Survival rate of the implants placed without bone graft for sinus floor elevation in posterior maxilla area

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I. Introduction

Poor residual bone height in the posterior maxilla beneath the sinus is still a problem during dental implantation. Because the alveolar process tends to resorb with age and the maxillary sinus becomes larger. That is seems to be caused by the further bone resorption and edentulous-related maxillary sinus pneumatization due to osteoclastic erosion of the periosteal sinus floor leads to progressive hollowing out of the alveolar process from the apical aspect[1-3]. Therefore, available bone volume in this region is little, sinus floor elevation procedure has become important. Sinus floor elevation with a lateral approach is the most common one[4]. However, when the residual bone height is more than 6mm, the sinus floor elevation through the crestal approach could be applied with simultaneous implant placement[5]. The osteotome sinus floor elevation procedures are less invasive, operation time is reduced, and the postoperative discomfort is minimized[6]. Moreover, during the osteotome sinus floor elevation procedure, regardless of optional bone addition, the local bone of the alveolar crest is condensed or expanded and the primary stability of implants can be improved[7,8]. So, if the bone continuity of the expanded socket with osteotome is supported, implant can be placed without bonegraft. In this study we evaluated survival rate of implants placed without bone graft in posterior maxilla area.

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II. Material and Methods

1. Patients

During the period of 2003-2009, 62 dental implants were inserted in a group of 56 (31 men and 25 women)patients at the LivingWell Dental Hospital. The selection of patients was based on the availability of CT studies and whether implants were inserted into the maxillary sinus without grafting material after osteotome sinus floor elevation procedure. Pre-operative remaining bone height of all patients were >5mm. Average remaining bone height was 9.86±4.03(range 5.6-13)mm and mean age of participated patients was 49.6 years(range 18 to 77 years)(Table 1).

■ Table 1. patients

Number of patients	56
Male/female(n)	31/25
Mean age, range(yr)	46.6, 18-77
Average remaining bone height, range(mm)	9.86±4.03, 5.6-13

2. Implants

A total of 62 implants(50 Taperd screw-Vent®, implants and 12 PITT-EASY® implants) were purchased from Zimmer, USA and Oraltronics, Germany. The implant lengths between 11.5 and 16 mm were used. Most implants (77%) were length of 13mm and their diameter was 3.5-40mm(45%) and 4.5-5.0mm (41%)(Table 2-4).

■ Table 2. Implant system

Implant system	Number of implants
PITT-EASY®	12
TSV®	50
Total	62

■ Table 3. survival rate related with implant diameter

Length(mm)	placed	Failed	Survival rate(%)
11.5	1	0	100
12	9	0	100
13	48	1	97.9
14	3	1	66.7
16	1	0	100
Total	62	2	96.8

■ Table 4. survival rate related with implant diameter

Diameter(mm)	placed	Failed	Survival rate(%)
3.0-3.5	1	0	100
3.5-4.0	28	0	100
4.0-4.5	7	1	85.7
4.5-5.0	26	1	96.2
Total	62	2	96.8

3. Surgical Technique

A local injection of anesthesia was performed with 2% lidocaine with 1:100,000 epinephrine. A mid-crestal incision with or without releasing incision was made. After the full-thickness flap elevation, a first drill(locator drill) was used to perforate the cortical bone. To minimize the risk of a sinus floor perforation, the following drills was used at least 2mm shorter than the remaining bone height. After preparing the the site where the implant was to be placed with implant drills(Fig. 1), the osteotomes were inserted to expand the preparation area both horizontally and vertically(Fig. 2). Osteotomes in increasing diameters were used and elevate the sinus floor. The final step before placing the implant was to check for the membrane perforation, the continuity of inner side of prepared socket and to check that the preparation was patent to the planned insertion depth. Finally, implant was inserted and closed with cover screws before the flap was repositioned and sutured.

Fig. 1. Socket preparation with implant drills.

Fig. 2. Socket expansion with osteotomes.

4. Prosthetic treatment and follow-up

3 to 8 months afterwards, the implants were loaded. Abutments were tightened with a 30Ncm torque. When the implant resisted the applied torque, the classical prosthetic steps were conducted and porcelain fused to gold prostheses were fabricated. Patients were followed up every 4 months for supportive care and evaluation. The mean observation follow-up period was 28.3 months. Panoramic radiographs were made pre-, post-operative and after 12 months in order to evaluate the peri-implant bone and maxillary sinuses.

5. Survival criteria

Survival meant as follows:

a. immobile when manually tested
b. none peri-implant radiolucency
c. none irresolvable clinical symptoms or mechanical problems
d. clinically intact, and fully met its prosthodontic purpose

All clinically failed implants were removed and were recorded as failures in the database. Patients with failed implants were subsequently treated outside of the study.

III. Results

The cumulative survival rate of the osteotome implants after a mean follow-up time of 28,3 months, was 96.8%. From the original 62 implants inserted, one implant was lost during the follow-up time. It was a 4.7mm diameter implant placed without grafting material in a site with a residual bone height of 12.5mm. The second implant was lost before loading. The 4mm diameter implant was inserted without grafting material. The residual bone height was 11.2mm. After 6 weeks, the implant became loose and was removed. 10 weeks after the implant was removed a second 4mm implant was placed. The healing was uneventful and the implant was functioned.

According to the implant length, the survival rates were 100% for 11.5, 12mm and 16mm implants, 97.9% for 13mm implants, 98.7% for 8mm implants and 66.7% for the 14mm implants ($p>0.05$)(Table 3).

Table 6 summarizes the survival rate of the implants by diameter of implants, the survival rates were 100% for 3.0-4.0mm, 96.2% for 4.5-5.0mm implants, 85.7% for 4.0-4.5mm implants($p>0.05$)(Table 4).

Table 5 summarizes the survival rate of the implants by remaining bone height. Each implant site of posterior maxilla were measured in the pre-operative CT. Between 5 and 7mm of the bone height beneath the sinus were 6 cases. The survival rates were 100% for implant sites with between 5 and 11mm residual bone height and 90% for sites with residual bone height was above 11mm. Survival rate of the implants associated with gender, age and site was examined(table 6-8). They did not show statistical difference($p>0.05$).

■ Table 5. survival rate according to the remaining bone height

RBH(mm)	Number of implants	Fail	Survival rate (%)
5<RBH<7	6		100
7<RBH<9	17		100
9<RBH<11	19		100
11<RBH	20	2	90

■ Table 6. survival rate associated with gender

Gender	placed	Failed	Survival rate(%)	P-value
Male	36	2	94,4	
Female	26	0	100	0.23

■ Table 7. survival rate associated with age

Age	placed	Failed	Survival rate(%)	P-value
11-20	1		100	
21-30	2		100	
31-40	8	1	87.5	
41-50	22	1	95.5	
51-60	19		100	
61-70	9		100	
71-80	1		100	0.75

■ Table 8. survival rate associated with the implant sites

Site	placed	Failed	Survival rate(%)	P-value
1st pre molar	7	1	85.7	
2nd pre molar	14	0	100	
1st molar	25	1	96.0	
2nd molar	16	0	100	0.28

Ⅳ. Discussion

Currently, there are 2 main approaches for the maxillary sinus floor elevation. Among of them, a lateral approach is the classic and the more commonly performed technique originally described by Tatum[10]. More recently, Summers advocated a crestal approach using osteotome and it is considered a less invasive method[7]. According to the consensus conference held on sinus lift in 1996, if the remaining bone height is 10mm or 7-9mm, the osteotome sinus floor elevation through the crestal approach is applied with concomitant implant placement[11]. In addition, some author(Nedir et al. 2006) suggested that is the osteotome sinus floor elevation procedure can be performed on the remaining height 4-6mm area when primary stability can be achieved[12].

In this study, the average remaining bone height was 9.83±4.03 (range 5.6-13)mm. In the six cases, the remaining bone height was 6mm or less and for implant sockets of that area were sequently tapped using osteotome. After desire height was gained, implant fixtures were placed. The implants achieved primary stability and have been successfully functioned.

Bone augmentation may be needed in partially or totally edentulous patients with severe atrophy of the jaws in order to enable implant placement and subsequent prosthetic rehabilitation. According to some authors, augmentation procedures are required when residual bone height beneath the sinus cavity is less than 8-10mm[13-15]. On the other hand, Nedir R et al.[16] reported the osteotome procedure without grafting material was effective. Through using osteotome peri-implant bone was densed and the implant have been functioned successfully.

In our study, all 62 implants, due to the prepared socket through the crestal approach using osteotome were achieved bony continuity, the bone graft was not perfomed. Implant site preparation was completed to less than the diameter of the implant used. The under preparation ensures increasing lateral pressure of the implantion the site because of the typical elasticity of the maxilla. This allowed to greater initial stability of implants[17]. However, in this time, the last osteotome with too small diameter must not be used. Because if the last osteotome diameter is too small compared with the implant diameter, too much torque will be used when inserting the implant. Excessive compression of the bone results in more trauma to the bone and hence, greater bone resorption may be encountered. This, in turn, may delay the osseointegration process[18]. When placing implants in sites with reduced bone volume, it is important to keep a balance between primary stability and minimizing trauma to the bone.

In a longitudinal study consisting of 303 patients and 449 implants, Bruschi et al.[19] suggested using

different instruments from Summers' osteotomes for the preparation of implant sites, and reported a success rate of 97.5%. Fugazzotto et al.[20] described a two-stage technique using trephine drills combined with osteotomes, achieving a success rate of 100%. Toffler et al.[14] proposed the use of modified osteotomes, with a survival rate of 93.5%.

In our study, total survival rate of placed implants was 96.8%. One implant was failed during healing period and one implant was failed after loading. All 62 implants were HA-coated or FBR surface implants. Suchlike surface texture of implants seems to play an important roll in overall survival rates[21]. This result of in our study is similar to the longitudinal study consisting of 614 implants with bone graft in the posterior maxilla of the patients who visited LivingWell Dental Hospital, Jang et al.[22] reported a survival rate a 96.9% in the journal of the Korean Academy of Implant Dentistry.

The typical Summer's bone added osteotome sinus floor elevation technique is at some risks according to some factors of the surgical procedure or a experience of the surgeon. When a thick layer of alveolar bone remains coronal to the sinus floor, the technique may require extensive malleting trauma during the sinus floor elevation, which may eventually cause post-surgery complication such as benign paroxysmal positional vertigo (BPPV)[23,24]. In addition, the action of osteotomes can hardly be controlled during the application of malleting pressure, thus resulting in an unwanted penetration of the instruments in the sinus cavity with a potential membrane perforation and the graft materials could be a problem[25,26]. Because of the risks stated above, some modified techniques have been reported[14,20] and in our procedures, without bone added osteotome sinus floor elevation technique combined with drilling system was used. In our all procedures, well controlled hammering was carried out and we could not experence the patient response like as BPPV.

Over the years, many different implants and drilling systems have been introduced. Combined with a deveolpoment of the equipments, surgical technique is considered to be important factor for successful osseointegration of dental implants. Biological failures of oral implants have been associated with bone quality and the degree of surgical trauma[27,28]. The osteotome sinus floor elevation technique is considered a 'minimal trauma' procedure. During the implant site preparation using the osteotome incresing diameter, the bone is compressed rather than removed and soft type Ⅲ or Ⅳ bony quality tend to be increased[29]. Therefore, in our procedures, we have made a first choice the osteotome sinus floor elevation technique without bone graft availing the natural elasticity of the maxilla. However, if the bone of the prepared socket for implantation was not expanded but splitted, because bony continuity was not achieved, generally we have done implantation with bonegraft. In addition, if the sinus menbrane was perforated, the lateral window technique have been carried out and in such cases were excepted in this study.

V. Conclusion

The results indicate that sinus floor elevation procedure without bone graft is acceptable method in posterior maxilla area if the bone continuity of the expanded socket with osteotome is supported.

REFERENCES

1. Tallgren A. The continuing reduction of the residual alveolar ridges in complete denture wearers: a mixed longitudinal study covering 25 years. J Prosthet Dent 1972;27(2):120-132.
2 Blomqvist JE, Albrius P, Lsaksson S. Retrospective analysis of one-stage maxillary sinus augmentation with endosseous implant. Int J Oral Maxillfac Implants 1996;11(4):512-521.
3. Ulm CW, Solar G, Krenrimair G et al. Incidence and suggested surgical management of septa in sinus lift procedures. Int J Oral Maxillofac Implants 1995;10(4):462-465.
4. Smiler DG. The sinus lift graft: basic techniques and variations. Pract Periodont Aesth Dent 1997;9(8):885-893.
5. Jensen OT, Shulman LB, Block MS, Iacone VJ. Report of the Sinus Consensus Conference of 1996. Int J Oral Maxillofac Implants 1998;13:11-32.
6. Fugazzotto P. Augmentation of the posterior maxilla:a proposed hierarchy of treatment selection. J Periodontol 2003;74(11):1682-1691.
7. Summers RB. A new concept in maxillary implant surgery: The osteotome technique. Compend Cont Educ Dent 1994;15(2)152-160.
8. Cavicchia F, Bravi F, Petrelli G. Localized augmentation of the maxillary sinus floor through a coronal approach for the placement of implants. Int J Periodont Rest Dent 2001;21(5):475-485.
9. Jensen OT. Treatment planning for sinus grafts. In: Jensen OT, ed: The Sinus Bone Graft. Chicago: Quintessence 1999:49- 68. 7.Nedir, R. Bischof, M. Briaux, J.M., Beyer, S. Szmukler-Moncler, S. & Bernard, J.P. A 7-year life table analysis from a prospective study on ITI implants with special emphasis on the use short implants. Results from a private practice. Clinical Oral Implants Research 2004;15:150-157.
10. Tatum H Jr. Maxillary and sinus implant reconstructions. Dent Clin North Am 1986;30:207.
11. Jensen OT, Shulman LB, Block MS, Iacone VJ. Report of the Sinus Consensus Conference of 1996. Int J Oral Maxillfac Implants 1998;13:11-32.
12. Nedir R, Bischof M, Vazquez L, Szmukler-Moncler S, Bernard JP. Osteotome sinus floor elevation without grafting material: a 1-year porspectivepilot study with ITI implants. Clinical Oral Implants Research 2006;17:679-686.
13. Schwarz-Arad D, Dolev E. The challenge of endosseous implants placed in the posterior partially edentulous maxilla: a clinical report. Int J Oral Maxillofac Implants 2000;15:261-4.
14. Toffler M. Osteotome-mediated sinus floor elevation:a clinical report. Int J Oral Maxillofac Implants 2004;19;266-73.
15. Nedir R, Bischof M, Briaux JM, Beyer S, Szmukler-Moncler S et al. A 7-year life table analysis on the use of short implants. Results from a private practice. Clin Oral Impl Res 2004;15:150-7.
16. Nedir R, Bischof M, Vazquez L, Szmukler-Moncler S, Bernard JP. Osteotome sinus floor elevation technique without grafting material: 3-year results of a prospective pilot study. Clin Oral Impl Res 2009;20:701-707.
17. Pjetursson BE, Rast C, Bragger U, Schmidlin K, Zwahlen P, Lang NP. Maxillary sinus floor elevation using the (transalveolar) osteotome technique with or without grafting material. Part I: implant survival and patients perception. Clin Oral Impl Res 2009;20:667-676.
18. Abrahamsson I, Berglundh T, Linder E, Lang NP, Lindhe J. Early bone formation adjacent to rough and turned endosseous implant surfaces. An

experimental study in the dog. Clinl Oral Impl Res 2004;15:381-392.

19. Bruschi GB, Scipioni A, Calesini G, Bruschi E. Localized management of sinus floor with simultaneous implant placement: A clinical report. Int J Oral Maxillfac Implants 1998;13:219-226.
20. Fugazzotto PA. The modified trephine/osteotome sinus augmentation technique: Technical considerations and discussion of indications. Implant Dent 2001;10:259-264.
21. Maxian SH, Zawadsky JP, Dunn MG. Mechanical and histological evaluation of amorphous calcium phosphate and poorly crystallized hydroxyapatite coatings on titanium implants J Biomed Mater Res 1993;27:717-28.
22. Jang HY, Kim HC, Lee SC. Maxillary Sinus Floor Augmentation and Simultaneous Implant Placement; A retrospective study of 614 dental implants (514 HA-coated Tapered Screw-Vent implants and 100 FBR coated Pitt-Easy implants.) 2009;28(1):29-40.
23. Rodriguez Gutierrez C, Rodriguez Gomez E. Positional vertigo afterwards maxillary dental implant surgerywith bone regeneration. Med Oral Patol Oral Cir Bucal 2007;12:E151-E153.
24. Penrrocha-Diago M, Rambla-Ferrer J, Perez V, Perez-Garrigues H. Benign paroxysmal vertigo secondary to placement of maxillary implants using the alveolarexpansion technique with osteotomes: A study of 4 cases. Int J Oral Maxillofac Implants 2008;23:129-132.
25. Tan WC, Lang NP, Zwahlen M, Pjetursson BE. Asystematic review of the success of sinus floor elevation and survival of implants inserted in combination with sinus floor elevation. Part II: Transalveolar technique. J Clin Periodontol 2008; 35(Suppl. 8):241-254.
26. Berengo M, Sivolella S, Majzoub Z, Cordioli G. Endoscopic evaluation of the bone-added osteotome sinus floor elevation procedure. Int J Oral Maxillofac Surg 2004;33:189-194.
27. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants. Succeess criteria and epidemiology. Eur J Oral Sci 1998;106: 527-551.
28. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated oral implants.(II). Etiopathogenesis. Eur J Oral Sci 1998;106:721-764.
29. Lekholm U, Zarb G. Patient selectionand preparation. In: Brånemark PI, Zarb G, Albrektsson T(eds). Tissue Integrated Prosthesis: Osseointegration in Clinical Dentistry Chicago: Quintessence, 1985:199-210.

상악구치부에 골이식 없이 식립된 임프란트의 생존률에 관한 연구

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현재 임상에서 치조정 접근술 사용시 무조건 골이식을 하는 술자가 많고 이는 과잉한 방법이라 생각된다. 그리하여 본 연구에서는 상악구치부에서 osteotome을 이용한 상악동 거상술 시 골이식 없이 뼈의 탄력성을 이용하여 식립된 임프란트의 생존률을 평가하였다.

상악 구치부에 임프란트를 식립한 56명의 환자(62개 임프란트: 50 Tapered Screw-Vent®, Zimmer, USA, 12 Pitt-Easy®, Oraltronics, Germany)를 대상으로 하였다. 모든 환자에서 osteotome을 이용하여 치조정 접근을 통한 상악동 거상술이 시행되었다. 3~6개월 후 임프란트는 보철을 수복을 통해 부하가 가해졌으며, 평균 follow-up 기간은 28.3개월이었다. 거상된 상악동을 평가하기 위해 파노라마 방사선 검사가 술 전, 수술 직후 그리고 12개월마다 시행되었다.

술 전 잔존 치조골의 평균 높이는 9.83±4.03(range 5.6-13)mm 이었고 1개의 임프란트가 치유 기간 중 골유착이 되지 못해 실패하였으며 1개의 임프란트가 기능적 부하가 가해진 후 실패하였다. 임프란트의 전체 생존률은 각각 96.8%이었고 이는 본원에서 장등이 2009년 대한치과이식학회지에 보고한 상악구치부에 식립된 614개의 임프란트의 생존률 96.9%와 유사하다.

osteotome을 이용하여 치조정 접근법을 통한 상악동 거상술 시행 시 임프란트가 식립될 형성된 socket 내부의 골연속성이 유지된다면 골이식 없이 임프란트를 식립하는 술식은 예지성을 가지는 술식이라 사료된다. *[대한치과이식(임프란트)학회지 2010;29(1):54-61]*

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