Histologic evaluation of a threaded hydroxyapatite-coated root-form implant located at a dehisced maxillary site and retrieved from a human subject: A clinical report

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This clinical report describes the microscopic analysis of a threaded hydroxyapatite-coated root-form implant retrieved from an 89-year-old subject after 10 months of service. The implant was never loaded and was removed because it was nonrestorable. Clinically, the buccal area of the implant was covered by soft tissue, whereas the palatal side was covered by bone. Light microscopic evaluation revealed tight contact between hydroxyapatite and bone with no sign of coating dissolution. Osteocytes were present, and Haversian canals were in close proximity to the implant surface. The buccal side of the implant demonstrated mild to moderate inflammatory infiltrate and signs of hydroxyapatite coating dissolution. These observations suggest that hydroxyapatite coatings can resist degradation in contact with bone but may be more prone to dissolution in contact with soft tissue. (J Prosthet Dent 2002;87:140-4.)

Titanium and titanium alloy dental implants have become a valid treatment modality for the totally1,2 or partially3,4 edentulous patient. Reports of more rapid or advanced osseointegration of hydroxyapatite (HA)-coated titanium or titanium alloy implants5-9 have generated interest in the solubility and longevity of the coating after the implants are placed. It has been reported that the HA coating is prone to dissolution.10-13 However, histologic observations from osseointegrated HA-coated implants retrieved from humans have failed to demonstrate HA dissolution.14-19 It has been hypothesized that the HA coating in contact with a nonbony surface may be prone to dissolution.7,17,20-22 Ogiso et al22 implanted HA-coated dental implants in dogs, creating a dehiscence on one side of the implants. Histologic evaluation revealed dissolution of the coating toward the dehisced side. Matsui7 reported comparable observations in a similar animal study with dogs. Piatelli17,21 evaluated implants retrieved from human subjects and suggested that HA coating in contact with biologic fluids may initiate resorption of the coating.

The exact consequence of an HA-coated implant opposed by soft tissue instead of bone is unknown. This clinical report presents the results of a histologic evaluation of an HA-coated root-form titanium implant retrieved from a human subject. The implant was opposed partially by bone and partially by soft tissue.

CLINICAL REPORT

An 89-year-old man presented at the Center for Prosthodontics and Implant Dentistry, Loma Linda University, to receive an implant-supported, screw-retained fixed partial denture for the maxillary left canine to first molar (Fig. 1). Ten months previously, 3 threaded HA-coated root-form implants (Steri-Oss; Nobel Biocare USA, Yorba Linda, Calif.) had been placed by a private practitioner to replace the maxillary left canine, second premolar, and first molar. The implant in the maxillary left canine area appeared to be positioned too far buccally to be restorable. A decision was made to replace that implant with another in a more favorable position. Before implant retrieval, the area around the existing implant was probed at 6 locations: distal-palatal, mid-palatal, mesio-palatal, mesio-buccal, mid-buccal, and distal-buccal. The healing abutment was removed, a cover screw was placed, and a periapical radiograph was taken (Fig. 2).

A full-thickness buccal-palatal flap was reflected around the implant (Fig. 3). The implant was removed with a 4-mm internal diameter trephine bur (ACE...
Surgical Supply Co, Brockton, Mass.) and immediately placed in 10% buffered formalin. A new HA-coated threaded root-form implant (Steri-Oss; Nobel Biocare USA) was placed in a more favorable position. On the appropriate form released by the Institutional Review Board at Loma Linda University, the subject gave his informed consent for histologic evaluation of the retrieved implant.

The implant was dehydrated through ascending concentrations of ethanol and transferred to acetone. The specimen was then infiltrated with methyl methacrylate monomer and later with polymethyl methacrylate. Subsequently, the retrieved implant was embedded in polymethyl methacrylate for undercalci-fied sectioning after vacuum bench polymerization and hardening in a heated vacuum oven. Five serial sections were obtained with a diamond wafering blade affixed to a low-speed saw. The sections were ground, if necessary, and stained with toluidine blue/basic fuchsin mixture at 50°C.

Clinical findings. Probing depths around the implant were as follows: 3 mm at distal-palatal, mid-palatal, mesio-palatal, and mesio-buccal; 4 mm at...
mid-buccal; and 5 mm at distal-buccal. There was bleeding on probing on the buccal side and a total lack of keratinized tissue at the buccal surface. On flap reflection, a 9 mm bony dehiscence along the buccal surface of the implant was observed (Fig. 3). Soft tissue appeared to be adhered to the buccal surface. The implant was clinically immobile. On retrieval, it appeared well attached to the palatal bony area. The area healed uneventfully after implant retrieval.

**Radiographic findings.** A periapical radiograph suggested osseointegration with the surrounding bone, with no sign of peri-implant radiolucency (Fig. 2).

**Histologic findings.** The implant appeared to be surrounded by mature trabecular bone (Fig. 4), with tight contact between HA and bone. The bone on the palatal aspect of the implant appeared mature and healthy with osteocytes present. Excellent trabecular bone remodeling could be observed close to the implant (Figs. 5 and 6). The HA coating was present with no signs of active resorption. The tips of the implant threads were denuded of the HA coating, and the exposed metal surface was in close contact with bone (Fig. 5). On the buccal side of the implant, which was in contact with soft tissue, large and sometimes multinucleated cells were observed (Fig. 7). These cells were consistent with macrophages and osteoclasts. A mild-to-moderate inflammatory cell infiltrate was observed, as were indentations and focal regions of HA loss (Fig. 8).

**DISCUSSION**

The histologic findings for the current specimen are in agreement with previous reports. They demonstrate that the HA coating may not be susceptible to dissolution in contact with bone. The presence of Haversian canals in close proximity to the bony surface implies a remodeling activity. The bone was in tight contact with the HA surface, as reported previously, supporting the theory that a special kind of bonding mechanism may exist between the coating surface and the bone.

The absence of HA at the tips of the threads in the current specimen is consistent with what HA-coated implants typically demonstrate after retrieval. It has been reported that the friction forces during implant placement result in mechanical detachment of the coating at these areas. It seems unlikely that a resorptive process is responsible for this phenomenon since the lack of HA has been selectively identified at the tips of the threads.

The current specimen provides histologic support for the hypothesis that the HA coating in contact with
Indentations along the implant surface (arrow) and mild inflammatory cell infiltrate suggest focal loss of HA (original magnification × 20).

Fig. 8. Indentations along implant surface (arrow) and mild inflammatory cell infiltrate suggest focal loss of HA (original magnification × 20).

Despite these limitations, these observations offer useful information given the scarcity of literature on clinically osseointegrated dental implants retrieved from humans. Typically, implants retrieved from humans have already failed, which means that no information about the bone-to-implant contact can be obtained.

SUMMARY

The histologic evaluation of a single HA-coated root form implant retrieved from a human subject has been described. Clinical, radiographic, and histologic findings support the idea that the HA coating is not prone to dissolution in contact with bone. In contact with a nonbony surface, however, the coating may initiate an inflammatory reaction and active resorptive process.

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REFERENCES


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