Osseointegration of a Zirconia Implant: A Histologic Assessment

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Purpose: The aim of this study was to describe the histologic and histomorphometric features of a retrieved, functional endosseous zirconia implant in a human subject. ***Materials and Methods:*** A maxillary zirconia implant (ZV3) placed in a 52-year-old man was retrieved after 2 years of uncompromised service and prepared for light microscopic evaluation. ***Results:*** Histologic examination demonstrated good osseointegration. Bone contact measurements revealed a mean percentage of bone-to-implant contact of 55.8% (SD 3.8%). ***Conclusion:*** The histologic data provide further evidence of the potential of zirconia implants to osseointegrate to a similar degree as titanium in humans. *Int J Prosthodont 2017;30:370–372. doi: 10.11607/ijp.5230*

The blue-gray color of titanium dental implant components may be intraorally visible when surrounded by thin overlying mucosa,[1] and some patients prefer dental implants that are metal free. High-strength ceramics such as yttria-stabilized zirconium dioxide (Y-TZP) could offer an alternative material choice. Y-TZP, being white, offers better light dynamics, especially in cases with thin overlying mucosa. It can be milled according to individual specifications by means of a computer-aided design/computer-assisted manufacture (CAD/CAM) production process. Both bone and soft tissue respond favorably to Y-TZP.[2]

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The aim of this case history report was to describe the histomorphometric and histologic features of a retrieved, functional zirconia implant in a human subject.

Materials and Methods

A zirconia (Y-TZP) implant (5 mm wide × 11 mm long) (ZV3) in a 52-year-old man at the position of the maxillary right first molar was damaged and rendered unsalvageable as a result of an intubation procedure necessary for unrelated treatment involving general anesthesia. The proximal crown of a natural abutment tooth was also injured. The implant was immobile and had functioned successfully without objective or subjective concerns for approximately 2 years. After informed consent was obtained, the implant was carefully retrieved, along with approximately 1 mm of surrounding alveolar bone, using a trephine drill at low speed and copious cooling. The specimen was stored in a cool place and eventually fixed in buffered formaldehyde (pH 7.4) 10% for 24 hours and subsequently dehydrated in ethanol.

After embedding the implants in methylmethacrylate following polymerization, three nondecalcified, 10-µm-thick longitudinal sections were prepared in a plane parallel to the long axis using a modified sawing microtome technique[3] and subsequently stained with methylene blue and basic fuchsin.

Light microscopic evaluation of all sections was performed using an automated Axio Imager Z1 microscope (Carl Zeiss) at ×10 and ×200 magnification. This evaluation consisted of a complete morphologic qualitative description and quantitative analysis of the hard tissue response.

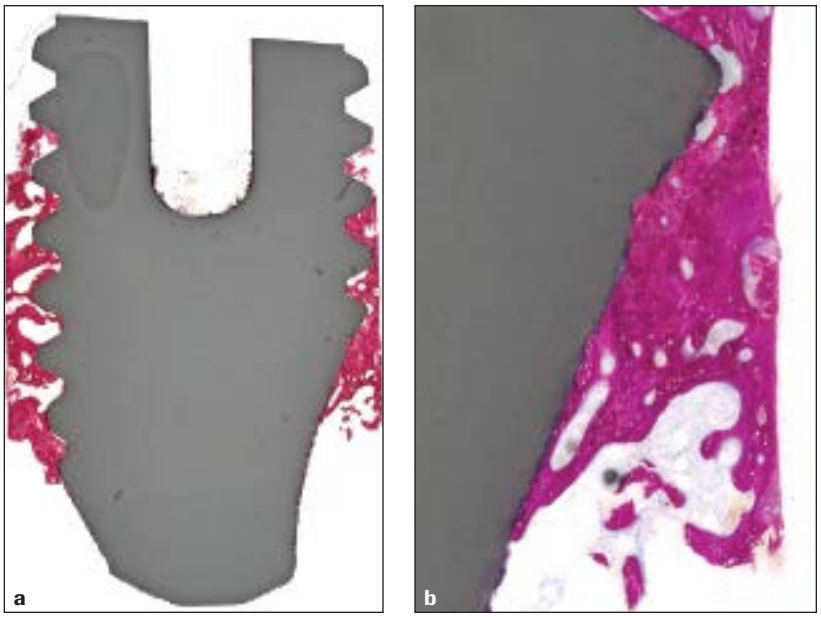

Fig 1 **(a)** Characteristic histologic section showing intimate contact between the zirconia implant (*gray*) and the red-colored adjacent bone (×10 magnification). **(b)** The area depicted in the framework in Fig 1a emphasizes the intimate contact between the zirconia implant (*gray*) and the red-colored bone (×200 magnification). The vital bone is bounded by osteoblasts.

Fig 2 ZV3 standard implant with a prepared glass-fiber post (*bottom*) and an implant with a personalized epigingival profile and unprepared glass-fiber post (*top*).

Results

At the time of retrieval, after a mucoperiosteal flap was raised, the implant appeared clinically healthy and was fully surrounded by alveolar bone. Characteristic histologic sections are presented in Fig 1.

Histologic examination demonstrated that most of the screw threads were filled with bone, showing a uniform color, which was in close contact with the zirconia surface. No intervening fibrous tissue layer was observed between implant and the surrounding bone. In the calcified tissue, many osteocytes were visible.

Bone contact measurements were performed, measuring from the most coronal aspect to the lowest thread. The mean percentage of bone-to-implant contact seen in the three sections was 55.8% (SD 3.8%), taking into consideration that coronally, some alveolar bone seemed to have been severed from the implant.

Discussion

Only sparse information is available with respect to the successful osseointegration of zirconia implants in humans. The best indication of their potential for osseointegration is obtained from animal studies or compromised situations. This report may therefore be of interest.

The clinical performance of the particular implant type used in the present study was described in a retrospective evaluation involving 74 patients and 121 implants, with an observation time of up to 3 years. Implant survival was 96.5% with healthy periimplant conditions, both clinically and radiographically.[4] It was a two-piece implant (Fig 2) with a surface roughness average of 20 to 40 μm accomplished by blasting with zirconia grit before sintering (Fig 3).

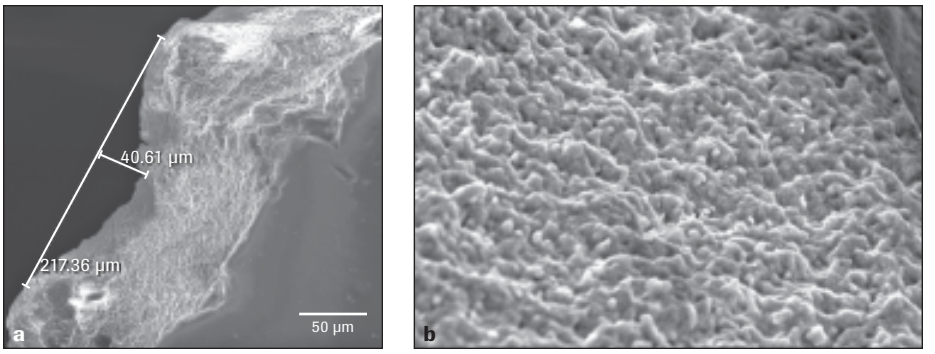

Fig 3 **(a)** Reflection electron microscope image of the ZV3 implant surface. **(b)** Detail of Fig 3a, focused at the center of the image.

The histologic and histomorphometric data associated with the retrieved implant demonstrate a successfully osseointegrated zirconia implant after 2 years of clinical functional loading.

Conclusions

Histologic data presented in this case history report describe a well-osseointegrated single zirconia implant after 2 years of functional loading. Observations from the retrieved implant confirm the potential of zirconia to successfully osseointegrate, at least in the short term.

Acknowledgments

This work was supported by the authors' institutions. The authors confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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