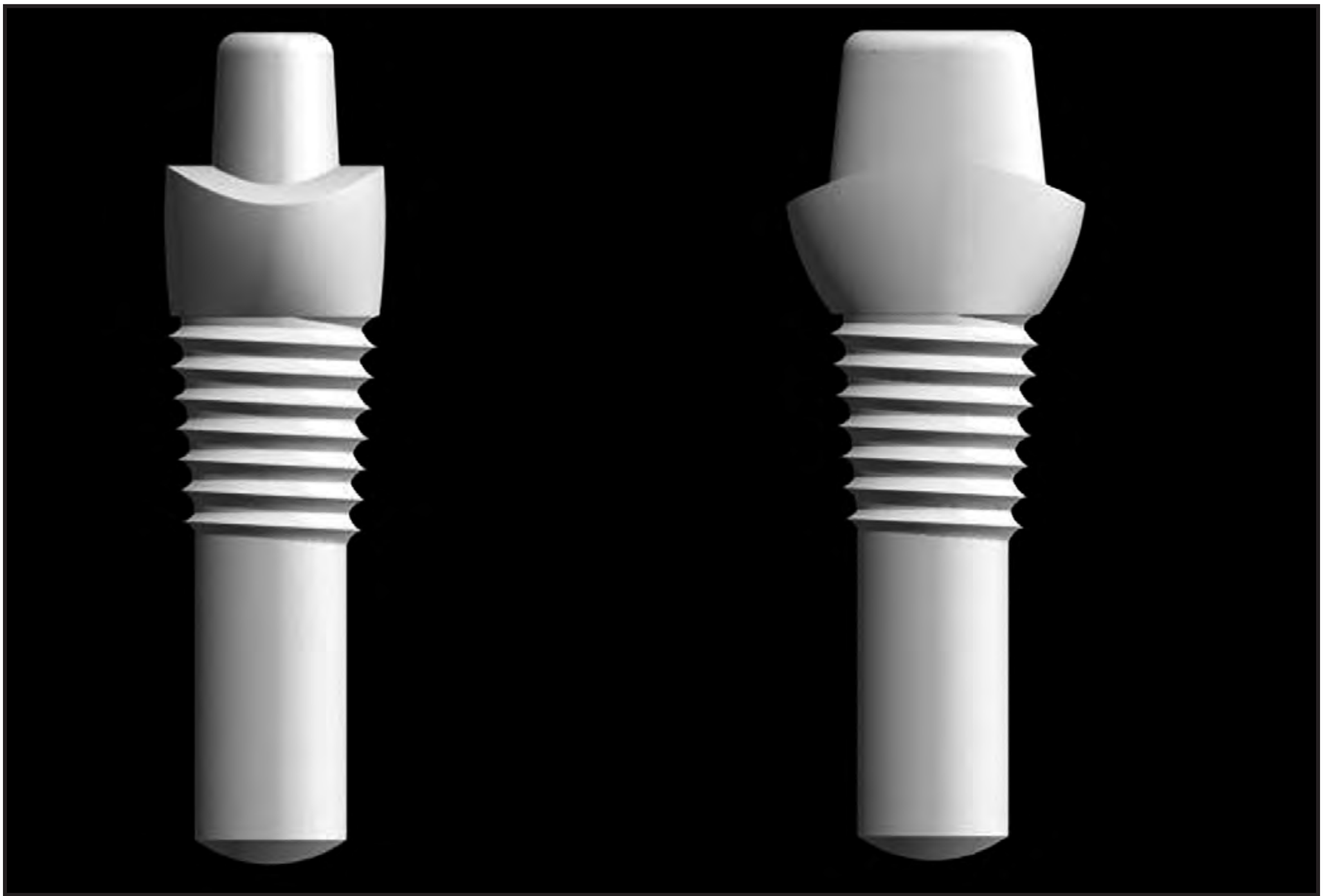

Ovoid Zirconia Implants: Anatomic Design for Premolar Replacement

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Traditionally, missing and hopeless teeth have been replaced by threaded cylindric implants. Implant manufacturers have tried to design implants that more closely resemble tooth anatomy, but the neck and abutment connection areas have not changed much in the past 30 years. Some companies have produced titanium implants with scalloped contours, but the clinical application of this remains uncertain. The combination of anatomically oriented implant designs, newer biomaterials such as zirconia ceramics, and modified surfaces has resulted in dental implants that can be specially designed for the replacement of individual teeth in both arches. Ovoid zirconia implants have been specially developed and produced to replace missing or hopeless premolars. This article discusses the treatment of a patient with an ovoid zirconia implant (CeraRoot Type 14) to replace a premolar. (Int J Periodontics Restorative Dent 2008;28:609–615.)

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Commercially pure titanium is the material of choice for dental implants because of its well-documented biocompatibility and suitability for tooling. This material[1] has been used for about 30 years as an implant substrate and has shown high rates of success.[2] However, titanium might show through thin mucosa, a drawback in esthetic areas.[3,4] Furthermore, over time the implant head might become visible because of peri-implant soft tissue recession. One possible solution would be to make implants from tooth-colored materials, such as ceramics. Ceramic materials are highly biocompatible and can be used as dental devices.[5] One ceramic material that has been used for dental implants is aluminum oxide (Al_2O_3).[6–8] This material osseointegrates well but does not have the sufficient mechanical strength for long-term loading; Al_2O_3 implants were therefore withdrawn from the market.

Recently, another ceramic material with potential use as a dental implant material was introduced. Zirconia as a metal substitute possesses good physical properties, such as high flexural strength (900 to 1,200 MPa), hardness (1,200 Vickers), and Weibull modulus (10 to 12).[9–11] Furthermore, its biocompatibility has been demonstrated in several animal investigations.[12–19] In vitro experiments have shown that the material is capable of withstanding simulated long-term loading.[16] Kohal and Klaus[20] reported on a patient who received a machined zirconia implant and a zirconia crown; excellent esthetics were demonstrated. Modern implant research shows that rough surface topography is desirable to enhance the bone integration process,[21] but the turning of zirconia rods results in a relatively smooth surface. Sennerby et al[19] demonstrated better implant retrieval torque resistance with porous zirconia surfaces in rabbits. Oliva et al[22] studied the success rate of 100 rough-surfaced zirconia implants in humans and reported a success rate comparable to that seen for titanium implants after 1 year. In a recent publication, Oliva et al[23] presented the esthetic potential of zirconia implants to restore two hopeless upper central incisors.

Traditionally, missing and hopeless teeth have been replaced by threaded cylindric implants. In the past several years implant manufacturers have modified implants to more accurately reflect the actual shape of teeth and tooth roots. As a result, root-form and tapered implants have become more and more popular. These improvements in implant design have usually been in the intraosseous part of the implant. However, the neck and the abutment connection area have not changed much since the first dental implants appeared. Recently, some companies have produced titanium implants with scalloped contours, but the clinical application of these remains uncertain.

Today, the combination of anatomically oriented implant designs, new biomaterials such as zirconia ceramics, and surface technologies has resulted in dental implants that are specially designed to replace each individual tooth. Premolars will probably benefit the most from anatomically oriented implant designs. On one hand, the axial section of a premolar in the cervical region is clearly ovoid. On the other hand, the axial section of all dental implants is a circle. For this reason, the emergence profile of the crown might be compromised.

Ovoid zirconia implants have been specially developed and produced to replace missing or hopeless premolars. The present article reports on the results that can be achieved with the use of an ovoid zirconia implant (CeraRoot Type 14, Oral Iceberg s.l.) to replace a premolar.

Case presentation

The patient was a 29-year-old woman and a nonsmoker in good general health. The patient requested the replacement of the hopeless root of the maxillary right first premolar (Figs 1 to 3). She was very concerned about esthetics in the area.

The patient's oral hygiene was poor. The maxillary right first premolar, along with the maxillary right second and third molars, had been destroyed by caries lesions. A panoramic radiograph was done to confirm the absence of infection in the area of the tooth in question. The patient pre-

Fig 1 (left) *Initial exam. Detail of broken maxillary right first premolar.*

Fig 2 (right) *Occlusal view of broken premolar.*

Fig 3 *Panoramic radiograph obtained at presentation.*

sented a molar and canine Class I occlusion. The premolar space had been preserved by the presence of the remaining root. The patient had a thin periodontal biotype with highly scalloped gingival contours.

Treatment plan

Several different treatment options were presented to the patient and discussed with her. The use of a titanium implant with a ceramic crown was presented to the patient as the most predictable and evidence-based situation. However, in a patient such as this with a thin biotype, the implant may have shown through the buccal bone and mucosa, resulting in an unpleasant appearance. The ovoid zirconia implant with a ceramic crown was presented as the most esthetic alternative because of the white color of the implant and the implant's ovoid shape, which would give a very natural look to the mucosa and the definitive restoration. However, no long-term results are yet available with zirconia implants. The patient decided to have the premolar replaced by an ovoid zirconia implant because of her esthetic concerns.

Surgery

Local anesthesia was administered for the extraction of the roots of the right first premolar, second molar, and third molar. The roots were easily luxated and then extracted without raising a flap. The extraction socket of the first premolar was debrided and irrigated with saline for 1 minute. Because of the patient's very thin biotype, a mini-flap that included the papillae only was elevated so that the clinicians could ensure the integrity of the buccal cortical bone plate. Standard drilling for implantation was performed with low

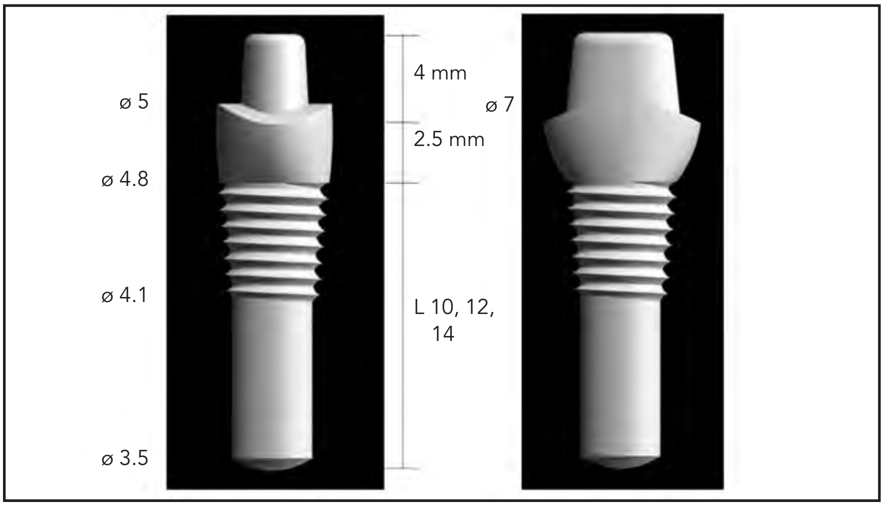

Fig 4 (left) *CeraRoot implant in place. Miniflaps are raised at the papillae to verify bone structure and ensure the integrity of the cortical bone.*

Fig 5 (above) *CeraRoot zirconia implant Type 14.*

speed and thorough irrigation to prevent bone overheating. The apical third of the implant site was prepared with the osteotome technique to slightly elevate the sinus floor. The implant used in this case was CeraRoot Type 14 (patent pending, ES 200502865) (Fig 4). This is an ovoid implant with an acid-ethced surface (ICE-Surface) that must be placed with a press-fit technique using an inserting key with a rubber end and a hammer. Three small percussions were needed to firmly adapt the implant into the site. As judged from the occlusal view, the implant completely filled the extraction socket, ensuring perfect osseointegration of the implant (Fig 5). A provisional healing cap was cemented onto the abutment portion of the implant to prevent soft tissue healing above the shoulder of the implant. Finally, sutures were placed to adapt the papillae and close the site.

Sutures were removed seven days after surgery, and the soft tissues showed normal healing. The patient reported minimal discomfort and inflammation.

Prosthetic treatment

Two months after surgery, the gums had healed perfectly around the zirconia implant (Figs 6 and 7). There was no inflammation or bleeding on probing around the implant. The papillae were intact, and the color of the soft tissue was identical to that around the neighboring teeth, giving the site a natural appearance. The definitive restoration (Figs 8 and 9) was fabricated using an all-ceramic system, and final cementation was performed 3 months after surgery with a glass-ionomer cement (Fuji II). Special attention was paid to the occlusal scheme; excess contact in eccentric and protrusive displacements was avoided. Following placement of the restoration, a periapical radiograph was obtained to confirm adequate fit of the restoration (Fig 10).

Fig 6 (left) *Occlusal view at 3 months postsurgery.*

Fig 7 (right) *Lateral view at 3 months postsurgery. The site is ready for final impressions.*

Fig 8 (left) *Occlusal view of definitive restoration.*

Fig 9 (center) *Lateral view of definitive restoration.*

Fig 10 (right) *Periapical radiograph at 1 year posttreatment.*

Discussion

There are no previously published articles in the literature about dental implants with an ovoid design. The CeraRoot zirconia implant Type 14 is anatomically designed for the replacement of premolars. Typically, premolars have been replaced with standard cylindric titanium implants, which has led to some problems with prosthetic rehabilitation. To create prosthetic rehabilitations with a progressive emergence profile with cylindric implants, the surgeon has to place the implant deep subgingivally, and thus, a biologic problem occurs with possible loss of bone and therefore loss of papillae. On the other hand, if the implant is placed only 1 or 2 mm subgingivally, the emergence profile is often problematic, especially buccolingually, where the anatomy of the restorative crown has to compensate for the anatomy of the cylindric implant, which is always narrower.

The new anatomically designed dental implants, along with new biomaterials and implant surfaces, may become very useful for the improvement of treatment outcomes and patient satisfaction. The illustrated ovoid zirconia dental implants combine the special anatomic design, which is ideal for the replacement of premolars; yttrium–partially stabilized zirconia, an ideal esthetic material; and a rough surface for optimal osseointegration.

Finally, the appropriate selection of cases is crucial when using zirconia implants. Only cemented restorations can be used to restore these situations. For this reason the implant must be placed in the perfect position and inclination. In addition, the patient should have a favorable and stable occlusion to avoid placing undue stress on implants.

Conclusion

Ovoid zirconia implants can be a good alternative for premolar replacement. The anatomic design of the implants and restorations ensures the best esthetic result and respects the biologic space around dental implants. Long-term results are needed to verify the efficacy of ovoid zirconia implants.

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