwang, Seoul, Korea) before the operation. Following a 2% lidocaine with 1:100,000 epinephrine local anesthetic injection, a flap including the mid crestal incision and the vertical incision was reflected, also the lateral wall was prepared with a hydraulic lift kit (Hydro-Lateral Approach Kit®, Shinhung, Seoul, Korea) (Figure 2A). After the perforation of the sinus wall by the sequential use of lateral drills (Figure 2B), Hydro membrane lift cap was connected and the lift cap was engaged with a 1.0 ml syringe filled with saline solution. Approximate 0.3 ml of the sterile saline was pumped back and forth gently to elevate the sinus membrane (Figure 2C). And after that, the lateral wall was opened by trephine drill and elevation of the sinus membrane was performed with curettes to make space for the bone graft. A graft of bovine hydroxyapatite 1.25 g (Bio-Oss®, Geistlich Pharm AG, Wolhusen, Switzerland) was prepared and carefully packed without excessive pressure into the anterior part of the sinus cavity and then into the posterior part (Figure 2D).

Postoperative recovery was uneventful without complication. It has been 3 months since patient had a surgery, dome-shaped radiopacity was observed in panorama and CT view (Figure 3A). Vertical augmented height measured from the distance between inferior border of the sinus floor and most coronal margin of the dome was 12.0 mm and 13.5 mm (Figure 3B and C).

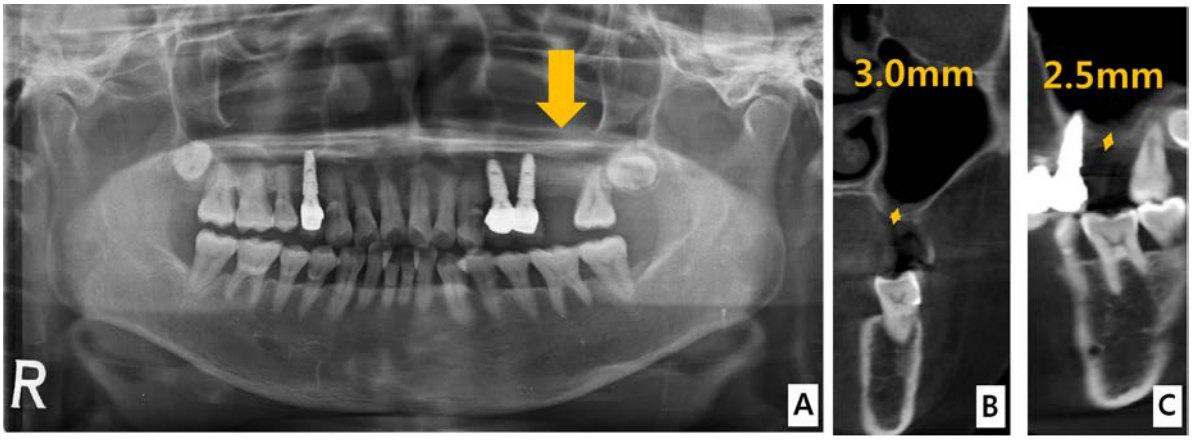

Figure 1. (A) Preoperative panoramic view, (B) Preoperative CT scan (paraxial view), (C) Preoperative CT scan (axial view).

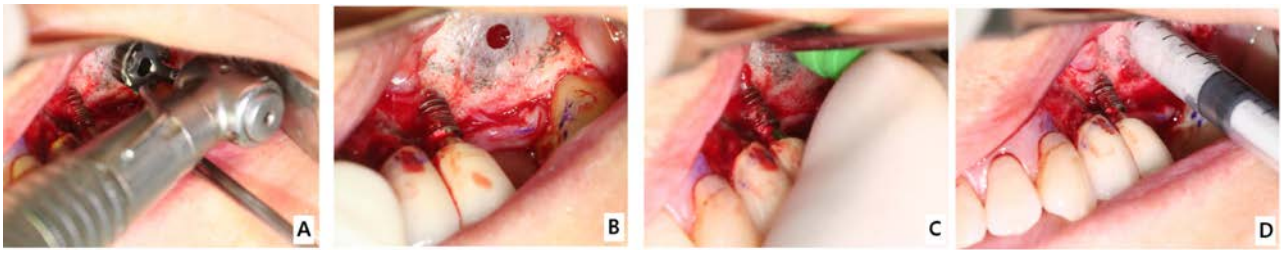

Figure 2. (A) Process of the lateral wall perforation with the use of the hydraulic lift kit, (B) After the perforation of the sinus wall with the use of lateral drills, (C) Hydro membrane lift cap was connected, pumped back and forth gently, (D) The bone graft material was prepared and packed carefully without an excessive pressure.

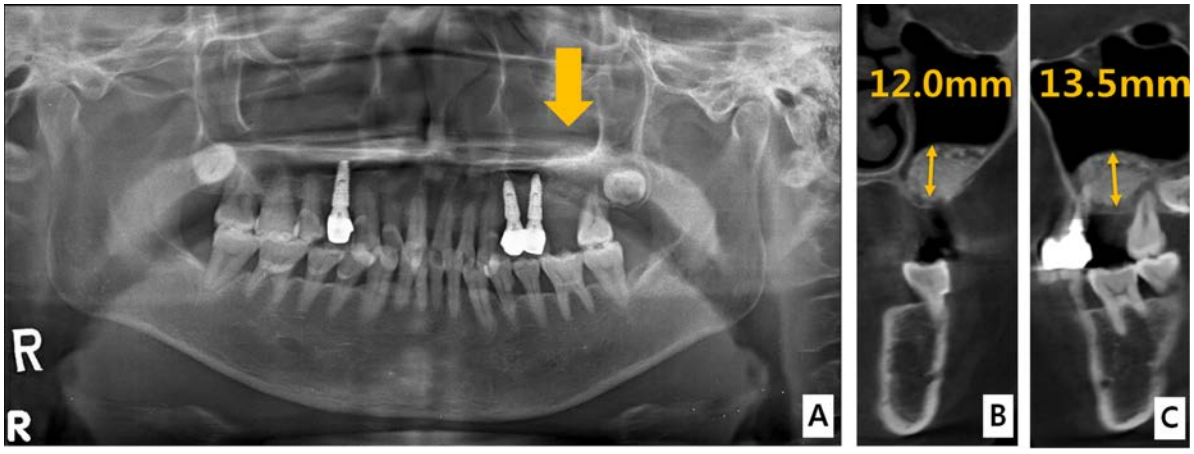

Figure 3. (A) The dome shaped radiopacity was observed (postoperative panorama at 3-month), (B) In CT view, vertical augmented height is enough for dental implant, (C) In CT view, vertical augmented height is enough for dental implant.

2. Case II

A 45-year-old male patient had an extraction of molar teeth in left maxillary visited the Department of Oral and Maxillofacial Surgery of Ewha Medical Center in August 2016 for the rehabilitation of the posterior maxilla with implant. His past medical history was unremarkable. Panoramic radiography and CT examinations were performed, panoramic view showed deficient RBH in left maxilla with sinus pneumatization (Figure 4A). In computed tomography, the RBH at the first molar in left maxilla was measured to be 1.7 mm and 2.3 mm (Figure 4B and C). Dental implants with simultaneous sinus augmentation were planned using a hydraulic lift kit.

Prior to surgery, the patient rinsed with 0.12% chlorhexidine digluconate solution (Hexamedine, Bukwang, Seoul, Korea). Following local anesthetic injection, a full-thickness mucoperiosteal flap was reflected, and the lateral wall was prepared with a hydraulic lift kit (Hydro-Lateral Approach Kit®, Shinhung, Seoul, Korea) (Figure 4D). After the perforation of the sinus wall by the sequential use of lateral drills, Hydro membrane lift cap was connected and the lift cap was engaged with a 1.0 ml syringe filled with saline solution. Approximate 0.3 ml of the sterile saline was pumped back and forth gently to elevate the sinus membrane.

And after that, the lateral wall was opened using trephine drill and elevation of the sinus membrane was performed with curettes to make space for the bone graft. Bone graft material 1.0 g (Bio-Oss®, Geistlich Pharm AG, Wolhusen, Switzerland) was inserted beneath the elevated membrane (Figure 4E), and two fixtures (TS III® diameter 4.5 × 11.5 mm & 5.0 × 11.5 mm; Osstem, Seoul, Korea) were installed (Figure 4F and G).

Postoperative recovery was uneventful with no complication. In panoramic view after 1 month, dome-shaped radiopacity which is surrounding implant apex was observed (Figure 4H).

3. Case III

In October 2016, a 39-year-old male patient was referred for the treatment in his right maxillary second molar area. The patient did not have any medical abnormal conditions. Panoramic radiography and CT examinations were performed, panoramic view showed deficient RBH in right maxilla with sinus pneumatization (Figure 5A). In computed tomography, the RBH at the second molar in right maxilla was measured to be 2.5 mm (Figure 5B). Treatment plan consisted of implant installation with simultaneous sinus augmentation using hydraulic lift kit in the right posterior area was being set up.

Prior to surgery, the patient rinsed with 0.12% chlorhexidine digluconate solution (Hexamedine, Bukwang, Seoul, Korea). Following local anesthetic injection, a full-thickness mucoperiosteal flap was reflected, and the lateral wall was prepared with a hydraulic lift kit (Hydro-Lateral Approach Kit®, Shinhung, Seoul, Korea). After the perforation of the sinus wall by the sequential use of lateral drills, Hydro membrane lift cap was connected and engaged with a 1.0 ml syringe filled with saline solution. Approximate 0.3 ml of the sterile saline was pumped back and forth gently to elevate the sinus membrane.

And after that, the lateral wall was opened using trephine drill and elevation of the sinus membrane was performed with

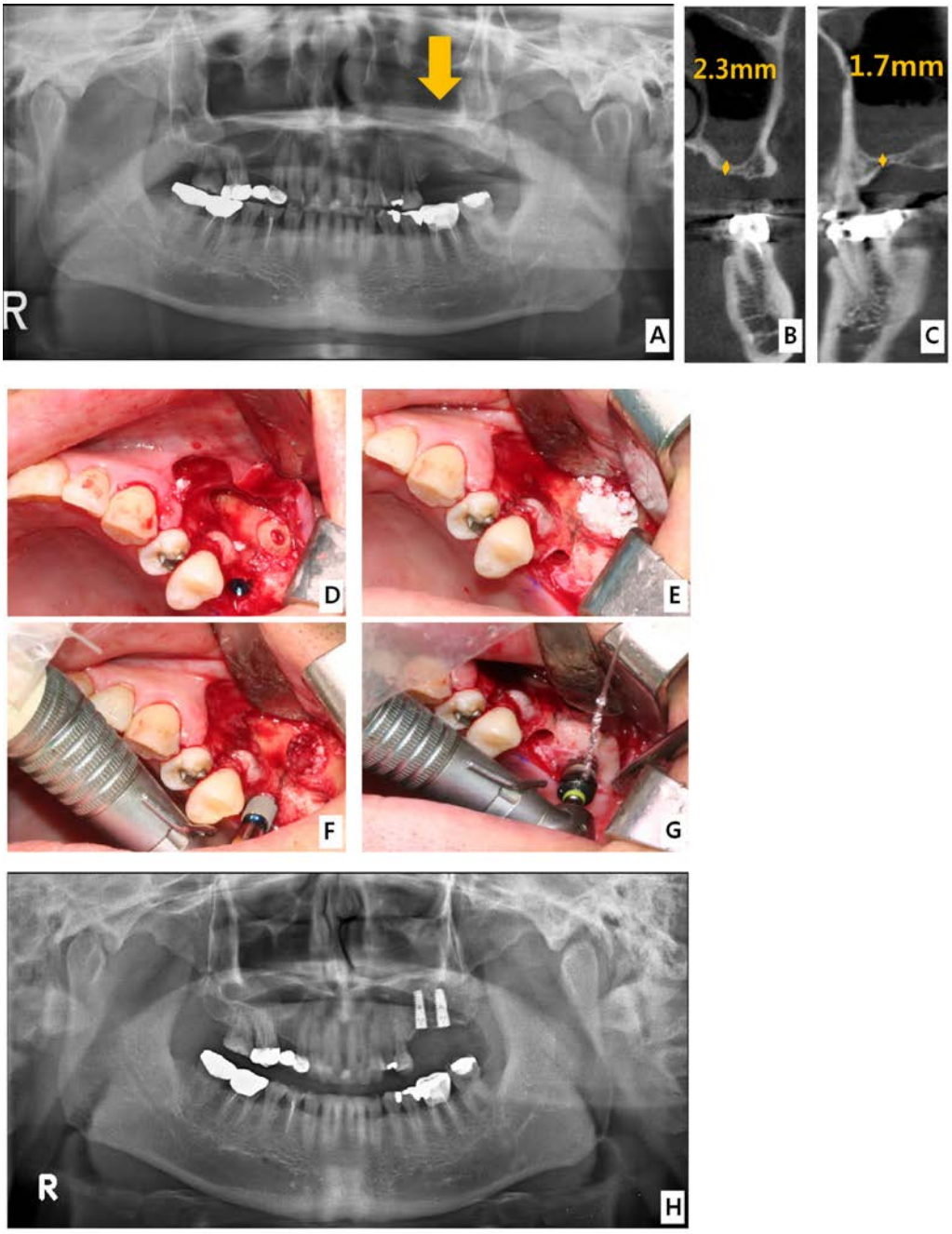

Figure 4. (A) Preoperative panoramic view, (B) Preoperative CT scan (paraxial view), (C) Preoperative CT scan (axial view), (D) The Lateral wall was prepared with a hydraulic lift kit, (E) Bone graft material was inserted beneath the elevated membrane, (F, G) Two fixtures were installed (Length = 11.5 mm), (H) The dome shaped radiopacity was observed which is surrounding the implant apex (Postoperative panorama at 1-month).

curettes to make space for the bone graft (Figure 5C). Bone graft material 0.5 g (Bio-Oss®, Geistlich Pharm AG, Wolhusen, Switzerland) was inserted beneath the elevated membrane. After the placement of fixture and the wound was closed with sutures (Figure 5D and E). Postoperative recovery was uneventful without complication.

Dome-shaped sinus bone augmentation around the implant apex was shown immediately after the surgery (Figure 5G) and prosthetic delivery was done within 4 months of healing periods.

DISCUSSION

Rehabilitation of missing posterior teeth in maxilla with

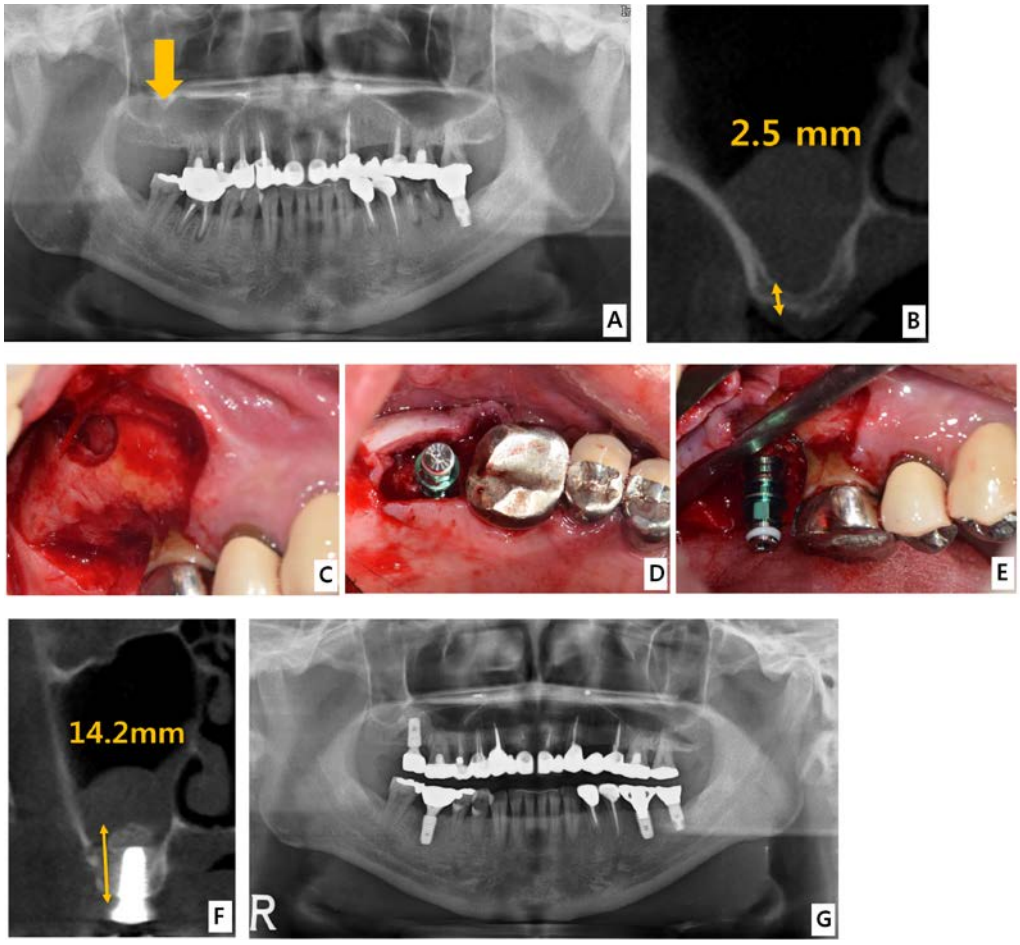

Figure 5. (A) Preoperative panoramic view, (B) Preoperative CT scan (paraxial view), (C) Lateral wall was prepared with a hydraulic lift kit and elevation of the sinus membrane was performed, (D, E) A fixture was placed (TS III® diameter 5.0 × 10.0 mm; Osstem, Seoul, Korea), (F) Dome-shaped sinus bone augmentation around the implant apex was shown, (G) Prosthetic delivery was done within 4 months of healing periods.

dental implants often face with clinical challenges from the limited bone height and poor bone quality[9]. To overcome the reduced vertical bone height associated with the sinus pneumatization and ridge atrophy, SFE has been accepted to be a solid procedure with predictable results[2,3]. Different approaches have been reported to augment the maxillary sinus cavity of the severely atrophied posterior maxilla[10-12]. Pjetersson et al.[7] reported that implant placement in the combination with a lateral window sinus lift is a predictable treatment option, showing high implant survival rates and low incidences of complications. However, maxillary sinus floor elevation using a lateral approach implies execution of a large mucosal periostel flap that inevitably affects postoperative recovery and the additional expense of the augmentation procedure[13]. Thus, surgical tools and skills have been developed for less invasive and effective way of sinus floor elevation.

Among them, several surgical techniques have been proposed by using hydraulic pressure, so-called "hydraulic sinus lift" procedure. Kao and DeHaven[14] reported that using the controlled hydrostatic sinus elevation kit includes pressure sensor meter, hand-actuated pump, stainless steel Luer-Loc cannula allows smooth, evenly applied, force application through gentle fluid pressure in a closed system to elevate the Schneiderian membrane. Chen and Cha[15] have developed a new kit that consists of round diamond sinus burs and titanium-coated sinus graft condensers. They suggested that clinicians can safely separate the Schneiderian membrane from the sinus floor and prepare the area for immediate implant placement using these tools in the combination with hydraulic pressure supplied by a surgical handpiece. Son et al.[16] informed the technique using ultrasonic piezoelectric vibration and hydraulic pressure, so-called Hydrodynamic piezoelectric internal sinus elevation. Hydrodynamic piezoelectric internal sinus elevation breaks the sinus floor with ultrasonic vibration and elevates the sinus

membrane using hydraulic pressure, without bone compaction. Besides that, many alternative tools and technique have been reported.

Unlike previous reports, in the present cases, the alternative method of the lateral sinus wall osteotomy (the lateral approach) using special devices of "Hydro membrane lift system" was described and it showed an adequate amount of SFE to place standard fixture length at the site showing reduced remaining bone height of 1.5 to 3.0 mm preoperatively. This device included specially designed drills to minimize the trauma of the membrane while cutting the sinus wall for the lateral approach and showed no signs of perforations in clinical detection. In addition, Hydro membrane lift cap connected with the water syringe brought out hydraulic pressure into the cavity and elevation of the floor was done indirectly without any contact of instruments to the membrane. Results on the reduced perforation rates were in accordance with the former clinical studies utilizing these devices, which also suggested that the safer surgery makes less dependent on the operator's skill[8]. As results, three patients with an insufficient alveolar bone height were treated with successful sinus augmentation without any complications. A radiographic evaluation showed that augmented bone height was consistently maintained through the follow-up periods and no specific bone resorption was shown.

CONCLUSION

From the present case reports, it could be concluded that the hydraulic pressure method might be an effective procedure to elevate sinus floor with/without implant placement and can reduce the risk of membrane perforation in atrophied posterior maxilla. Future clinical trials are needed to evaluate the effectiveness of this technique on a broader scale than these case reports.

REFERENCES

1. Galindo P, Sánchez-Fernández E, Avila G, Cutando A, Fernandez JE. Migration of implants into the maxillary sinus: two clinical cases. Int J Oral Maxillofac Implants 2005;20:291-295.
2. Boyne PJ. Grafting of the maxillary sinus floor with autogenous marrow and bone. J Oral Surg 1980;38:613-616.
3. Rosen PS, Summers R, Mellado JR, Salkin LM, Shanaman RH, Marks MH et al. The bone-added osteotome sinus floor elevation technique: multicenter retrospective report of consecutively treated patients. Int J Oral Maxillofac Implants 1999;14:853-858.
4. Tetsch J, Tetsch P, Lysek DA. Long-term results after lateral and osteotome technique sinus floor elevation: a retrospective analysis of 2190 implants over a time period of 15 years. Clin Oral Implants Res 2010;21:497-503.
5. Taum H. Maxillary and sinus implant reconstruction. Dent Clin North Am 1986;30:207-229.
6. Summers RB. A new concept in maxillary implant surgery: the osteotome technique. Compendium 1994;15:152-162.
7. Pjetursson BE, Tan WC, Zwahlen M, Lang NP. A systematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation: part I: lateral approach. J Clin Periodontol 2008;35:216-240.
8. Hong JY, Lim HC, Herr Y, Chung JH, Shin SI, Shin SY. Sinus floor elevation using alternative methods for the transalveolar approach: a case report on hydro membrane lift system and hatchreamer. Implantology 2015;19:218-226.
9. Sharan A, Madjar D. Maxillary sinus pneumatization following extractions: a radiographic study. Int J Oral Maxillofac Implants 2008; 23:48-56.
10. Chiapasco M, Casentini P, Zaniboni M. Bone augmentation procedures in implant dentistry. Int J Oral Maxillofac Implants 2009; 24(Suppl):237-259.
11. Esposito M, Felice P, Worthington HV. Interventions for replacing missing teeth: augmentation procedures of the maxillary sinus. Cochrane Database Syst Rev 2014;13:CD008397.
12. Meloni S, Jovanovic S, Lolli F, Cassisa C, De Riu G, Pisano M et al. Grafting after sinus lift with anorganic bovine bone alone compared with 50: 50 anorganic bovine bone and autologous bone: results of a pilot randomised trial at one year. Br J Oral Maxillofac Surg 2015; 53:436-441.
13. Geminiani A, Weitz DS, Ercoli C, Feng C, Caton JG, Papadimitriou DE. A comparative study of the incidence of Schneiderian membrane perforations during maxillary sinus augmentation with a sonic oscillating handpiece versus a conventional turbine handpiece. Clin Implant Dent Relat Res 2015;17:327-334.
14. Kao DW, DeHaven Jr HA. Controlled hydrostatic sinus elevation: a novel method of elevating the sinus membrane. Implant Dent 2011;20:425-429.
15. Chen L, Cha J. An 8-year retrospective study: 1,100 patients receiving 1,557 implants using the minimally invasive hydraulic sinus condensing technique. J Periodontol 2005;76:482-491.
16. Kim JM, Sohn DS, Heo JU, Park JS, Jung HS, Moon JW, et al. Minimally invasive sinus augmentation using ultrasonic piezoelectric vibration and hydraulic pressure: a multicenter retrospective study. Implant Dent 2012;21:536-542.