●臨床研究

Transcrestal sinus floor elevation using HA-coated implants without bone grafts: A 10-year retrospective clinical study

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Abstract

The aim of this study is to evaluate the clinical outcomes of transcrestal sinus floor elevation (TSFE) procedure using HA-coated implants without bone grafts. Using TSFE procedure without bone grafts or bone substitutes, 175 HA-coated implants were placed in the elevated sinus of 107 cases. The survey was performed on the cases with prosthesis restoration completed over a time period of 130 months from March 2004 to December 2014.

All implants except one gained osseointegration. Five implant failures occurred in 4 cases after addition of occlusal force. Four implants were replaced in 3 failed cases, and all 4 implants gained osseointegration. In all 107 cases, no postoperative complication such as sinusitis, nasal bleeding or rhinorrhea was experienced.

TSFE procedure using HA-coated implants without bone graft is highly reliable, predictable and less invasive. There is no risk of maxillary sinusitis induced by grafted bone's migration into sinus cavity or infection by an unknown virus derived from the use of xenograft and allograft. After performing TSFE even on cases with small vertical bone height, replacement of failed implants is possible.

Keywords: transcrestal sinus floor elevation, HA-coated implant, bone graft

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1. Introduction

Implant treatment is often difficult in the posterior maxilla due to the lack of the vertical bone height. With sinus floor elevation, maxillary sinus membrane is elevated from the sinus floor in order to increase the vertical bone height to allow the placement of dental implants. There are two ways for a sinus lift: sinus floor elevation (SE) which is a lateral approach and Transcrestal Sinus floor elevation (TSFE) which is a transcrestal approach. Generally autogenous bone and various bone substitutes are inserted in the created secluded space and implants are placed. Autogenous bone grafting creates a new surgical wound and is more invasive. Also resorption of autogenous bone has been observed to occur over time. There are risks of infection by an unknown virus derived from the use of xenograft and allograft. Grafted bone or bone substitutes could migrate into sinus cavity and cause maxillary sinusitis. Therefore if SE or TSFE

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can be performed without bone grafts, it would be ideal. On the other hand, HA-coated implant is known to accelerate osseointegration. This study is a 10-year retrospective review of clinical cases with HA-coated implants placed using Transcrestal Sinus Floor Elevation (TSFE) procedure without bone grafts and evaluates the clinical effectiveness of TSFE.

2. Materials and methods

Using TSFE procedure without bone grafts or bone substitutes, 175 HA-coated implants were placed in the elevated sinus of 107 cases. The survey was performed on the cases with prosthesis treatment completed over a time period of 130 months from March 2004 to December 2014 (Table 1).

Table 1 : Sex and age distribution

age \ sex	Male	Female	Total
Under 30	4	13	17
30 to 40	3	12	15
40 to 50	24	13	37
50 to 60	8	10	18
60 to 70	3	13	16
Over 70	2	2	4
Total	44	63	107

All dental implants used in this study were AQB one-piece type implants manufactured by Advance Co. The AQB implants are coated with α-TCP on pure titanium using a plasma spraying technique in the first stage, and the α-TCP is transformed into crystalline HA by hydrothermal treatment in the second stage. Implants used in this study were 6, 8, 10 and 12mm in length, 3, 4 and 5mm in diameter (Table 2).

Table 2 : Diameter and length of implants used

length \ diameter	3mm	4mm	5mm	Total
6mm	0	29	2	31
8mm	12	91	15	118
10mm	4	11	9	24
12mm	0	0	2	2
Total	16	131	28	175

Inclusion criteria were as follows:

1) No lesion of the maxillary sinus was observed clinically and radiographically
2) Vertical stop was maintained on the opposite side of the implant site
3) Residual bone height beneath the sinus was more than 1mm

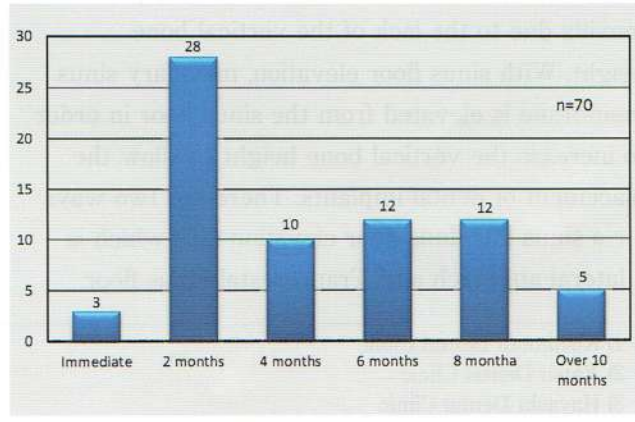
The following parameters were assessed:

1) Period from tooth extraction to implant placement
2) Location where the implants were inserted
3) Duration of the healing period from implant placement up to addition of occlusal force (including acrylic provisional crown)

3. Results

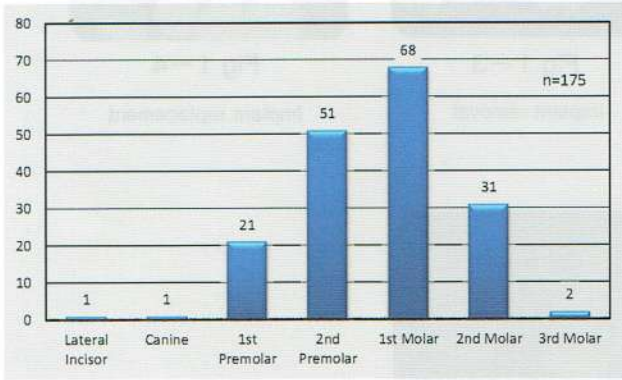
1) In 40.0% of the cases, implant placement was done within 2 months of tooth extraction. 17.1% were done within 6 to 8 months (Table 3).
2) Implants were mainly inserted for the first molar

Table 3 : Period from tooth extraction to implant placement



tooth (38.9%) and the second premolar tooth (29.1%) (Table 4).

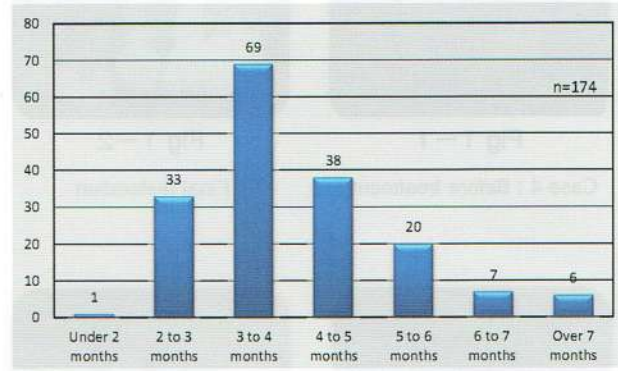
Table 4 : Location of implants inserted



3) Duration of the healing period from implant placement up to addition of occlusal force (including acrylic provisional crown) was mostly within 4 months (39.7%) or within 5 months (21.8%) (Table 5).

Osseointegration was gained for 174 implants in 106 cases out of 175 implants in 107 cases. One implant in one case failed to gain osseointegration. In this case maxillary sinus membrane was perforated

Table 5 : Period from implant placement up to addition of occlusal force



but implant placement was proceeded. Five implant failures occurred in 4 cases after addition of occlusal force (Table 6). After removal of implants, dental x-ray showed x-ray impermeable images like lamina dura around all 5 failed implants (Fig 1-3, Fig 2-3). At the time of implant removal, a rounded probe confirmed hardness like a bone between the socket of failed implant and the sinus floor. Out of 5 implants in 4 failed cases, 4 implants in 3 cases were replaced and osseointegration was established on all 4 implants. No serious complication such as maxillary sinusitis occurred.

Table 6 : Details of implant failure

Case No	Sex	Age	Location	Implant size	Functional period	Smoking	Outcome
1	male	47	1st molar	D4mm × H8mm	----------	smoker	no osseointegration
2	female	40	1st premolar	D4mm × H6mm	24 months	no	replacement
			2nd premolar	D4mm × H6mm	24 months		replacement
3	male	50	2nd premolar	D4mm × H6mm	32 months	no	replacement
4	female	39	1st molar	D4mm × H6mm	22 months	no	replacement
5	female	29	2nd premolar	D4mm × H6mm	6 months	smoker	no replacement

Fig 1－1

Case 4 : Before treatment

Fig 1－2

Final restoration

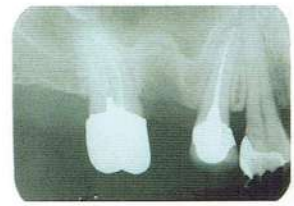


Fig 1－3

Implant removal

Fig 1－4

Implant replacement

Fig 2－1

Case 5 : Before treatment

Fig 2－2

Final restoration

Fig 2－3

Implant removal

4. Discussion

Since Shimizu et al. [1] reported sinus floor elevation (SE) can be done without bone grafting, its effectiveness has been rapidly recognized by Lundgren et al.' report [2]. Two papers [3,4] on randomized controlled study reported that there was no significant difference in the survival rate of implants placed by osteotome sinus floor elevation procedure with or without bone grafting.

On the other hand, using laboratory animals, some papers on SE without bone grafting reported bone-to-impact contact was high [5], bone density was high [5], bone formation started earlier [6], faster and greater new bone formation was observed [12], little bone resorption occurred over time [5] compared to SE with bone grafting.

Nedir et al. [7] reported that osteotome sinus floor elevation procedure without grafting material obtained 100% survival rate at 10 years. Brusshi et al. [8] reported a cumulative survival rate of 95.45% up to 16 years. Two papers above reported that bone resorption did not occur in the augmented bone. Therefore TSFE procedure without grafting material is considered to be effective in a long term. Some papers state negative opinions that the application of grafting materials has no advantages in terms of clinical success [3,5,8,20].

Fukuoka et al. [9] focused on the surface modification of the implant, and SE using HA-coated implant without bone grafts obtained more than 88% of bone-to-implant contact. Kishimoto et al. [10,11] reported favorable results in TSFE procedure using HA-coated implants without bone grafts.

There are different opinions on the mechanism of new bone formation in the elevated sinus after SE or TSFE is performed. There are papers reporting that the residual bone beneath the sinus is capable of forming a new bone [18,19], that maxillary sinus membrane is capable of forming a new bone [6,13,16,17], or that there are more osteoblast-lineage cells in peripheral blood than it has been considered to exist, and consequently there is a possibility that these cells may be involved in the process of bone formation and the healing of fractures [15]. There is a paper reporting that HA-coated implant enabled the growth of the bone tissue into the gap between

the implant and the surrounding bone without significant formation of intermediate fibrous tissue [14], that precipitation of calcium phosphate was detected around HA-coated implant when exposed in simulated body fluid with ion concentrations similar to those of human blood plasma [14].

After removal of implants in the present study, dental x-ray showed x-ray impermeable images like lamina dura around the implants (Fig 1-3, Fig 2-3). At the time of implant removal, a rounded probe confirmed hardness like a bone between the socket of failed implant and the sinus floor. At the time of implant placement, implant apex and the elevated sinus membrane was in direct contact and there was no bone in between. Therefore it means that a structure like a bone was formed between implant apex and the elevated sinus membrane. It can be argued that the structure like a bone may not regenerate from the residual bone beneath the maxillary sinus only but also from the sinus membrane. Further osteoblast-lineage cells in peripheral blood, calcium phosphate precipitating around HA-coated implant in contact with blood or bone-forming protein accumulating around it could all be the possible cause of new bone formation between the elevated sinus membrane and the original sinus floor.

This study is a 10-year retrospective review of clinical cases with HA-coated implants placed using TSFE procedure without bone grafts or bone substitutes. Out of 175 implants in 107 cases, 174 implants in 106 cases gained osseointegration. Five implant failures occurred in 4 cases after addition of occlusal force. At the time of removal of all 5 implants in 4 cases, a rounded probe confirmed hardness like a bone between the sinus floor and the socket of failed implant. X-ray also confirmed x-ray impermeable images like lamina dura (Fig 1-3, Fig 2-3). Four implants in 3 failed cases were replaced (Table 6) and have been functioning well (Fig 1-4). There has been no report on replacement of failed implant after performing SE and TSFE. In those cases with small vertical bone height, TSFE increased the vertical bone height and made replacement of failed implants possible. HA-coated implant may have played an important role and further basic study is considered to be necessary.

5. Conclusion

The results of this retrospective study confirmed that transcrestal sinus floor elevation procedure using HA-coated implants without bone grafting is a highly reliable treatment with excellent prognosis. It is not only less invasive without creating a new surgery wound to collect autogenous bone, but also prevents the risk of maxillary sinusitis caused by the migration of graft material into sinus cavity and infection by an unknown virus derived from the use of xenograft or allograft. Also the use of HA-coated implant has possibly accelerated the healing process and thus gained osseointegration. However surgical field is invisible with TSFE, therefore developing a method to avoid the perforation of the sinus membrane would possibly result in a favorable outcome.

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