●症例報告

Ten-year retrospective clinical study of 95 one-piece narrow HA-coated implants

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Abstract

The aim of this study was to evaluate the clinical results of one-piece narrow hydroxyapatite-coated (HA-coated) implants. The implants were coated with HA on pure titanium using a plasma spraying technique and, after the coating was applied, a hydrothermal treatment was carried out in order to transform the HA into pure crystal. Between January 2003 and December 2012, 60 partially edentulous patients with narrow alveolar ridges or limited mesio-distal space were treated with a total of 95 one-piece narrow HA-coated implants 3.0mm in diameter. Among the 95 pieces, one implant was lost during the healing phase because of peri-implant infection and one implant was fractured after 2 years of loading. The other implants were not lost. The survival rate was 97.9%, even though the implants were placed in maxillary bone that was poor in quality or that was narrow or lacking in height. These clinical evaluations indicate that the one-piece narrow HA-coated implants were found to be effective even in cases where bone width or mesio-distal span is limited.

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1. Introduction

With the improvement of implant treatment techniques and clinical prediction, implant treatments have been applied to a wider variety of cases. When there is not enough buccolingual bone width or mesio-distal width, implants are normally placed after a bone construction or an orthodontic treatment. Such implant treatments increase not only the invasive potential of the surgery, but also prolong the treatment period and are expensive. Narrow implants could avoid such issues, but the mechanical strength of the implant and the durability of the bond between the implant and the surrounding bone against the occlusal load come into question. In this study, one-piece implants were used to increase mechanical strength and HA-coatings were used to increase the bonding strength between the implant and the surrounding bone.

2. Methods

In a 10 year timespan between January 2003 and December 2012, narrow implants were placed in 60 patients, aged 22 to 63 years old (26 male, 34 female) (Table 1) . To be included in this study, implants had to have been occlusally loaded for at least 1 year. 95 implants have been examined retrospectively. The implants were coated with HA on pure titanium

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using a plasma spraying technique and, after the coating was applied, a hydrothermal treatment was carried out in order to transform the HA into pure crystal. All implants used were one-piece type and 3.0mm in diameter(AQB implant®, ADVANCE CO, Japan). The following items were examined:

1) Period from tooth extraction to implant placement
2) Location where the implants were inserted
3) Length of the implants used
4) Types of surgical approach
5) Duration of the healing period from implant placement up to addition of occlusal force(including acrylic provisional crown)
6) Types of prosthesis

age \ sex	Male	Female	Total
20～30	1	5	6
30～40	4	5	9
40～50	16	8	24
50～60	5	11	16
60～70	0	5	5
Total	26	34	60

Table 1 : Sex and age distribution

3. Results

1) In 58.3% of the cases, implant placement was done within 2 months of tooth extraction. 19.4% were done within 4 months (Table 2).
2) Most of the implants placed in the maxilla were for the lateral incisor (29.2%) and the first premolar tooth (29.2%) (Table 3).
3) Implants in the mandible were mainly done for the first molar tooth (34.0%) or the second premolar tooth (29.8%) (Table 4).
4) Twenty-five out of 95 of the implants were 8mm in length (26.3%), 66 were 10mm in length (69.5%), 2 were 12mm in length (2.1%), and 2 were 14mm in length (2.1%) (Table 3, Table 4).
5) In the maxilla, 9 implants were placed using drilling only (18.7%), 27 were combined with ridge expansion (REO) (56.2%), 8 were combined with osteotome sinus floor elevation without bone graft (OSFE) (16.7%), 3 were combined with both REO and OSFE (6.3%), 1 was done with bone substitute (2.1%) (Table 3).
6) In the mandible, only 1 implant was combined with REO (2.1%) and all others were placed by drilling only (97.9%) (Table 4).
7) Duration of the healing period from implant placement up to addition of occlusal force (including acrylic provisional crown) was mostly done within 3 months (46.8%) or within 4 months (19.1%) (Table 5).
8) Splinted crowns were used for 61 out of 94 implants (64.9%). Single crowns for molar teeth were used for 4 implants (4.3%), but they were applied for cases when small mesio-distal distance was caused by mesial movement of the second molar tooth (Table 6).
9) Out of 60 cases and 95 implants, only 1 implant failed to obtain osseointegration, however, this implant was the only case in which bone substitute was used. 1 implant fracture was observed after 2 years of loading. Out of 58 other cases, the 93 implants have been functioning without any problems.

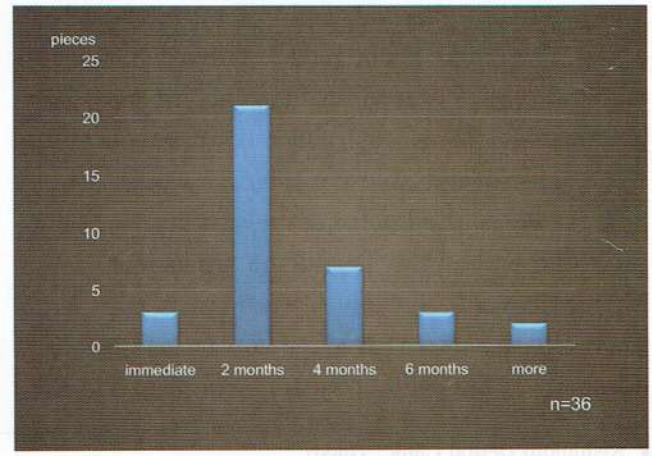

Table 2 : Period from tooth extraction to implant placement

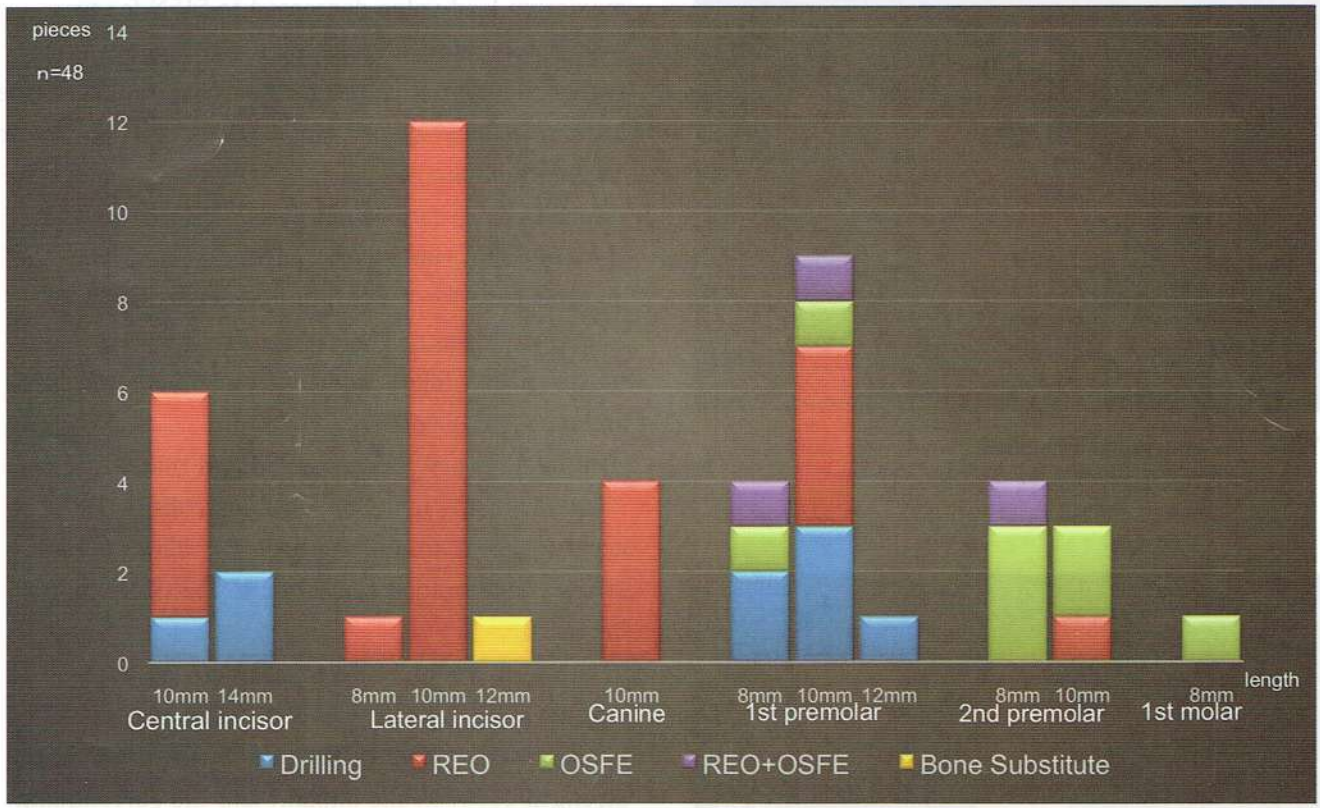

Table 3 : Narrow diameter implant distribution by location, length and type of surgical approach in the maxilla

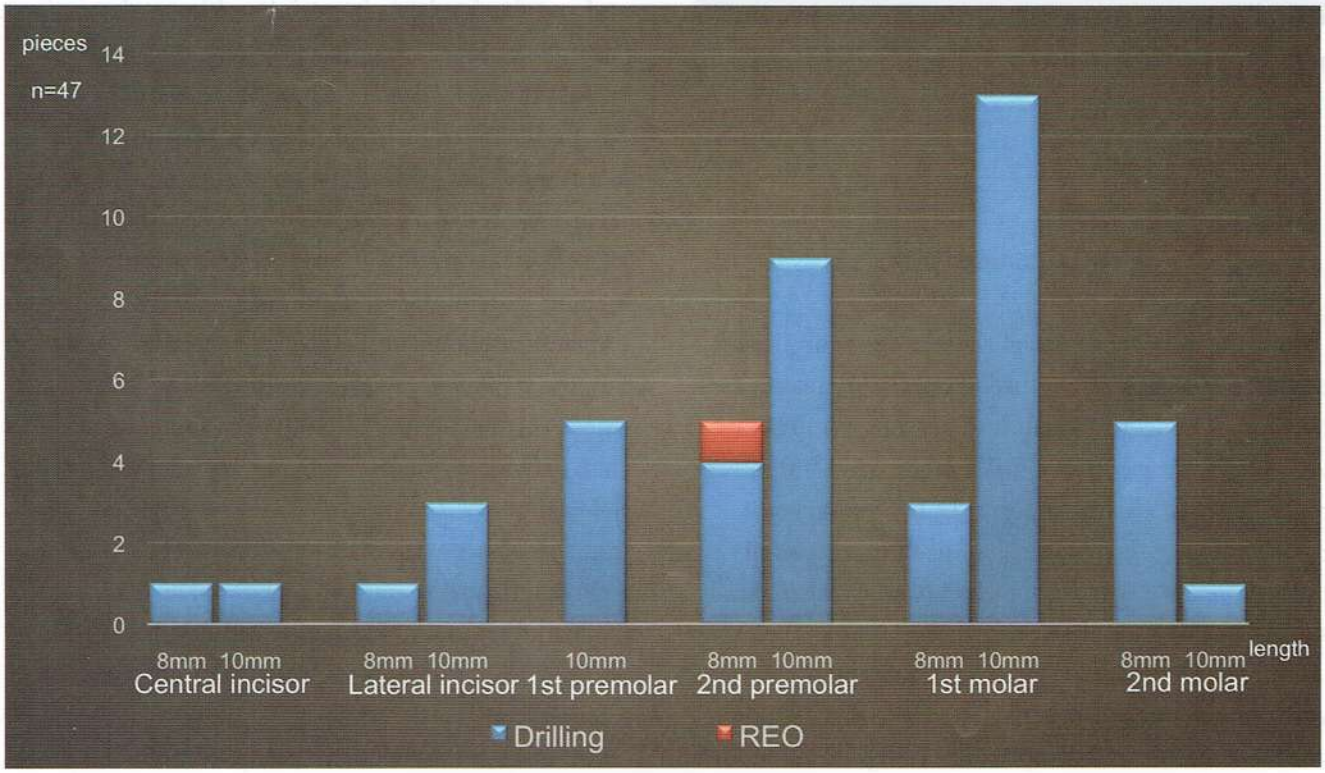

Table 4 : Narrow diameter implant distribution by location, length and type of surgical approach in the mandible

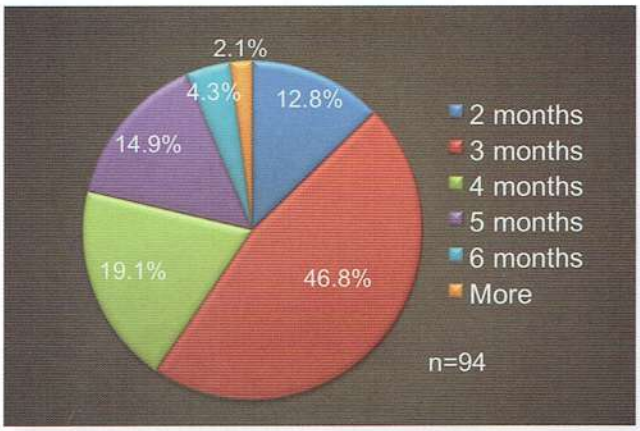

Table 5 : Duration of the healing period from implant placement up to addition of occlusal force

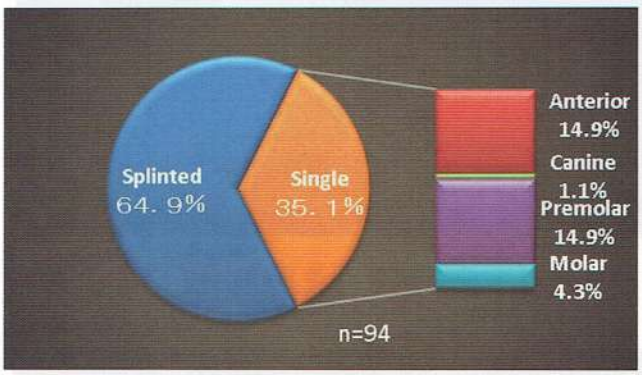

Table 6 : Type of prosthesis

4. Discussion

From the point of material science there are many negative opinions on the use of narrow implants because of concerns about low bending strength or low fatigue strength[1,2]. On the other hand, there are many positive clinical reports[3~6,8~9,12] and several reports of long-term successful use for periods of over 10 years[3,6] are available. This study also found similar positive results.

Allum, et al.[1] reported that the maximum load value of a commercially marketed one-piece implant with a diameter of 3.00mm made of type 4 titanium is 572N using an over load test. However, the maximum load value decreased to 515N for two-piece implants with a diameter of 3.3mm made of type 4 titanium. This means one-piece implants have more resistance against static loads in comparison to two-piece implants.

Block et al. [10] carried out an experiment in which HA-coated implants were pulled out from dog alveolar bone for 3 different diameters, 3.0mm, 3.3mm and 4.0mm. They reported that there was no significant difference in the pulling-out strength among the implants.

On the contrary Aoki et al.[7] stated that the HA-coated implants most homogenously dispersed occlusal stress around the bone and alleviated more stress concentration compared to the titanium implants.

Therefore, one-piece narrow HA-coated implants may be clinically effective because of greater mechanical strength or because of better bonding strength between the implant and the surrounding bone against occlusal stress. There is another report that there is no difference between narrow implants and regular implants in peripheral bone absorption[9].

Dental implants come in various shapes and the results of the load test cannot be determined only by the diameter or material of an implant. There is a report that the fatigue strength declined with treatment using a roughened surface process[11], therefore the results of over load tests and cyclic loading tests on the commercially marketed implants used should be referred to before adopting narrow implants.

Most reports about the lengths of implants stated that 10.0mm or longer implants are adopted for use. Sohrabi et al.[8] stated in a ' Literature review' that implants shorter than 13.0mm had been lost more often compared to implants longer than 13.0 mm. This study adopted implants 8.0mm in length for 26.3% of the cases in this study with no implant loss experienced.

Aoki et al.'s finite element analysis method, which was previously mentioned, also brings into

consideration that HA-coated implants were found to drastically disperse occlusion stress on the bone and alleviate stress concentration, which may explain why no 8.0mm implants were lost in this study.

There are very few reports about the surgical approaches used for adopting narrow implants, and no reports are available on maxillary sinus floor elevation. In this study, implant placements on the maxilla were performed as follows; 18.7% of implants were placed by drilling only, 56.2% were done with ridge expansion (REO) supplying the shortage of the buccolingual bone width, 16.7% were done using ostetome sinus floor elevation without bone graft (OSFE) supplying the shortage of the vertical bone height, and 6.3% were done with both REO and OSFE. In only one case (2.1%) bone substitute was required to widen the buccolingual bone, but the implant was lost because there was no osseointegration.

For the mandible, in 97.9% cases drilling only was adopted except, in one case, (2.1%) REO was adopted. This study shows that it is possible to avoid invasive surgical approaches such as bone transplantation or GBR in delicate areas with low bone quantity or poor quality on the maxilla and that it is possible to perform the implant placement by adopting REO or OSFE with HA-coated narrow implants.

It is known that the loss of alveolar bone is minimized because one-piece implants do not have a micro gap between the fixture and the abutment[13]. That is why microbacteria can accumulate in the micro gap and can cause bone absorption or gum inflammation[14].

Hermann[13] stated that, in one-piece implants, the gingival margin is located more coronally than in two-piece implants and looks better aesthetically. Therefore, one-piece implants result not only in better mechanical strength but also in healthier periimplant tissues compared to two-piece implants.

5. Conclusion

One-piece narrow HA-coated implants were effective even in cases when the alveolar ridge was narrow or the mesio-distal space was limited by adjacent teeth. Also, even in maxillary bone that was poor in quality or that was narrow or lacking in height, HA-coated narrow implants can be placed with ridge expansion or sinus floor elevation. Results using 8mm long implants were also satisfactory.

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抄　録

本研究はHAでコートされた1ピースナローインプラントの臨床成績を評価したものである。使用したインプラントはプラズマスプレー法でHAをコーテイングした後、水熱処理法で純粋なＨＡ結晶へ変換し作製されたものである。2003年1月から2012年12月の間、歯槽骨が委縮しているか、あるいは歯槽骨の近遠心距離が不足している60人の部分歯牙欠損患者に95本の直径3.0mmのHAでコートされた1ピース型ナローインプラントが埋入された。95本のうち、1本が治癒期間中に感染のため脱落した。1本が機能開始2年で破折した。その後、インプラントの脱落および破折は起こっていない。上顎の骨質や骨量が悪い部位にインプラントが埋入されたにも関わらず、残存率は97.9％である。本後ろ向き研究の結果、直径3.0mmのHAでコートされた1ピースナローインプラントは歯槽骨幅が狭い部位や隣接する歯牙のため限られた近遠心距離の部位に埋入するのには有効であることが示唆された。