Evaluation of two Vitallium blade-form implants retrieved after 13 to 21 years of function: A clinical report

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This article describes the clinical, radiographic, and histologic evaluation of 2 immediately loaded Vitallium blade-form implants retrieved from the posterior maxilla of 2 patients after 21 and 13 years of function. Neither implant demonstrated mobility or signs of pathosis, and both appeared to have integrated well with surrounding bone. The hydroxyapatite coating of the second implant, which was retrieved after 13 years of function, showed no dissolution. These observations suggest that immediately loaded dental implants have the potential to achieve and maintain osseointegration and that hydroxyapatite coatings can resist degradation over long-term service. (J Prosthet Dent 2002;87:412-5.)

Titanium and titanium alloy root-form implants have become a valid treatment modality for the totally[1,2] or partially[3,4] edentulous patient. Blade-form implants have become less popular due to their reportedly lower survival rate,[5,6] which has been attributed to the formation of connective tissue around the implant in both animal[7,8] and human[9,10] studies. Animal studies[11,12] and clinical reports[13,14] have also, however, demonstrated the ability of the blade implant to achieve osseointegration. In contrast to the protocol established for titanium root-form implants, in which a 3- to 6-month healing period is recommended before the implants are loaded,[15] the protocol for blade-form implants includes the fabrication of an interim implant-supported prosthesis on the day of implant surgery.[16] Reports on the immediate loading of root-form implants provide encouraging results.[17,18]

This article describes the clinical, radiographic, and histologic evaluation of 2 immediately loaded blade-form implants retrieved from human subjects after 13 and 21 years of function.

CLINICAL REPORT

Two patients with immediately loaded blade-form implants were seen at the Center for Prosthodontics and Implant Dentistry at Loma Linda University (LLU). The first patient, a 78-year-old female, sought treatment for partial edentulism in the area extending from the left maxillary first premolar to the left maxillary third molar (Fig. 1, *A*). Clinical evaluation revealed that a blade-form implant was present in the area of the left maxillary first molar. This custom-made implant was made of Vitallium (Austenal Inc, Chicago, Ill.) and had been placed at LLU in October 1978. Its transmucosal post had fractured, which caused dislodgment of the existing prosthesis. The implant was retrieved in January 1999, and a computed tomography scan was made from the maxilla. The second patient, a 74-year-old female, presented with a fractured post on the blade-form implant in the area of the maxillary first molar (Fig. 1, *B*). This custom-made Vitallium hydroxyapatite (HA)-coated implant had been placed at LLU in February 1986. It was retrieved in March 1999.

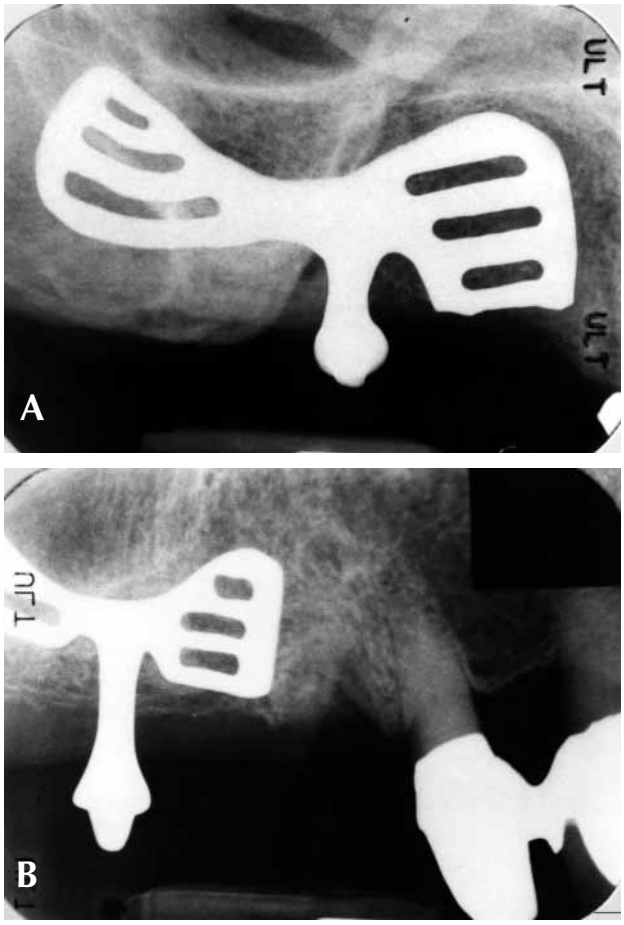

Fig. 1. Periapical radiographs before implant retrieval. **A,** Implant in function for 21 years; **B,** implant in function for 13 years.

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Fig. 2. Implant 21 years after loading: Bone in vent area appears to be in direct contact with implant surface. *White line* represents 400 µm. (Original magnification × 4.)

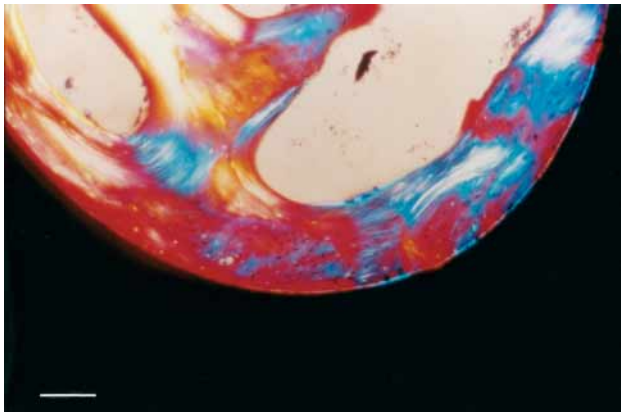

Fig. 3. Implant 21 years after loading: Bone appears dense and in direct contact with implant surface. Polarization shows that bone is mature and at remodeling phase. *White line* represents 160 µm. (Polarized light, original magnification × 10.)

Periapical and panoramic radiographs were taken before the implants were retrieved. Peri-implant probing depth and bleeding on probing were measured and recorded at the mesial, buccal, distal, and palatal surfaces of the transmucosal post. Implant mobility was evaluated manually (bidigitally with the handles of 2 instruments).

Both specimens were immediately placed in a 10% buffered formalin solution. The specimens were dehydrated with a graded series of alcohols for 9 days. After dehydration, the specimens were infiltrated with light-polymerizing embedding resin (Technovit 7200 VLC; Kulzer, Wehrheim, Germany). After 19 days of infiltration with constant shaking at normal atmospheric pressure, the specimens were embedded and polymerized with 450 nm light at a maximum specimen temperature of 40°C. The resin blocks containing the blade implants were cut into 3 different sections, which were mounted on plexiglass slides and prepared with Donath's method.[19,20] The specimens were cut to a thickness of 150 µm on a cutting/grinding system (EXACT Apparatebau, Norderstedt, Germany), and the slides were polished to a thickness of 50 µm with the microgrinding system followed by alumina polishing paste. The slides were stained with Stevenel's blue and Van Gieson's picro fuchsin.

Neither implant demonstrated mobility. Peri-implant soft tissue appeared healthy, with no bleeding on probing. A 3- to 4-mm probing depth was recorded. No pain was elicited upon percussion. During implant retrieval, no sign of pathosis was noted around the implants. Upon removal, the bone around the implants appeared to be attached to the implant surface.

Periapical radiographs demonstrated no sign of peri-implant radiolucency (Fig. 1). The computed tomography scan taken after removal of the 21-year-old implant showed 60 to 130 Hounsfield units in the area of implant placement (posterior maxilla), which is consistent with type IV bone quality.[21]

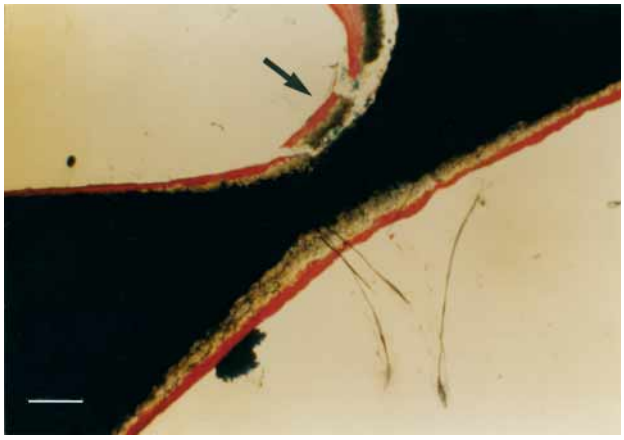

Fig. 4. Implant 13 years after loading: HA coating appears to form continuous layer along implant surface; bone appears in tight contact with coating and with detached HA coating fragments. *White line* represents 400 µm. (Original magnification × 4.)

Both implants appeared to have integrated with surrounding bone (Figs. 2 to 5). In the first patient, the bone appeared to be in direct contact with the implant (Figs. 2 and 3). The vent areas were covered continuously by bone, and fatty tissue was seen within these areas. Mature bone in tight contact with the implant surface was seen across most of the surface. When the implant was observed under polarized light, a remodeling pattern was identified (Fig. 3).

Similar observations were recorded for the second patient. The bone was in close contact with the coating (Figs. 4 and 5), and the coating appeared as a

Fig. 5. Implant 13 years after loading: Under higher magnification, tight bone-coating contact is evident. *White line* represents 80 μm. (Original magnification × 20.)

continuous layer along the implant surface. A few fragments of the HA appeared to be detached from the implant surface but were still in close contact with the bone (Fig. 4). No evidence of dissolution or degradation of the HA coating was observed. Even under high magnification (Fig. 5), the bone was in contact with the coating, with no intervening space. Thin, fine strands of bone appeared to be inserted into the coating.

DISCUSSION

The reported low survival rate for blade-form implants[5,6] has almost eclipsed their use. Nevertheless, the observations reported in this article, besides having historical value, may have some application to root-form implants.

The blade-form implants described in this article were immediately loaded and received a prosthesis during first-stage surgery. Human histologic reports on immediately loaded blade-form implants have demonstrated osseointegration around the implant,[13,14] as well as fibrous tissue encapsulation.[9,10] What determines the quality of the peri-implant tissue in these situations is unknown, although micromovement induced on the implant by the prosthesis has been suggested as the determining factor.[22] Early micromotion of an implant can lead to differentiation of cells into fibroblasts. The retrieved implants described above demonstrate that, even with the use of Vitallium, which has less potential for osseointegration than titanium,[23] immediately loaded dental implants can achieve and maintain osseointegration under long-term function.

Tight bone-to-HA contact was observed with the specimen in function for 13 years. A bonding mechanism has been proposed to explain this type of contact.[24] There was no evidence that the HA coating was subjected to degradation or dissolution. In vitro[25] and short-term animal studies[26] have supported the idea that HA may dissolve after implantation. However, histologic evaluations of root-form implants retrieved from humans have failed to demonstrate dissolution of the coating up to 2.5 years after loading.[27-29] Moreover, Proussaefs et al[30] found no evidence of dissolution or degradation of the HA coating on 2 root-form implants in function for 7 years. Given that the specimen described in the present article functioned for 13 years with no discernable degradation of the HA coating, it can be hypothesized that, even under long-term function, HA coating surfaces can resist dissolution.

Some parts of the coating did appear to be detached from the implant surface (Fig. 4), as previously observed with HA-coated root-form implants.[31,32] Although frictional stress during implant installation[33] has been shown to cause particle detachment, the particles could have been detached during specimen preparation. They appeared to be in intimate contact with the bone, with no evidence of adverse reaction. Detached coating particles have been correlated with implant failure,[34] but a close relationship between bone and detached HA fragments also has been observed under long-term function without any clinical or histologic sign of pathosis.[31] All currently available data regarding detached coating particles is based in anecdotal reports. An animal study that evaluated the effects of these particles at controlled time periods would provide useful information.

SUMMARY

Two immediately loaded Vitallium implants that achieved and maintained osseointegration over 13 and 21 years of function have been described. These specimens represent the potential for success with immediately loaded dental implants. The implant retrieved after 13 years of service demonstrated no obvious signs of HA dissolution, calling into question the idea that HA-coated implants are susceptible to degradation or dissolution under long-term function.

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REFERENCES

1. Adell R, Lekholm U, Rockler B, Branemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. Int J Oral Surg 1981;10:387-416.
2. Adell R, Eriksson B, Lekholm U, Branemark PI, Jemt T. Long-term follow-up study of osseointegrated implants in the treatment of totally edentulous jaws. Int J Oral Maxillofac Implants 1990;5:347-59.
3. Jemt T, Lekholm U, Adell R. Osseointegrated implants in the treatment of partially edentulous patients: a preliminary study on 876 consecutively placed fixtures. Int J Oral Maxillofac Implants 1989;4:211-7.

4. van Steenberghe D. A retrospective multicenter evaluation of the survival rate of osseointegrated fixtures supporting fixed partial prostheses in the treatment of partial edentulism. J Prosthet Dent 1989;61:217-23.
5. Cranin AN, Rabkin MF, Garfinkel L. A statistical evaluation of 952 endosteal implants in humans. J Am Dent Assoc 1977;94:315-20.
6. Smithloff M, Fritz ME. The use of blade implants in a selected population of partially edentulous adults. A 15-year report. J Periodontol 1987;58:589-93.
7. Babbush CA. Endosseous blade-vent implants: a research review. J Oral Surg 1972;30:168-75.
8. Meenaghan MA, Natiella JR, Armitage JE, Greene GW Jr, Lipani CS. The crypt surface of blade-vent implants in clinical failure: an electron microscopic study. J Prosthet Dent 1974;31:681-90.
9. Smithloff M, Fritz ME, Giansanti JS. A clinical and histologic evaluation of a single blade implant and surrounding bone. J Prosthet Dent 1975;33:427-32.
10. Steflik DE, McKinney RV, Sisk AL, Parr GR, Marshall BL. Dental implants retrieved from humans: a diagnostic light microscopic review of the findings in seven cases of failure. Int J Oral Maxillofac Implants 1991;6:147-53.
11. Lum LB, Beirne OR, Curtis DA. Histologic evaluation of hydroxyapatite-coated versus uncoated titanium blade implants in delayed and immediately loaded applications. Int J Oral Maxillofac Implants 1991;6:456-62.
12. Fritz ME, Braswell LD, Koth D, Jeffcoat M, Reddy M, Brogan D, et al. Analysis of consecutively placed loaded root-form and plate-form implants in adult Macaca mulatta monkeys. J Periodontol 1996;67:1322-8.
13. Feigel A, Makek M. The significance of sinus elevation for blade implantology—report of an autopsy case. J Oral Implantol 1989;15:237-48.
14. Trisi P, Quaranta M, Emanuelli M, Piatelli A. A light microscopy, scanning electron microscopy, and laser scanning microscopy analysis of retrieved blade implants after 7 to 20 years of clinical function: a report of 3 cases. J Periodontol 1993;64:374-8.
15. Lekholm U, Zarb GA. Patient selection and preparation. In: Branemark PI, Zarb GA, Albrektsson T, editors. Tissue-integrated prostheses: osseointegration in clinical dentistry. Chicago: Quintessence; 1985. p. 199-209.
16. Babbush CA. Endosteal blade-vent implants. Dent Clin North Am 1986;30:97-115.
17. Schnitman PA, Wohrle PS, Rubenstein JE, DaSilva JD, Wang NH. Ten-year results for Branemark implants immediately loaded with fixed prostheses at implant placement. Int J Oral Maxillofac Implants 1997;12:495-503.
18. Tarnow DP, Emtiaz S, Classi A. Immediate loading of threaded implants at stage 1 surgery in edentulous arches: ten consecutive case reports with 1- to 5-year data. Int J Oral Maxillofac Implants 1997;12:319-24.
19. Donath K, Breuner G. A method for the study of undecalcified bones and teeth with attached soft tissues. The Sage-Schliff (sawing and grinding) technique. J Oral Pathol 1982;11:318-26.
20. Rohrer MD, Schubert CC. The cutting-grinding technique for histologic preparation of undecalcified bone and bone-anchored implants. Improvements in instrumentation and procedures. Oral Surg Oral Med Oral Pathol 1992;74:73-8.
21. Hounsfield GN. Computerized transverse axial scanning (tomography): Part I. Description of system. 1973. Br J Radiol 1995;68:H166-72.
22. Cameron HU, Pilliar RM, MacNab I. The effect of movement on the bonding of porous metal to bone. J Biomed Mater Res 1973;7:301-11.
23. Johansson CB, Sennerby L, Albrektsson T. A removal torque and histomorphometric study of bone tissue reactions to commercially pure titanium and Vitallium implants. Int J Oral Maxillofac Implants 1991;6:437-41.
24. Tracy BM, Doremus RH. Direct electron microscopy studies of the bone-hydroxylapatite interface. J Biomed Mater Res 1984;18:719-26.
25. Gross KA, Berndt CC, Goldschlag DD, Iacono VJ. In vitro changes of hydroxyapatite coatings. Int J Oral Maxillofac Implants 1997;12:589-97.
26. Gottlander M, Johansson CB, Albrektsson T. Short- and long- term animal studies with a plasma-sprayed calcium phosphate-coated implant. Clin Oral Implants Res 1997;8:345-51.
27. Piattelli A, Trisi P. Microscopic and chemical analysis of bone-hydroxyapatite interface in a human retrieved implant. A case report. J Periodontol 1993;64:906-9.
28. Piattelli A, Scarano A, Piattelli M. Histologic observations on 230 retrieved dental implants: 8 years' experience (1989-1996). J Periodontol 1998;69:178-84.
29. Piattelli A, Scarano A, DiAlberti L, Piattelli M. Bone-hydroxyapatite interface in retrieved hydroxyapatite-coated titanium implants: a clinical and histologic report. Int J Oral Maxillofac Implants 1999;14:233-8.
30. Proussaefs PT, Tatakis DN, Lozada J, Caplanis N, Rohrer MD. Histologic evaluation of hydroxyapatite-coated root-form implant retrieved after seven years in function: a case report. Int J Oral Maxillofac Implants 2000;15:438-43.
31. Proussaefs PT, Lozada JL, Ojano M. Histologic evaluation of threaded HA-coated root form implants after being in function for 3.5 to 11 years. A report of 3 cases. Int J Periodontics Restorative Dent 2001;20:20-9.
32. Rosenlicht JL, Tarnow DP. Human histologic evidence of integration of functionally loaded hydroxyapatite-coated implants placed simultaneously with sinus augmentation: a case report 2 1/2 years postplacement. J Oral Implantol 1999;25:7-10.
33. Edmonds RM, Yukna RA, Moses RL. Evaluation of the surface integrity of hydroxyapatite-coated threaded dental implants after insertion. Implant Dent 1996;5:273-8.
34. Piattelli A, Scarano A, Piattelli M. Microscopical aspects of failure in osseointegrated dental implants: a report of five cases. Biomaterials 1996;17:1235-41.

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