

Superior osseointegration success of Patent™ Implants scientifically proved

Zircon Medical Management, Switzerland



For a long time, the main challenge with zirconia dental implants was their ability to successfully osseointegrate. For years, researchers and manufacturers were concerned with finding ways with which osseointegration of zirconia implants could be improved. In recent years, the scientific community has reached the consensus that the surface roughness of a zirconia implant determines its ultimate ability to integrate into the bone. Studies have found that zirconia implants with smooth endosseous surfaces are associated with comparatively long healing periods.¹⁻⁴ Cionca et al. argue that the endosseous surface of a zirconia implant should be as rough as possible to achieve reliable osseointegration.⁵

High surface roughness—the key to success

When it comes to surface roughness, Zircon Medical Management, manufacturer of the Patent™ Dental Implant System (Fig. 1), is leading the way. For the manufacture of Patent™ Implants, made from yttria-stabilised zirconia, the company employs a revolutionary

patent-protected process in which all surface-machining steps are carried out prior to sintering. Only in this way is a surface roughness (5.7 $\mu\text{m Ra}$) achieved that is up to five times greater than other documented zirconia implant surfaces.^{6, 7} Thanks to their highly rough endosseous BBS (blasted before sintering) surface, Patent™ Implants achieve fast and predictable osseointegration—this has now been definitively proved (Fig. 2).

In order to evaluate whether a high endosseous surface roughness leads to accelerated and reliable osseointegration of zirconia implants, Drs Roland Glauser and Peter Schüpbach conducted a preclinical animal model study, in which they examined the early bone formation and bone healing mechanisms around two-piece zirconia Patent™ Implants.⁸ They found that the Patent™ Implant, thanks to its highly rough BBS surface, outperforms all other dental implants that have been investigated in comparable studies to date regarding bone healing speed and success and overall tissue stability. Their study has been published in the *International*

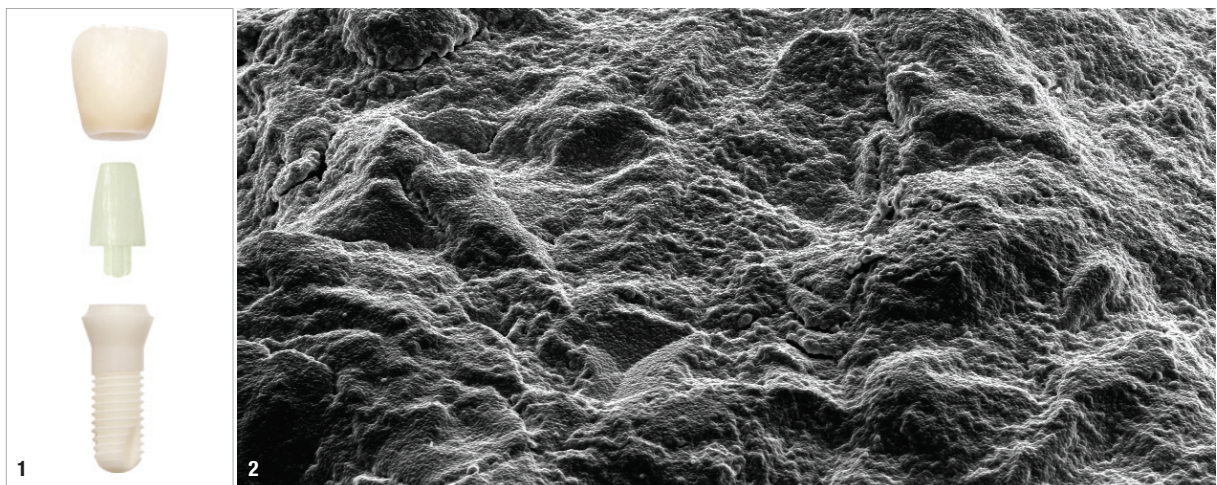
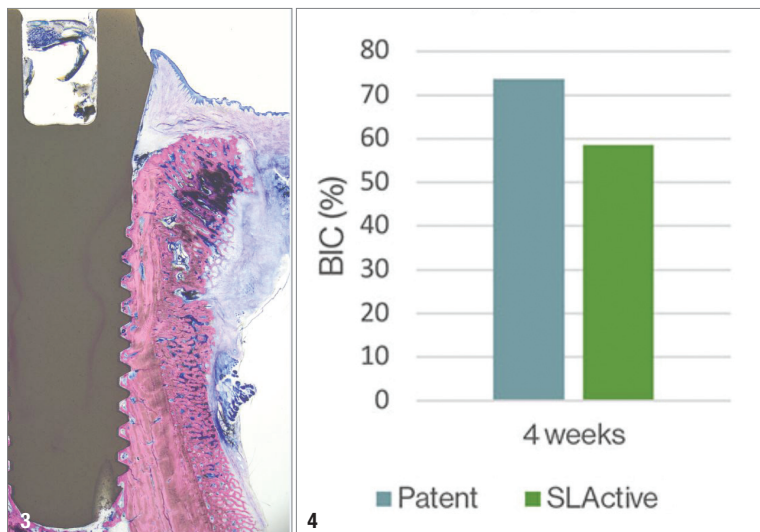


Fig. 1: The tissue-level design and prosthetic concept of the two-piece Patent™ Implant is in perfect harmony with the unique material properties of zirconia. A highly stable yet flexible glass fibre post with dentine-like properties is cemented into the 3C connection of the Patent™ Implant. The post is then prepared to form using a high-speed diamond bur and restored with the prosthetic superstructure. **Fig. 2:** The endosseous BBS surface of the Patent™ Implant is up to five times rougher than other documented zirconia implants, ensuring fast and predictable osseointegration (2,500 \times magnification). (© Dr Peter Schüpbach)



“The Patent™ Surface may be classified as highly osteoconductive”—Drs Roland Glauser and Peter Schüpbach

Fig. 3: Histological analysis after four weeks of healing. The soft tissue had grown into close contact with the transmucosal implant collar. (© Dr Peter Schüpbach) **Fig. 4:** The bone–implant contact (BIC) determined for Patent™ Implants after four weeks of healing was higher than 70%.

*Journal of Implant Dentistry*⁹ and is summarised in this article.

Method

Six premolars were extracted in four miniature pigs. Five Patent™ standard two-piece zirconia soft-tissue-level implants (diameter: 4.1 mm; length: 11.0 mm) and one titanium tissue-level control implant (Straumann Standard; regular neck; Roxolid; SLActive surface; diameter: 4.1 mm; length: 10.0 mm) were immediately placed in the extraction sockets of each animal under full sedation. In addition to their highly rough endosseous surface, Patent™ Implants incorporate a transmucosal portion with a machined surface. The titanium control implants have an endosseous surface roughness of 2.2 µm Ra, and a machined transmucosal portion. After implant placement, the flaps were closed with sutures and the implants were left for transmucosal healing. No levelling of the bone was performed, and no grafting procedures or membranes were used. No implants were lost during the healing phase. Two animals were sacrificed after four weeks and two after eight weeks. Histology samples were analysed using Leica light microscopes. Bone–implant contact (BIC) was measured from the most crestal BIC point to the apex of the implant.

Results

The Patent™ Implants investigated demonstrated high rates of osseointegration four and eight weeks after insertion. After four weeks, the BIC reported was 73.7% (SD: ± 16.8) for the Patent™ Implants and 58.5% for the control implants (Figs. 3 & 4). After eight weeks of healing, both implant types were completely osseointegrated, having BIC of 82.4% (SD: ± 16.9) and 93.6% (SD: ± 9.1), respectively. Contact osteogenesis was observed directly on and along the surface of the Patent™ Implants.

The authors concluded that the Patent™ Surface may be classified as highly osteoconductive. They also stated that the presence of bone debris is of vital importance to accelerate the initial bone formation process.¹⁰ During implant placement, a rough implant surface scrapes off bone along the walls of the osteotomy. This creates a micrometre-thick smear layer of bone debris and blood, covering part of the implant surface immediately after placement.^{11, 12} The bone debris guides new bone formation by distance osteogenesis towards the implant surface. The authors suggest that the highly rough surface of the Patent™ Implants may have generated more osteogenic bone debris and smear layer compared with the control implants, contributing to the high BIC ratio at four weeks of healing.

Conclusion

Based on the findings of their preclinical study, Drs Glauser and Schüpbach concluded that the endosseous surface roughness of a zirconia implant has a decisive influence on its ability to integrate into the surrounding bone. They reported that the immediately placed two-piece Patent™ Implants achieved fast and predictable osseointegration thanks to their highly rough endosseous BBS surface. The mean BIC ratio reported for the Patent™ Implants investigated in this animal model study was higher compared with previous studies evaluating other surface-modified zirconia implants in similar animal models.

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