ZIRCONIA IMPLANTS

Prosthetic restoration of ceramic implants: Special features, chances and limits

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→ Why should you read this article?
Zirconium oxide (often referred to as zirconia) implants are developing into the new "trendsetters" in the field of implantology. Their prosthetic restoration, however, requires an intensive examination of the product used, as there are considerable differences in the dental restoration protocols.

Translation: Jacobi Übersetzungen

INTRODUCTION

As conventional full-ceramic dental restoration cannot be imagined without "white steel", it meanwhile seems to have established itself in the field of implantation. Many companies have updated their portfolio and now offer zirconia implants and invest a great deal in advertising these innovative products. The consequences of their efforts are visible. At present many specialists are tempted to also use ceramic implants. Professional dental surgeons should therefore focus on the special characteristics these implants have to offer.

SPECIAL CHARACTERISTICS FROM A SURGICAL VIEWPOINT

From a surgical viewpoint there are some special characteristics which have to be taken into account within the scope of inserting implants and in connection with the healing process. First of all there are differences in the ceramics used. Not only the yttrium oxide content and possibly also the aluminium oxide content differ with regard to the sintering process depending on the various manufacturers. Statements cannot be made on a clinical basis with regard to the long-term durability of the one or other modification. In principle it is necessary to take a higher susceptibility to fractures into consideration as against elastic metal implants.

It is therefore hardly surprising that the majority of manufacturers first launched one-piece systems on the market and thereafter decided to refrain from using diameter-reduced implants. This approach has, however, changed over the past years, but ultimately there is practically no clinical long-term experience to date that can be drawn on with regard to diameter-reduced or even short implants in the ceramic field. That clearly shows that some indications which can be provided with titanium implants without augmentation can only be restored surgically using ceramic implants and involving high costs.

Even if ceramic implants are similar to their counterpart of titanium, it is nevertheless clear that the former are not self-tapping in any case. In titanium implants we have grown accustomed to the need to tap

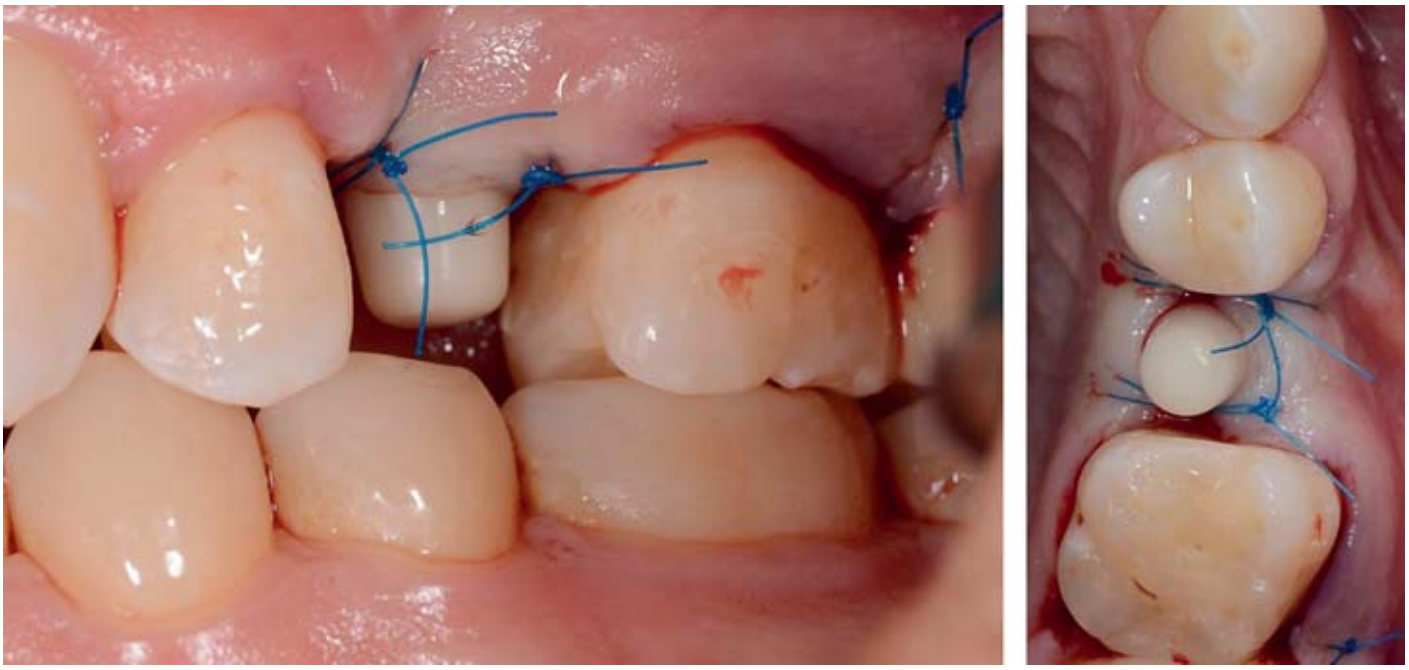

Fig. 1: Keyvan Sagheb

Fig. 1: Filling an individual tooth gap with a one-piece ceramic implant (System vitaclinical)

a screw thread only in exceptional cases, namely in the case of extremely hard bones. In the surgical protocol ceramic implants require the use of a thread cutter as a standard measure. This clearly reflects that the primary stability of ceramic implants due to the drilling protocol is in the majority of cases lower than that of titanium implants. It will, however, surely be possible to achieve a good primary stability also with ceramic implants after a short adaptation phase.

COMPARABLE OSSEOINTEGRATION AS IN THE CASE OF TITANIUM IMPLANTS

In the past years special focus has been on surface processing of ceramic implants. Following the sintering process the first generation was furnished with a relatively smooth surface. It has only been possible to produce micro-rough surfaces also on ceramic implants in the course of the last few years. That shows clearly that a comparable osseointegration as in titanium implants can only be expected with the current generation of ceramic implants. This is confirmed not only in the animal model, but also in current reviews. The osseointegration of modern ceramic implants can thus be regarded as a problem which has been solved and/or described as a clinically reliable process.

The issue of coupling between implant and abutment is by far more difficult according to the manufacturers. Due to the mechanical properties of ceramic it is extremely difficult to screw an abutment into the implant. Some manufacturers have thus decided to use a metal insert. Other manufacturers use plastic/carbon screws. Solutions with bonding agent are also available on the market. Data are not available for any of these connections, as the period of observation is only a couple of years in either of the cases. Two-piece ceramic implants are therefore still classified as an absolute novelty and patients therefore require comprehensive information. One-piece ceramic implants with a modern surface have, however, been demonstrated as reliable in several clinical studies.

In summary, it can be stated that ceramic implants are definitely no longer an unorthodox medical treatment. The special characteristics of the material, however, do require observation over a certain period in time. The use of one-piece ceramic implants can be classified as reliable from a surgical viewpoint. Nevertheless, close monitoring and harmonisation of the procedure with the dental technician and/or with regard to the planned prosthetic restoration is essential.

QUESTIONS ON THE TOPIC:

- Can zirconocide implants be subsequently prepared?
- Is an adhesive anchoring of the supply necessary?
- Do two-part systems offer far-reaching possibilities for changing the prosthetic restoration?
- What restrictions apply to prosthetic work on zirconium oxide implants?

POSSIBILITIES AND RESTRICTIONS FROM A PROSTHETIC POINT OF VIEW

In order not to insert the implant solely for its own sake, it is not sufficient to simply obtain information regarding the special characteristics of implants. It is moreover necessary for dentists to familiarise themselves with the prosthetic restoration methods and to take their limits into consideration. Clinical studies regarding the

Fig. 2: Six months following immediate implantation: In the case of optimum positioning no corrections are required if one-piece zirconia implants have been used.

Fig. 3: To reduce the cement washed out in the area of the step, it is recommended to implement an opening for drainage.

Fig. 4: The crown was made of zirconia and fastened with an adhesive element.

Fig. 2-4: Jeremias Hey

functionality of dental prostheses on zirconia implants are rare. With the exception of the manufacturer's instructions of use hardly any concrete information is available. However, the information provided could hardly be any more heterogeneous. However, first things first.

Currently the one-piece implants are dominating the full ceramic implant sector. The undisputed advantage of one-piece implants lies in their higher stability. This plus is, however, overshadowed by the disadvantage of requiring optimum positioning. If two pillars are required, it is often impossible to position these without complicated measures so that a homogeneous direction of insertion is achieved. In such a case relief can be produced by grinding the abutment. However, beware: Some manufacturers do not allow this step. Renowned material scientists also recommend a subsequent correction at present. The reason is a change in the surface quality which may induce a fissure. If the manufacturer, however, permits a correction, this means that in any case of doubt you would not have to face legal responsibility alone. The fraction of the brave agrees with regard to the approach. In principle preparation should take place under continuous cooling with at least 50 ml/min combined with the use of a fine-core diamond. There are drastically deviating recommendations with regard to the extent of post treatment. Some manufacturers exclusively permit occlusal shortening, others in turn only permit a reduction of the abutment up to half of the original diameter. It makes sense to follow the recommendation and initially form the unpolished abutments before producing abrasive caps in the laboratories. By adopting this approach abrasion can be reduced to a necessary minimum.

The variety of options and restrictions in the prosthetic restoration of zirconium oxide implants prevents generalisable advice.

In so far as an individualisation of the implant abutment has not taken place, impression caps with congruent shapes are available. Some manufacturers have saved their abutment design in construction programs to enable a high-precision intraoral scan. With this option the extent of transmission errors is reduced to a minimum. If the abutment is however adapted, the then existing form is moulded like a natural tooth using conventional methods or scanned. The order of magnitude of possible transmission errors thus has to be evaluated accordingly in this case.

With regard to fastening materials the recommendations could not be more diverse. Some manufacturers ascribe a buffering capacity to the cement. In these cases, adhesive bonding is recommended. Others in turn focus on biocompatibility and are convinced that glass ionomer cement is the agent of choice. However, not every manufacturer restricts the type of attachment. The simple consequence is that there is no recommendation in this respect.

TWO-PIECE SYSTEMS AS FAVOURITES

Based on the "special characteristics" of one-piece zirconia implants, two-piece systems are gaining increasing popularity. In consideration of the advantages, namely of disposing of a larger space for surgical positioning or of also having the option to modify the prosthetic setup, dentists tend to favourise this system. Without doubt the two-piece structure enhances the spectrum of indications. Even less data is, however, available on clinical performance, and the recommendations of the manufacturers with regard to prosthetic restoration are even more diverse. In principle, only confectioned abutments which can be adapted to meet individual requirements are available on the market. Their anchoring in the implant must stringently

comply with the manufacturers' recommendations: They are available with reversible screwing or irreversible cementing or irreversible screwing and cementing. In the case of cementing the connection becomes inseparable. This approach thus eliminates a key advantage of the two-piece systems. In addition thereto, various different materials some of which were introduced in dental engineering only a few years ago are used. Besides zirconia abutments there are also PAEK-based abutments. With regard to the screws not only titanium or gold alloys are offered, but also carbon fibre reinforced PAEK derivatives. The prescribed torque ranges from 5 to 35 Ncm. One thing all abutment and screw variations have in common is that no reliable statements with regard to their clinical performance are can be provided.

Impressions in the case of two-piece reversible systems are as a rule uncomplicated as a result of impression posts analog to the familiar procedure in the case of titanium implants. The impression posts and abutment replicas are, however, in most cases made of soft metal alloys and PAEK-based plastics. The materials can be elastically and plastically formed by applying less force than in comparison with titanium. Whether and to what extent transmission tolerances exist, cannot be stated at this point in time. Irreversible two-piece systems are in most cases formed after the cementing process. The procedure can then be compared with handling in the case of one-piece systems. Despite all differences in the prosthetic application, the question with regard to common features nevertheless arises. You will find these, primarily in connection with the restrictions.

Despite the fact that zirconia is one of the most stable ceramics at present, it nevertheless still remains a ceramic material in principle. Dentists working on and with ceramic should therefore once again think of the key properties of this group of materials. All ceramics react sensitively to pressure and strain. Fissures and surface defects can increase with such an exertion of pressure. A clinically relevant plastic or even elastic procedure is not available. After reaching the maximum limit, a rupture will invariably take place.

The length of the crown should principally not exceed the length of the osseointegrated section. Free-end bridges are principally not indicated as when exposed to pressure critical tensions arise which may induce tensile stress. Even composite bridges are not recommended. It is assumed that the natural range of movements of a tooth functions like a free end. A span of more than two interim joints is also viewed critically. The crown width of a denture should only amount to two thirds of the "standard" width. In the case of a removable restoration no less than four implants should be available. Diameter-reduced implants, thus speaking of an order of magnitude of ≥ 3.7 mm should only be used to replace individual teeth of the upper lateral and bottom incisors.

SUMMARY

Dentists desiring to prosthetically restore zirconia implants are therefore recommended to address the manufacturer in order to obtain more detailed information. Familiar treatment protocols from the restoration of titanium implants cannot be adopted one to one. The current diversity of options and restrictions prevents generalisable recommendations. Expressive clinical studies on proven concepts are not available to date either, so that a pioneering spirit is somewhat helpful in connection with realising dental solutions on zirconia implants. ■

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