# Ceramic implants: Yesterday a vision, today an everyday challenge?

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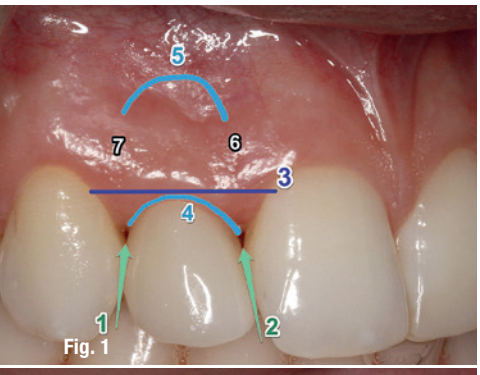
**When the first ceramic implants** were inserted in the 1960s and 1970s under the supervision of Prof. Willi Schulte in Tübingen in Germany, expectations were high and it appeared that an alternative to the already successful titanium implants had been found. However, in practice, it turned out differently. The implants had a high failure rate due to incomplete healing and fractures, meaning they were unacceptable for further use. This led to considerable initial scepticism around ceramic dental implants. In Germany specifically, there was a prejudice concerning the concept of ceramic implants as a whole. Fractures of ceramic components were familiar to all dentists. They saw chipping of veneer ceramics and ceramic-fused-to-metal restorations, as well as fractures of newly developed full ceramics, in everyday prosthetic practice. From these experiences, it appeared that ceramic implants would not be strong enough for use in implantation.

Consequently, research into titanium implants went forward quickly, while implant technology with ceramic implants was regarded as a maverick method. Despite all the positive differences in its chemical and physical properties compared with those of the previously used aluminium oxide ceramics, the advantages of zirconium dioxide only slowly gained recognition. In zirconium dioxide ceramic, we now have a material at our disposal with the properties necessary for successful and safe ceramic implants.

The safety of the material is the primary concern of zirconium dioxide ceramic implants and, once achieved, leads to additional advantages, for example good gingiva compatibility owing to their high adhesiveness and aesthetic benefits in avoiding shadow formations when a lower amount of peri-implant tissue is present.[1,2] Furthermore, overall, very good biocompatibility has been proven.[3]







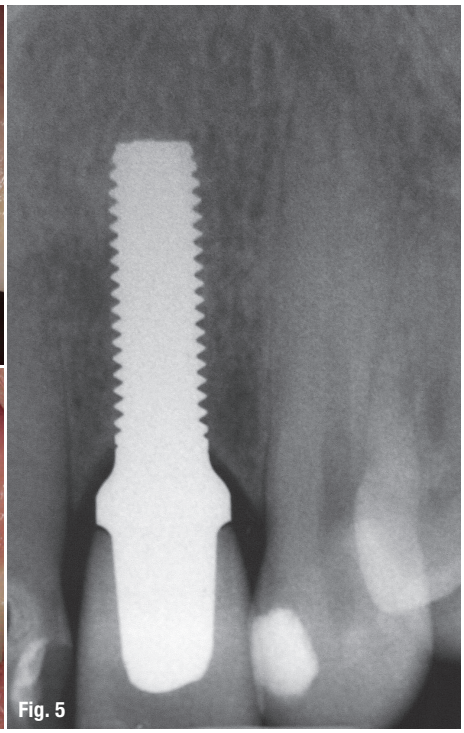



**Fig. 1:** Fürhauser's Pink Esthetic Score: 1 = left papilla; 2 = right papilla; 3 = soft-tissue level; 4 = soft-tissue contour; 5 = alveolar extension continuity; 6 = colour; 7 = texture. **Figs. 2–5:** Case 1: A Z5m implant was inserted in region #22. A high level of patient satisfaction was achieved.

Ceramics are hard materials with very low elasticity. Even small variations in the homogeneity of the powder mix lead to a not inconsiderable weakening of the material and possibly to complete failure. Processes such as powder compression and sintering also need a great deal of knowledge and experience on the manufacturers' behalf. Therefore, trust in the manufacturer on the part of the implantologist and very high product quality from the manufacturer are necessary.

We have been using zirconium dioxide in our practice since 2004. Functional and aesthetic results, along with material safety, are ultimately what count in any dental practice. Results must be close to, meet or exceed the expectations of patients. We use Fürhauser's Pink Esthetic Score (PES) to judge aesthetic results (Fig. 1).[4]

## Case 1 (2008)

This case is presented as an example of the PES. The gingiva was prevented from growing over the implant shoulder by a well-fitting temporary crown covering the implant shoulder. This resulted in a trauma-free procedure in forming of the gingiva and cementing of the crown. The circular step represented a special challenge in the vestibular aesthetic and in cementing the crown. The insertion depth was coronal to the top of the thread.

Implantology with single-piece implants requires special conditions in prosthetic treatment, and only a portion of the required indications can be treated (Figs. 2–5). Today, we can go further by using zirconia implants for various indications made by the manufacturer Z-Systems (Fig. 6).[5]

Z-Systems has a company history of 15 years, during which time it has concentrated solely on zirconium dioxide implants. The products have been developed and manufactured together with Swiss company Metoxit (Tab. 1).[6] The initial single-piece implants were followed by various two-piece implant types. Most indications today can be covered by this range. The most common indication in Germany is single-tooth replacement. Using the treatment results presented in this article, I would now like to direct the focus to the development cycles.

## Case 2 (2004)

The implant Z5m by Z-Systems, placed in region #25 is an example of long-term success. Thirteen years of post-treatment, and with very good dental care, it was difficult to tell whether there was more recession of the gingival margin at the natural teeth than at the implant site (Figs. 7–9).

## Case 3 (2015)

In this case, the screw implant Z5m(t) by Z-Systems, was inserted in region #15. The tapered screw design helps to avoid penetration of the sinus floor and additionally achieves a high primary stability in weak bone (Figs. 10–12).

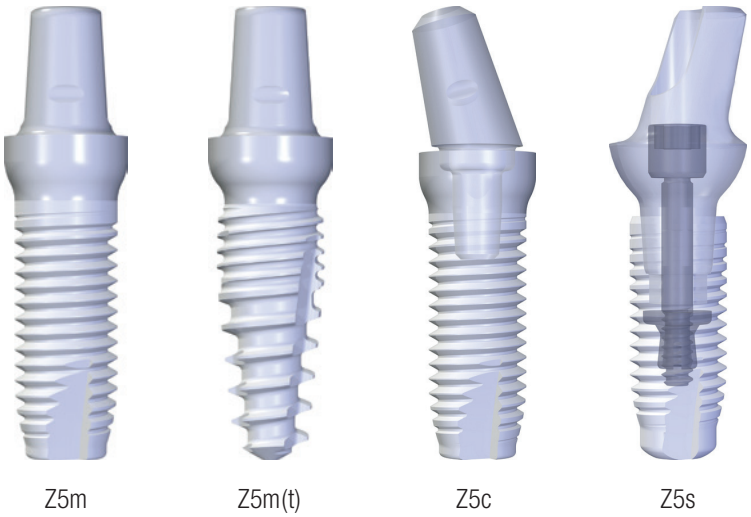



**Fig. 6**

## Case 4 (2013)

The implant placed in region #12 in this case was a tissue level two-piece Z5c implant by Z-Systems. The condition of the periodontium of the neighbouring teeth is important for predicting the shape of the papilla be-

| Description | Unit | TZP-A BIO-HIP® |
|---|---|---|
| Components | – | $ZrO_2/Y_2O_3/Al_2O_3$ |
| Composition | % | 95/5/0.25 |
| Density | g/cm³ | 6.05 |
| Open porosity | % | 0 |
| Grain size | µm | 0.35 |
| Vickers hardness | Hv | 1,200 |
| Mohrs hardness | – | 8 |
| Compression strength | MPa | 2,000 |
| Flexural strength | MPa | 1,200 |
| Elasticity index | GPa | 210 |
| Fracture toughness K1c | $MN/m^{3/2}$ | 8 |

**Tab. 1:** Table with the composition and material properties of the Z-Systems implants used in this report.[6] (Source: Metoxit)

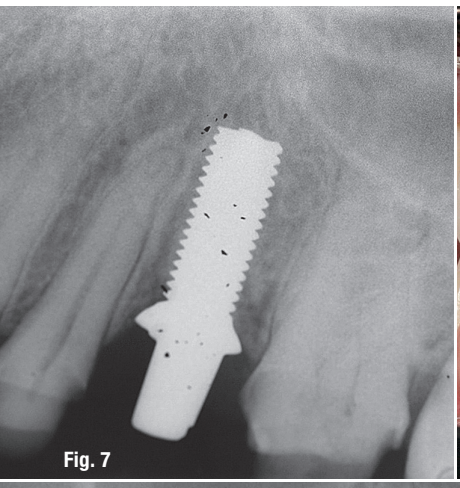


Fig. 7


Fig. 8


Fig. 9

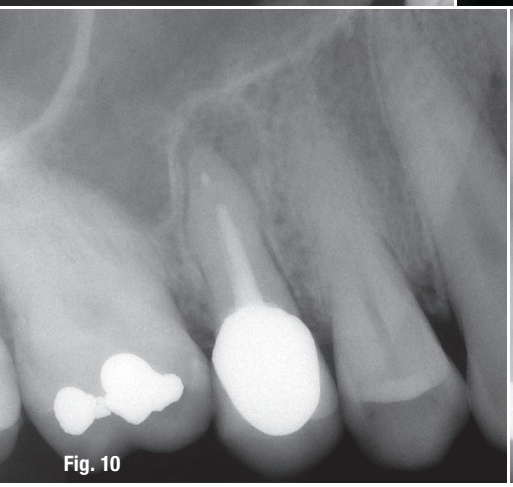


Fig. 10

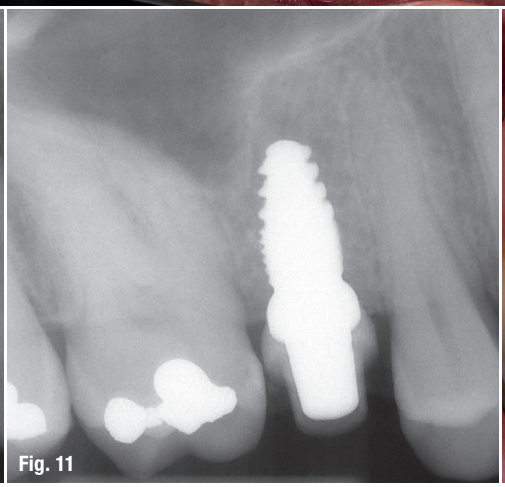


Fig. 11


Fig. 12

**Figs. 7–9:** Case 2: A Z5m implant inserted in region #25 is an example for long-term success. **Figs. 10–12:** Case 3: A Z5m(t) implant was inserted in region #15.

tween the implant crown and the natural or artificial crown of the adjacent tooth. The implant in this case was placed immediately (Figs. 13–16).

## Case 5 (2016)

Bone level indication extensions (Z5s implants in regions #46 and 47) were used in this case, in which, even with a two-piece tissue level implant, there were concerns about stable fixing owing to the lack of good primary stability. Furthermore, the desire of many oral surgeons to be able to collaborate clearly with the referring dentist has to be considered (Figs. 17–20).

## Scientific background

We currently have at our disposal many more studies, user observations and experiences for single-piece ceramic implants than for two-piece implants. There is a great need for further studies on two-piece ceramic implants, most of all controlled long-term studies. A race can be expected between the ever-more expensive studies and the fast development of the dental industry in the future market, and experts see great growth potential here for two-piece ceramic implant systems.

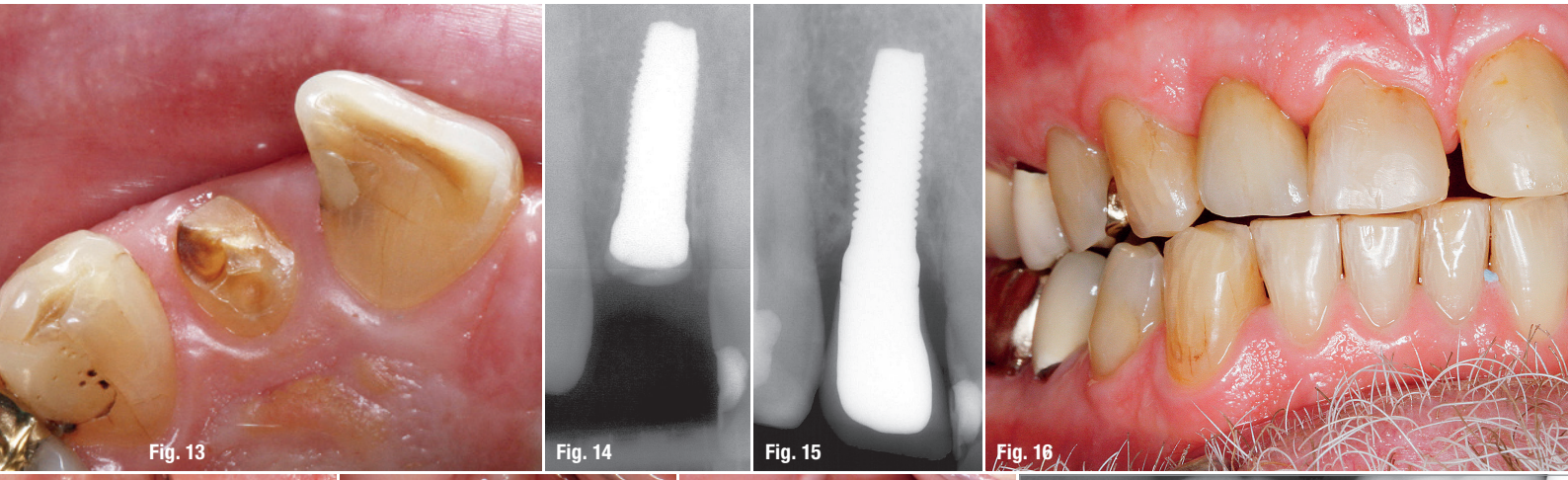
### Will two-piece implants become established?

The similarity in placement procedure of the two-piece ceramic implant to that of the two-piece titanium implant is its main benefit. The risk of undesirable stresses in the healing phase do not arise. There are more possible variations in the positioning in the current operation area during surgical intervention. There is more flexibility in prosthetic treatment through the choice of abutments, with various angles and diameters available. It is thus to be expected that two-piece ceramic implants will be used more often.

### Are two-piece implants safe?

There are currently no clear comparisons with a sound basis in studies between

1. one-piece and two-piece ceramic implants,
2. two-piece ceramic and titanium implants,
3. two-piece ceramic implants and two-piece implants consisting of a cemented titanium base with a zirconium dioxide superstructure.





**Figs. 13–16:** Case 4: A two-piece Z5c tissue level implant was inserted in region #12. **Figs. 17–20:** Case 5: Bone level indication extensions (Z5s implants in regions #46 and 47).

Such comparative studies will not be available in the near future, probably owing to the complexity in time involved in carrying them out, and a lack of a consistent study protocol reduces the possibility of easy comparability.

## Summary

Implantologists can complement their implant practice today with ceramic implants and thereby gain the necessary experience in handling them. Many uncertainties can be assuaged with clinical use in practice and the literature that is already available. Ceramic implants represent a realistic alternative to titanium implants. A thorough consideration of a metal-free approach is recommended. The statements about ceramic implants and their use that have been broadly propagated in the media have led to an increased demand for advice, and this must be properly addressed. There is greater clinical experience with single-piece implants, and the risks in the healing phase are fundamentally greater owing to undesired loading. The reverse is true for two-piece implants.

In private practice, dentists can be vulnerable and must carefully observe their duty to inform patients. Critical consideration of the subject and one's own responsibility of action thus remain of great importance to implantologists.

Ceramic implants as a vision? Everyday? In our practice, patients can choose between ceramic and titanium systems.

Literature

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