

Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note

Kwang-Ho Lee¹, Young-Kyun Kim^{2,3}, Woo-Jin Cho⁴, In-Woong Um⁴, Masaru Murata⁵, Masaharu Mitsugi⁶

¹Department of Perio/Implant Dentistry, Ajou University Medical Center, Suwon, ²Department of Oral and Maxillofacial Surgery, Section of Dentistry, Seoul National University Bundang Hospital, Seongnam, ³Department of Dentistry and Dental Research Institute, School of Dentistry, Seoul National University, Seoul, ⁴R&D Institute, Korea Tooth Bank, Seoul, Korea, ⁵Division of Oral and Maxillofacial Surgery, School of Dentistry, Health Sciences University of Hokkaido, Sapporo,

⁶Takamatsu Oral and Maxillofacial Clinic and Kochi Health Science Center, Kure Kyosai Hospital, Kure, Japan

Abstract (J Korean Assoc Oral Maxillofac Surg 2015;41:284-289)

In cases of severe alveolar bone atrophy in the posterior maxillary area, which has only a thin sinus floor, the autogenous tooth bone graft block (ABTB) was used to wrap the implant to enhance its primary stability and osseointegration in the sinus. These cases with four years of clinical follow-up demonstrate the applicability of the ABTB in maxillary sinus membrane elevation to improve the outcomes of implant placement.

Key words: Autogenous tooth bone graft block, Sinus

[paper submitted 2015. 8. 4 / revised 2015. 9. 7 / accepted 2015. 9. 8]

I. Introduction

There have been considerable efforts in basic and clinical research to find the best bone graft material for implant osseointegration in the sinus. The autogenous tooth bone graft (AutoBT; Korea Tooth Bank, Seoul, Korea) was firstly developed in 2008. There have been several clinical studies evaluating the use of AutoBT in the sinus, with all results showing more favorable outcomes in bone regeneration as compared to other conventional graft materials^{1,2}. The autogenous tooth bone graft block (ABTB), which is made from root dentin, has been shown to be both clinically safe and efficacious in several studies. In particular, the ABTB has been reported to be an appropriate material for socket preservation, guided bone regeneration (GBR), and ridge augmentation. ABTB

In-Woong Um

R&D Institute, Korea Tooth Bank, 622 Eonju-ro, Gangnam-gu, Seoul 06101, Korea

TEL: +82-2-548-2055 FAX: +82-2-548-2228 E-mail: h-bmp@hanmail.net ORCID: http://orcid.org/0000-0002-4628-3662 already has shown good osteoinductive, osteoconductive, and remodeling ability due to its type I collagenous nature as well as its three-dimensional scaffold^{3,4}. This collagenous nature could act as an excellent vascular scaffold in the sinus cavity, which has a poor blood supply. The major role of the ABTB in this report was to wrap around the implant to enhance its primary stability and osseointegration into the sinus. This is called the "ring technique".

II. Technical Note

This technique can be used in cases during which the residual alveolar bone height to the maxillary sinus floor is insufficient for implant stability. In our case, a 51-year-old man presented with his left maxillary first molar missing for several months. We decided to perform sinus bone graft and simultaneous implant placement.(Fig. 1) ABTB was prepared from his son's wisdom tooth because the patient did not have teeth to be extracted for manufacturing. This process met the standards of the technical manual of the Korea Tooth Bank, as has been previously reported^{5,6}. The extracted wisdom tooth was immersed in 75% alcohol and then the soft tissues and calculus were removed. Crowns were severed at the cement enamel junctions and ABTBs were made from the root

[©] This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http://creativecommons.org/licenses/by-nc/4.0/), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Copyright \bigcirc 2015 The Korean Association of Oral and Maxillofacial Surgeons. All rights reserved.



Fig. 1. The cone-beam computed tomography of the sinus before the operation. The residual bone height was about 1 to 2 mm on #26.



Fig. 2. The occlusal view of the autogenous tooth bone graft block, which was made from the root portion of the extracted tooth.

Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015

portion of the tooth. Additional holes sized 0.2 mm were made at the surface of the canal area to create macropores for promoting vascular invasion and bone formation.(Fig. 2)

Through the routine lateral window approach, we lifted the sinus membrane to identify the thin sinus floor, locate the implant hole, and spare the space for the ABTB.(Fig. 3) Before placing the ABTB into the sinus, the implant was adapted



Fig. 3. The sinus lateral window was opened and the membrane was elevated.

Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015



Fig. 4. The autogenous tooth bone graft block was adapted onto the implant.

Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015

to extraorally fit into the ABTB through the pulp chamber as tightly as possible. With this procedure, we could secure additional stability of the thin alveolar bone.(Fig. 4) After inserting the ABTB upside down into the sinus, the implant was placed through the thin sinus floor and into the apex of the ABTB while being grabbed by a small Kelly or mosquito clamp to provide stability without additional fixation. We could see blood pooling of the ABTB, which met the wet-



Fig. 5. The autogenous tooth bone graft block was adapted into the sinus.



Fig. 6. The implant was simultaneously installed through the alveolar bone and into the autogenous tooth bone graft block. *Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg* 2015

tability requirements of bone graft substitutes.(Fig. 5, 6) The lateral wall was then replaced *in situ*.(Fig. 7) When compared to the X-rays obtained immediately after the operation, the X-rays after four years showed well-formed bone surrounding the implant. The border between the implant and ABTB almost disappeared, which means the ABTB was successfully incorporated. Moreover, it was difficult to identify any marginal bone loss even with the final prosthesis.(Fig. 8, 9)



Fig. 7. The lateral window was repositioned. *Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015*



Fig. 8. The cone-beam computed tomography immediately after the simultaneous installation of the implant and the autogenous tooth bone graft block.

Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015

In another case, a 27-year-old man presented with a missing #16 tooth for several years without any restoration, so that only a thin sinus floor remained due to severe pneumatization. The #16 area became an anatomic defect of the alveolar bone with about 1 to 2 mm of residual bone height.(Fig. 10) In order to install the implant in a single stage, sinus augmentation was inevitable and an ABTB was chosen to obtain initial stability of the implant on the thin alveolar bone. An



Fig. 9. The cone-beam computed tomography after four years. *Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg* 2015



Fig. 10. The preoperative X-ray in a 27-year-old male patient with the loss of #16.

ABTB was prepared using his lower right impacted mandibular third molar.(Fig. 11) A pulp chamber that is too small to accommodate an implant can be enlarged with an instrument to fit the implant.(Fig. 12) The sinus membrane was elevated and simultaneous implant placement was performed using the ABTB graft similar to the case above.(Fig. 13-15) Four years later, we could see that the implant osseointegrated with the final prosthesis. The whole bone housing was intact and there was no marginal bone resorption around the implant neck area when compared to the films immediately after the opera-



Fig. 11. The occlusal view of the autogenous tooth bone graft block.

Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015



Fig. 12. The autogenous tooth bone graft block was used to adjust the size of the implant.

Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015

tion.(Fig. 16, 17)

III. Discussion

Since Murata⁷ reported that autogenous demineralized dentin matrix could be used for sinus augmentation, there have been several reports of the use of AutoBT in the sinuses. Lee et al.⁸ compared the use of AutoBT powder with synthetic



Fig. 13. The lateral sinus window opening and the preparation of the implant site on the alveolar bone.



Fig. 14. The insertion of the autogenous tooth bone graft block (ABTB) into the sinus and the installation of the implant through the thin alveolar bone to the ABTB.

Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015

hydroxyapatite (HA) in the sinus of miniature pigs. Histomorphometrical analysis showed that more new bone was formed in the AutoBT group than the synthetic HA group. In a clinical trial, Kim et al.⁹ reported that the AutoBT particles united well with the new bone in the sinus, with bone formation starting from the alveolus and gradually rising toward the sinus. When comparing the use of AutoBT with synthetic



Fig. 15. The positioned lateral window.

Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015



Fig. 16. Cone-beam computed tomography immediately after implant installation with the autogenous tooth bone graft block. *Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015*

HA in the sinus in both prospective and retrospective human clinical trials, the authors reported that AutoBT could be an alternative to synthetic bone grafts in sinus lifts based on the observation that the average bone resorption with AutoBT powder was similar to that of osteon composites 1 year after surgery with no serious complications or implant failures^{1,2}. Kim et al.⁴ reported the clinical results of 12 cases involving ABTB, which included GBR, ridge augmentation, extraction socket graft, and sinus bone graft. Among these cases, only 3 were in the sinus, though they showed that ABTB could be



Fig. 17. Cone-beam computed tomography four years later. *Kwang-Ho Lee et al: Autogenous tooth bone graft block for sinus augmentation with simultaneous implant installation: a technical note. J Korean Assoc Oral Maxillofac Surg 2015*

useful in various surgical procedures in the sinus. However, the ABTB in this report was used only when mixed with other powder forms of bone graft materials, and acted as a membrane.

In this technical report, the ABTB acted as a scaffold for the implant, which penetrates the thin sinus floor to the apex of the ABTB. This method is known as the "ring technique," which was developed based on reports from animal studies and human clinical trials^{10,11}. In 2014, the author was the first to report the technique and short-term clinical results of ABTB with simultaneous sinus implant. An additional four years of follow-up of these cases indicated that ABTB works very well in the sinus to secure primary stability, bone formation, and marginal bone resorption¹². In addition, the disappearance of the border between the sinus floor and the alveolus indicated that the ABTB has the capability of incorporation and continuous remodeling with low-crystalline inorganics and type I collagen^{13,14}.

Conflict of Interest

No potential conflict of interest relevant to this article was reported.

ORCID

Kwang-Ho Lee, *http://orcid.org/0000-0002-6450-2427* Young-Kyun Kim, *http://orcid.org/0000-0002-7268-3870* Woo-Jin Cho, *http://orcid.org/0000-0003-2952-2921* In-Woong Um, *http://orcid.org/0000-0002-4628-3662* Masaru Murata, *http://orcid.org/0000-0002-6442-9266* Masaharu Mitsugi, *http://orcid.org/0000-0002-8506-0971*

References

- Kim YK, Lee J, Yun JY, Yun PY, Um IW. Comparison of autogenous tooth bone graft and synthetic bone graft materials used for bone resorption around implants after crestal approach sinus lifting: a retrospective study. J Periodontal Implant Sci 2014;44:216-21.
- Jun SH, Ahn JS, Lee JI, Ahn KJ, Yun PY, Kim YK. A prospective study on the effectiveness of newly developed autogenous tooth bone graft material for sinus bone graft procedure. J Adv Prosthodont 2014;6:528-38.
- Park SM, Hwang JK, Kim YK, Um IW, Lee GH, Kim KW. Microscopic feature, protein marker expression, and osteoinductivity of human demineralized dentin matrix. J Korean Dent Sci 2012;5:77-87.
- Kim YK, Kim SG, Um IW, Kim KW. Bone grafts using autogenous tooth blocks: a case series. Implant Dent 2013;22:584-9.
- Kim YK, Um IW, Murata M. Tooth bank system for bone regeneration: safety report. J Hard Tissue Biol 2014;23:371-6.
- Lee JY, Kim YK, Um IW, Choi JH. Familial tooth bone graft: case reports. J Korean Dent Assoc 2013;51:459-67.
- Murata M. Autogenous demineralized dentin matrix for maxillary sinus augmentation in humans: the first clinical report. Gothenburg: 81th International Association for Dental Research; 2003.
- Lee DH, Yang KY, Lee JK. Porcine study on the efficacy of autogenous tooth bone in the maxillary sinus. J Korean Assoc Oral Maxillofac Surg 2013;39:120-6.
- Kim YK, Jun SH, Um IW, Kim SY. Evaluation of the healing process of autogenous tooth bone graft material nine months after sinus bone graft: micromorphometric and histological evaluation. J Korean Assoc Maxillofac Plast Reconstr Surg 2013;35:310-5.
- Kim SK, Kim SW, Kim KW. Effect on bone formation of the autogenous tooth graft in the treatment of peri-implant vertical bone defects in the minipigs. Maxillofac Plast Reconstr Surg 2015;37:2.
- Pikos MA. Mandibular block autografts for alveolar ridge augmentation. Atlas Oral Maxillofac Surg Clin North Am 2005;13:91-107.
- Um IW, Lee JK. Familial tooth bone graft. In: Murata M, Um IW, eds. Advances in oral tissue engineering. Chicago: Quintessence Publishing; 2014:67-72.
- Kim YK, Kim SG, Oh JS, Jin SC, Son JS, Kim SY, et al. Analysis of the inorganic component of autogenous tooth bone graft material. J Nanosci Nanotechnol 2011;11:7442-5.
- Murata M. Collagen biology for bone regenerative surgery. J Korean Assoc Oral Maxillofac Surg 2012;38:321-5.