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Georg Isbaner

Editorial Manager

A good year for ceramic implants

2018 has been a successful year for ceramic implantology in many ways. To begin with, the companies which are active in the field of ceramic implantology continue to prove the field's potential for innovation. Today, there are a great number of modern two-piece systems available for dental patients to choose from, which come close to the prosthetic possibilities of titanium implants. Moreover, the micro-rough surfaces of the new systems have already proven themselves. Recent patient surveys show that both the general demand for ceramic implants and the patient's interest in this regard is steadily increasing. I am delighted that both Dr Michael Gahlert, who is part of the Editorial Council of this very magazine, as well as Dr Stefan Röhling, Vice President of the just recently founded European Society for Ceramic Implantology (ESCI), contributed to the topic of ceramic implantology by providing us with an extensive article (see page 06). In regard to implant therapy, the article shows that there are patient groups who prefer ceramic implants over titanium implants—even if it might lead to higher expenditures.

In addition to that, the educational developments in the field of ceramic implantology have become increasingly diverse: Led by their President Dr Sammy Noumbissi, the International Academy of Ceramic Implantology (IAOCI) was celebrating already their seventh International Annual Congress in San Diego, USA, whereas the International Society of Metal Free Implantology (ISMI) was successfully hosting their fourth Annual Congress in Hamburg, Germany. Headed by Dr Karl Ulrich Volz, the event was welcoming far more than 200 participants.

Admittedly, the large and well-established expert associations are not able to do without lectures or special podiums with respect to ceramic implantology anymore—one needs to look no further than to either the EuroPerio held in Amsterdam, Netherlands, the congress of the European Association for Osseointegration (EAO) recently held in Vienna, Austria, or the first Future Congress of the German Association of Dental Implantology (DGZI) held in Duesseldorf, Germany.

Under the leadership of Dr Jens Tartsch, the European Society for Ceramic Implantology, which was founded at the end of 2017, primarily aims to foster the scientifically based discourse in close collaboration with the dental industry. In this regard, the ESCI published an initial statement in October formulating the current state of dental implantology including ceramic implants (see page 46).

In the coming year, both the IAOCI, as well as the ISMI will, again, each be hosting an International Annual Congress. In addition, the ESCI will be holding its very own Annual Congress for the first time. The education offerings in the form of congresses for practitioners continue to grow, and so, too, does the general demand for information about ceramic implantology.

In the light of these various developments, the actual task for us as publicists is to provide our readers with a comprehensive outlook which reflects the diversity of ceramic implants initiatives. We hope to live up to this claim in publishing this new issue of ceramic implants—international magazine of ceramic implant technology. I sincerely hope that you enjoy the read. Until next time.

Yours, Georg Isbaner


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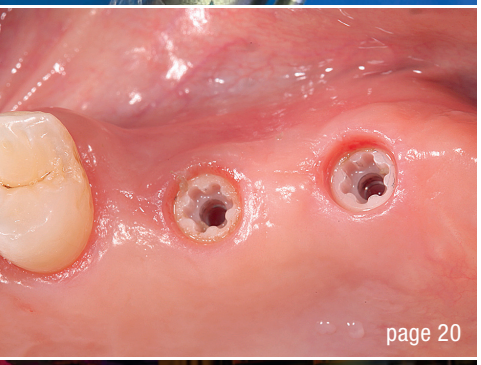
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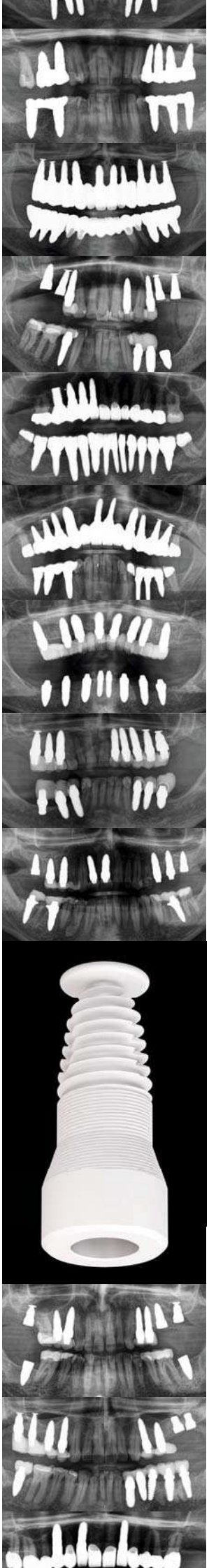

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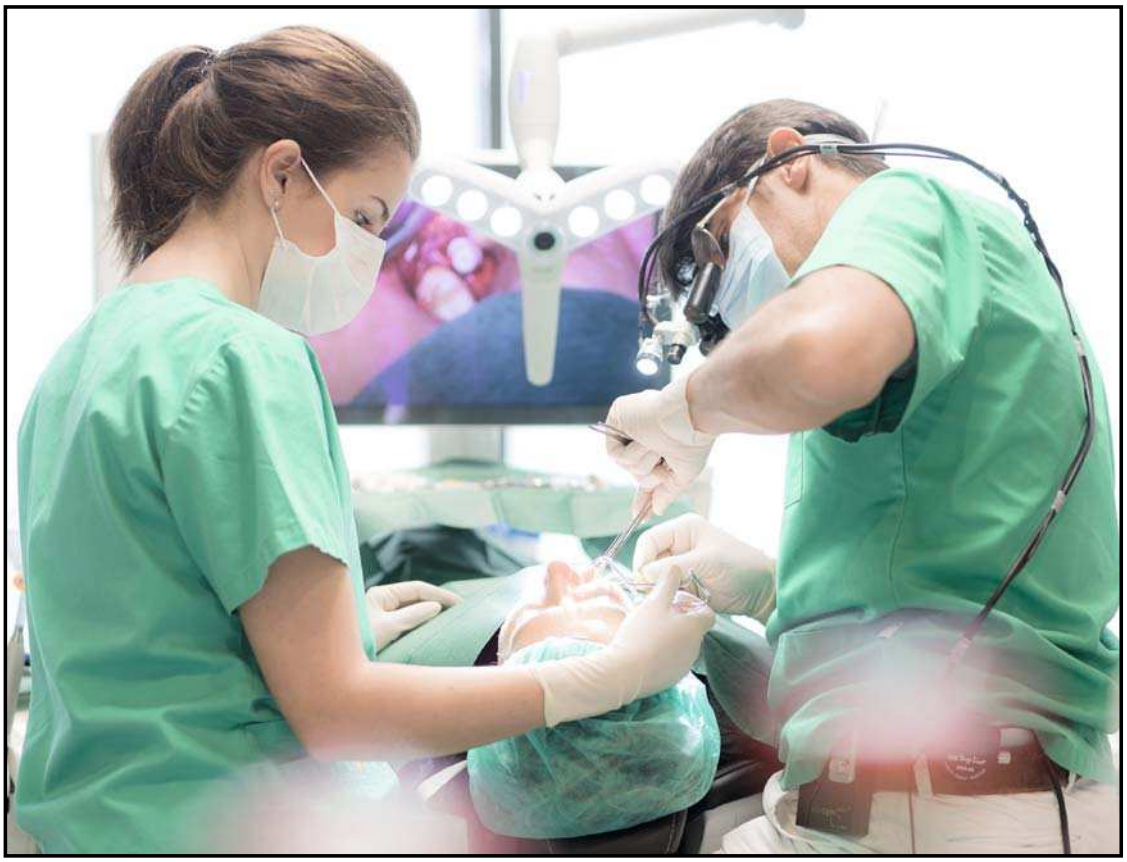

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Patient preference and knowledge of ceramic implants

Dr Michael Gahlert, Prof. Heinz Kniha, Prof. Henriette Wölfler, Germany;
Prof. Claude Jaquiéry & Dr Stefan Röhling, Switzerland

This investigation aimed to gather information from two dental patient populations on preferences regarding ceramic or metallic implants, and the factors that influence those preferences. Patients at dental centres in Switzerland and Germany received a 22-point questionnaire on knowledge of and preferences for implant materials. Patient demographic information was also gathered and used as the reference basis for multivariate logistic regression models. Subsequent steps considered knowledge of implant materials and acceptance of statements on strength, preference and allergenicity of implants. Four main questions were considered regarding preference of material and willingness to accept treatment costs. The overall response rate was 45.3 per cent. Age and gender had little effect on choice of implant material, but patients who viewed ceramic implants more positively (e.g. regarding strength and aesthetics) were more likely to prefer such an implant. Patients with higher incomes and greater education level were more likely to accept higher treatment costs for ceramic implants.

Introduction

The use of ceramic materials for restorative purposes in dentistry dates back to the early 1900s; however, dental implants made from ceramic materials are a relatively new phenomenon (i.e. in the last 40 years). The unsatisfactory biomechanical performance of early aluminium oxide implants led to the modern wave of zirconia (zirconium dioxide, ZrO_2) ceramic implants, with promising osseointegration, biomechanical strength and clinical outcomes.[1–8]

Development has particularly been driven by increasing patient requests for metal-free restorations and more demanding aesthetic standards.[1] Despite this, however, there is very little information on patient opinions and knowledge of ceramic implants, and patient questionnaires regarding ceramic implants in the literature are limited to outcome measurements or satisfaction,[9, 10] or include only a small number of participants.[11] The aim of this investigation, therefore, was to survey patients at two clinical centres on their knowledge and opinions regarding ceramic dental implants and to determine the social and demographic factors that may affect their preferences and decisions regarding such implants.

Materials and methods

A questionnaire was administered to 300 patients in Basel, Switzerland, and Munich, Germany, respectively, between June 2012 and April 2013. Participating patients had either recently received or were due to undergo dental implant treatment at one of two centres: the Clinic for Oral and Cranio-Maxillofacial Surgery at the University Hospital Basel or at Praxis Drs Kniha and Gahlert, a private practice in Munich. The questionnaire, completed by the patients themselves, consisted of 22 main questions that were broken down into detailed sub-questions, covering existing dental prostheses, how the patients had obtained their information on dental implants and the importance of such information, knowledge about different implant materials, aesthetic considerations, and treatment considerations. In addition, important information on socio-demographic factors was gathered, that is age, gender, level of education and monthly household net income. These socio-demographic factors were used as the reference categories for the logistic regression models.

The statistical analysis was based on a heuristic model in which these socio-demographic factors were considered using multivariate logistic regression models in the first step. In these, the probability that a particular statement would be accepted was divided by the probability that the statement would not be accepted (P (X = 1) / 1-(P (X = 1)) = odds ratio) as a linear function of demographic characteristics. The second step also considered knowledge about implant materials, and the third step considered the acceptance of certain statements, such as:

1. "ceramic implants have a longer lifespan than metallic implants";
2. "ceramic implants have higher strength than metallic implants";
3. "ceramic implants are more aesthetic than metallic implants";
4. "I would rather have a ceramic implant than a metallic implant in the body";

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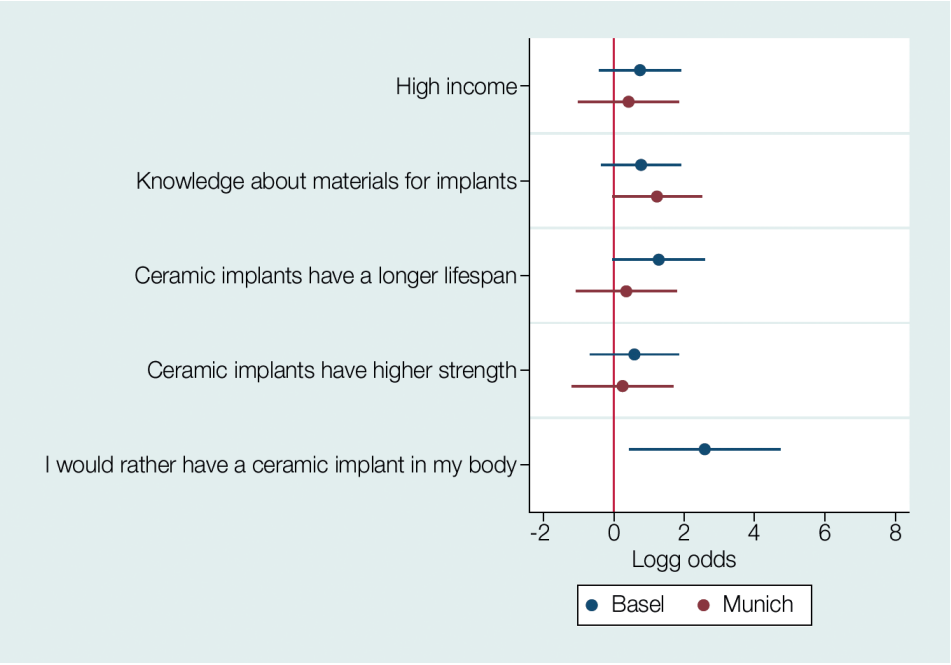

Fig. 1: Estimated odds ratios for the answer *"rather ceramic implant"* to the question *"Would you prefer a ceramic or a metallic implant?"*.

5. "metallic implants can cause allergies"; and
6. "ceramic implants can cause allergies".

For the estimated coefficients of the logistic model, a value of 1 indicated no effect, > 1 indicated a higher probability of agreement than in the reference category, while < 1 indicated a lower probability of agreement than in the reference category.

This short report focuses on the responses to four main questions:

A) Would you prefer a ceramic or a metallic implant?
B) Are you willing to accept higher treatment costs for an implant with a natural tooth colour?
C) Are you willing to accept higher treatment costs for an implant that is not made of metal?
D) Are you willing to accept a longer treatment duration for an implant with a natural tooth colour?

Results

Completed questionnaires were returned by 172 patients in Basel and 100 patients in Munich (response rates of 57.3 % and 33.3 %, respectively; average: 45.3 %). Most patients (70.9 % in Basel and 83.0 % in Munich; average: 77.0 %) already had some form of tooth restoration, mostly crowns and/or previous dental implant treatment. Most also had received some information about dental implants, mainly from their dentist (85.5 % in Basel and 89.3 % in Munich; average: 87.4 %); relatively few had gained information from implant company websites (20.7 % and 25.0 %, respectively) or neutral websites (13.1 % and 28.6 %, respectively).

The analyses were stratified by sex into male (reference category) or female; by age group into 18–39 years, 40–59 years (reference category) or 60–87 years; by education level into primary (minimum mandatory education), secondary (reference category; beyond minimum but not university level) or tertiary (university attendance); and by income level into low, medium (reference category) or high. The income levels in each country were calculated by splitting the range between the minimum and maximum reported incomes into equal thirds.

A) Would you prefer a ceramic or a metallic implant?

Of the patients who wished to have an implant (or additional implant), 29.5 % of patients in Basel would choose a ceramic implant, compared with 14.7 % for a metallic implant. In Munich, the preference was 52.6 % for a ceramic implant versus 1.3 % for a metallic implant. Overall, 38.9 % of patients at both centres would thus choose a ceramic implant, compared with 9.3 % who would choose a metallic implant. The probability of choosing a ceramic implant did not vary significantly between men and women or according to age and income, although there was a slightly greater preference for ceramic implants in 18- to 39-year-old patients in Basel and 60- to 87-year-old patients in Munich, and lower-third income patients in Munich.

Knowledge of dental implant materials showed no significant effect on the results (Fig. 1). The Basel patients who agreed with statements 1 and 2 on longer lifespan and higher strength of ceramic implants, as well as statement 4's preference for a ceramic versus a metallic implant in the body, showed greater probability of choosing a ceramic implant. These effects were not observed in Munich, but Munich patients who agree with statement 5, that metallic implants can cause allergies, were more likely to choose a ceramic implant.

B) Are you willing to accept higher treatment costs for an implant with a natural tooth colour?

Most patients (51.6 % in Basel and 51.7 % in Munich; average: 51.7 %) were prepared to accept higher treatment costs for a tooth-coloured implant. Gender, age, education level and income did not appear to have a significant influence on willingness to accept greater treatment costs for a tooth-coloured implant, although the upper-third income patients in both Basel and Munich showed a slightly greater likelihood, as did Munich patients with a tertiary education. Basel patients with a knowledge of dental implant materials showed a greater likelihood of accepting increased treatment costs for a

tooth-coloured implant. Munich patients who agreed with statement 4, that they would prefer a ceramic implant in their bodies, were more likely to accept higher treatment costs for a tooth-coloured implant, but none of the other statements showed any significant influence for the patients at either centre.

C) Are you willing to accept higher treatment costs for an implant that is not made of metal?

A total of 39.0 % in Basel and 47.1 % in Munich (average: 43.1 %) were prepared to accept higher treatment costs in this case. In both Basel and Munich, patients in the upper-third income group were more likely to accept higher treatment costs for a non-metal implant, but age, gender and education level showed no significant influence. Knowledge of implant materials showed no significant influence, though Basel patients who knew about implant materials were slightly more likely to accept increased treatment costs in this case. None of the statements had a significant influence on the likelihood of accepting higher treatment costs in this case, though a slightly greater likelihood was shown by Munich patients who agreed with statement 5, that metallic implants can cause allergies.

D) Are you willing to accept a longer treatment duration for an implant with a natural tooth colour?

Most patients (65.1 % in Basel and 63.5 % in Munich; average: 64.3 %) were prepared to accept a longer treatment duration. Gender, education and income had no significant effect, but there was a significant age effect in Basel.

Discussion

The results of this survey indicated that patients were generally well informed about different implant materials, and that age and gender had little influence on choice of material. Ceramic implants were viewed as just as strong and stable as metallic implants, if not more so, and were also seen as more aesthetic. Interestingly, the potential of allergies caused by metallic implants was not generally seen as a major concern by the patients in Basel, indicating that most preferences towards ceramic implants were motivated from the perspective of aesthetics. Higher-earning patients were more likely to accept greater treatment costs associated with ceramic implant placement.

To our knowledge, this is the first multicentre survey with reasonable patient numbers to give an indication of the most important perspectives regarding choice and knowledge of dental implant materials from the patients' point of view.

Despite these important strengths, several potential limitations must be acknowledged. It should be noted that the number of questionnaires returned by the patients at the Basel clinic was much greater than those at the Munich clinic. Since the Munich centre is a private practice, the patient population is narrower and tends to consist of those with higher incomes. This introduces a potential bias in the results, not least because these patients are generally less willing to respond to surveys. The Basel centre, however, is part of the university hospital and therefore includes a more heterogeneous patient population. Cultural differences and differences in terms of types of treatment and insurance practices may also have contributed to differences in results between the two centres.

Overall, ceramic implants are viewed as an attractive option for patients, particularly in terms of aesthetics, and they are generally viewed in a positive light regarding strength and lifespan. Interestingly, on average, four times more patients would prefer ceramic over metal implants. Any additional treatment cost associated with treatment using ceramic implants is not viewed as a deterrent to choosing them over metallic implants.

Declaration of conflicting interests: The survey was funded by the Straumann Group.

Literature

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Zirconia dental implants: An overview

Dr Paulo Leme, Brazil

Zirconium dioxide (ZrO_2), or zirconia as it is more commonly known, was discovered in 1789 by the German chemist M. H. Klaproth. This material was introduced into dentistry only a few decades ago. Zirconia became an attractive alternative material in dentistry because of its high aesthetic potential and comparable strength to the conventionally used metals. In the field of implant dentistry, titanium has been the mainstay in implant manufacturing. However, zirconia became a viable option because it possesses superior properties, including a higher tensile strength, compressive strength and modulus of elasticity compared with either titanium alloy or commercially pure titanium (Table 1).

Manufacturing zirconia

The zirconia used in dentistry today is not merely the zirconium dioxide discovered in the eighteenth century. The commercial-grade zirconia has several modifications that enhance its properties. In its pure phase, zirconia has a low shear strength and is very brittle, essentially making it useless as a dental material. The addition of small amounts of aluminium oxide and yttrium oxide increases the modulus of elasticity and helps to stabilise the material. This combination of oxides is mixed in the powder state and placed in a sintering oven to produce a monoclinic crystalline structure, with equally spaced,

Features	Bone	Titanium alloy	Commercially pure titanium	Zirconia
Tensile strength (MPa)	104–121	993	662	1,000
Compressive strength (MPa)	170	970	328	2,000
Modulus of elasticity (GPa)	10.0–15.0	113.8	103.0	200.0

Table 1: Zirconia compared with titanium alloy and commercially pure titanium.

non-overlapping particles (Fig. 1). Although the monoclinic crystal is a strong material, cracks can propagate easily in the structure, making it less desirable for use in a long-term implanted prosthesis.

In order to eliminate this issue, today's zirconia is also put through a process known as hot isostatic pressing (HIP). The high pressure under which the monoclinic zirconia is placed during HIP processing causes condensation of the particles and results in a tetragonal crystalline structure, where the particles appear to overlap (Fig. 2). The significance of this innovation is that it imparts the ability to stop crack propagation. When the surface of HIP-processed zirconia is prepared, any micro-cracks that may result are quickly stabilised as tetragonal particles expand into the monoclinic structure and fill the void. The self-repairing property is also known as the "airbag effect". The additional stability gained by the HIP process has enabled zirconia to be used for multiple medical prosthetic devices, including auditory, finger, hip, and dental prostheses.

Indications and contra-indications

Indications for zirconia implants are as follows:

1. all aesthetic zone cases, especially in those with a scalloped, thin biotype gingival architecture and in critical gingival papillary build-up cases;
2. patients with metal allergies and chronic diseases resulting from them; and
3. as an alternative to titanium dental implants in any intraoral location.

Contra-indications are the following:

1. patients that exhibit a lack of compliance with post-operative instructions;
2. a lack of operator clinical and technical knowledge about implant surgery and prosthetic restorations; and
3. any other general contra-indications to implant rehabilitation with one- or two-piece titanium implants, such as bruxism.

Bone relationship

One-piece implant concept

The one-piece implant allows axial forces to be applied to a solid but flexible structure without attachments, made entirely of one material with no physical interruption and excellent flexural strength. One of the major advantages of the HIP-processed zirconia is its ability to be prepared intraorally, as ceramics do not conduct heat like metal or natural tooth substance. Preparation of the abutment can occur immediately after insertion or after osseointegration and allows what is essentially a custom abutment to be prepared. Unlike one-piece ti-

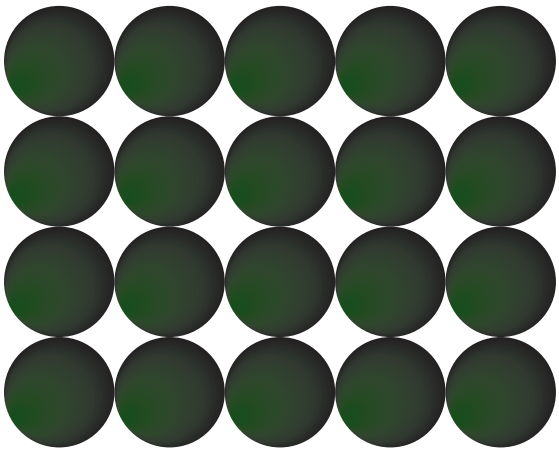


Fig. 1

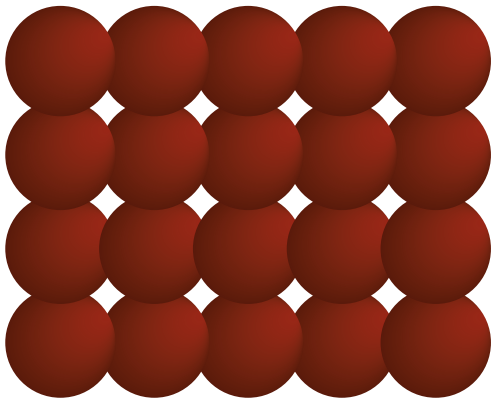
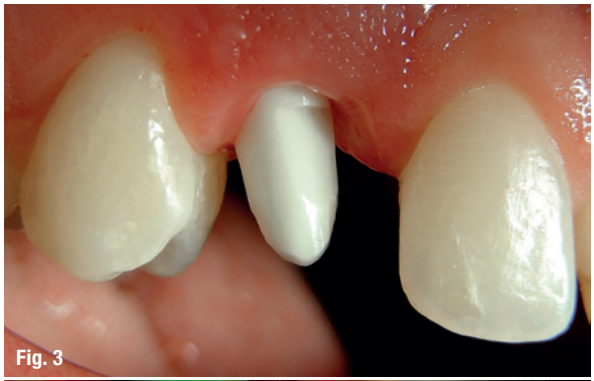


Fig. 2

Fig. 1: Monoclinical crystalline structure. **Fig. 2:** Tetragonal crystalline structure.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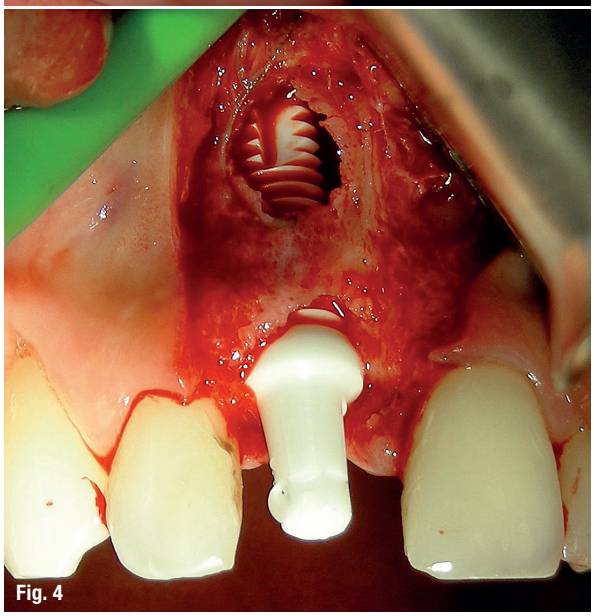
Fig. 4

Fig. 3: Post-op situation showing an optimal result. **Fig. 4:** Situation during a high-risk procedure, implant threads visible.

tanium implants, which were often used for immediate loading procedures and had not provided predictable success, the goal of one-piece zirconia implants is to provide immediate aesthetics. One should also consider the differences in the cost of manufacturing and the environmental implications for one- and two-piece implant systems. The need for more efficient and environmentally friendly industrial operations is critical and the push towards a more economical solution will continue.

Importance of proper planning

Proper implant positioning at the time of insertion is critical to the success of the restoration and aesthetics of the final product. The abutment in a one-piece system can allow for only around 20° to 25° of correction through preparation of the coronal aspect. In order to properly determine the ideal implant location, wax-ups and digital prototypes should be utilised when possible. When proper implant placement is achieved, the abutment will be in such a position that forces transmitted along the long axis will be favourable and the unfavourable loading will be minimised. Forces of the final crown are supposed to be placed on the shoulder of the implant (if possible). Such a relationship can then translate into a good long-term marginal bone level stability and a healthy, durable restoration (Fig. 3).

Tulip-shaped abutment neck

The tulip-shaped neck of the abutment is analogous to the cervical shoulder area of the implant. This area marks the transition between the implant and the abutment. It allows the implant to be inserted at a variable depth to establish the proper emergence profile with optimal gingival contour and enables correction of axial divergence by up to 20 per cent. The design and material of the implant allow vertical placement in bone to vary by up to 1.5 mm. Since zirconia is white, there is little aesthetic risk from not sinking the implant deep enough. If the crestal bone architecture is flat, the implant shoulder does not have to be countersunk.

For aesthetic reasons, such as thickness of mucosa and need for vertical adjustment of the preparation border, or with uneven crestal bone architecture, it is frequently necessary to countersink the implant up to the transition of the implant tulip to a maximum of 1.5 mm. When attempting to place immediate implants in the aesthetic zone, the shoulder or tulip insertion should extend to cover the edge of the extraction socket to achieve greater stability and the same results as with tapered implants. After five years of clinical use and studies, the current recommendation is to try to avoid over-insertion of the shoulder when not needed in non-aesthetic areas, as it may lead to a greater degree of bone loss over time.

Angled abutments

When placing implants in the anterior region, the operator often has a tendency to base the implant angulation off of the future restoration, which can consequently lead to buccal cortex violation. With the implant body at the correct angulation, the restorative components may not be properly angled for a good aesthetic result; often, the abutment protrudes buccally, leaving little room for fabrication of a natural-appearing crown. Two-piece implant systems may use angled abutments to compensate for this discrepancy. In one-piece zirconia implants, the issue is easily addressed by preparation of the abutment aspect to the desired angle, up to a maximum of 20° to 25°. This is possible because the wide implant shoulder, in combination with the large abutment, allows an even force distribution, which minimises bone loss and increases longevity of the restoration.

Soft-tissue relationship

Zirconia surface

The zirconia implant surface is biocompatible with the oral soft tissue. As a ceramic, zirconia inhibits formation of plaque and promotes a healthy soft-tissue attachment.

There has been no evidence of any inflammatory reaction or irritation to the gingiva from the zirconia surface.

Implant shoulder

The implant shoulder may be adjusted to better follow the scalloping of the gingiva to obtain the most aesthetically pleasing results in the anterior region.

Micro-gaps

Eliminating the micro-gap between the implant body and abutment eliminates the possibility of bacterial attachment and inflammation. Without a micro-gap, there is less long-term soft-tissue irritation.

Gingival papillary growth

The gingival soft tissue has been found to have an affinity for the zirconia surface, which leads to excellent aesthetics. Not only can zirconia preserve the existing gingival papillary height, but it has even been observed to induce gingival growth. For papillary build-up cases, zirconia has a distinct advantage over conventional titanium implants. The best results have been shown in cases with a thick and flat gingival biotype, as well as a good emergence profile without violation of the biological width.

Surgical considerations

For the best aesthetic results, one should start soft-tissue contouring at the time of tooth extraction in the case of immediate placement and when the provisional is first made in the case of the conventional protocol. When planning an immediate placement case, a conservative, atraumatic extraction will aid tremendously in maintaining the best gingival architecture. The provisional should have a smooth and well-contoured finishing line to facilitate the best gingival health. Often, the tissue will be inflamed at the time of surgery, especially with immediate implant placement, because of a pre-existing infection in the tooth. Therefore, it is quite common to have what appears to be recession of the tissue during the healing process. As the zirconia surface is biocompatible and does not trap plaque, tissue inflammation will subside in one to two weeks after placement. Flapless surgery is a good alternative to help with soft-tissue maintenance.

Intraoral adjustments

Implant selection

Several factors must be taken into consideration when planning for one-piece zirconia implants. The minimum height required for one-piece zirconia is thought to be 7 mm (Fig. 4). Bone grafting procedures should be undertaken when necessary to achieve this minimum height. If the crestal bone architecture is flat, the implant does not need to be countersunk; however, if the soft-tissue aesthetics dictate that the implant must be countersunk, it may be placed up to 1.5 mm deeper than the last thread. All one-piece zirconia implants should be surrounded by at least 1.5 mm of bone, with 3 mm of bone between two implants. The implant diameter should be based on the tooth being replaced, anticipated occlusal forces and the available space between the roots of adjacent teeth. The minimum distance of the implant shoulder to the adjacent teeth is 0.5 mm, measured from the greatest curvature of the adjacent teeth, keeping in mind that the implant shoulder can be adjusted up to 1.0 mm when necessary.

Abutment preparation

After insertion of the one-piece implant, it may be necessary to prepare the abutment to meet the anatomical demands of the site. Ideally, all biting forces should be directed along the long axis of the implant, but the abutment aspect of the implant may be prepared to compensate for angulations of up to 25°. If available, wax-ups should be used to aid in treatment planning. When adjusting the abutment immediately after implant placement, red ring, ultra-fine-grain (46 µm) diamond burs should be used to a maximum bur speed of 160,000 rpm. A minimum of 50 ml/min of irrigation should be utilised during the procedure, and excessive forces should be minimised on the newly placed implant.

The abutment should only be prepared enough to allow for adaptation of the provisional restoration, as more definitive adjustments will be made after soft-tissue healing. If the shoulder needs to be lowered in the mesial or distal aspects of the site, this should be completed prior to closure of the soft tissue. As the provisional restoration will need to be out of occlusion, the abutment should be a minimum of 1.5 mm below the plane of occlusion, but no less than 3.0 mm in height. After the healing phase and implant osseointegration, the definitive preparation of the implant shoulder can be completed.

Bone–implant contact

One of the key factors in dental implantology is good primary stability. What we considered in our learning curve is that we increased the bone–implant contact by condensing the spongy bone. Depending on the bone, we drilled with the final drill only through the cortical bone and no longer the spongy bone. By inserting the implant at a higher torque (up to 45–50 Ncm), we compressed the spongy bone with the implant and increased the bone–implant contact in the spongy bone. This technique should only be used for the spongy bone.

Ideal emergence profile

Gingival biotype

The thick and flat gingival biotype offers the best overall aesthetic results, including the best coverage of the margin and papillae preservation. The thin and scalloped biotype makes it more challenging to adjust and maintain the best cervical margin. However, using zirconia implants eliminates the problem of the grey gingival shadow as-

sociated with titanium implants. If recession occurs and exposes the crown margin, although less aesthetically pleasing, it will not be as undesirable as with an exposed titanium surface.

Surface characteristics

In a number of clinical studies, zirconia has been shown to have great tissue biocompatibility and long-term stability. When in contact with tissue fluids, the implant surface carries a neutral polarity, which disables bacterial aggregation. This, in combination with the lack of a micro-gap, makes the one-piece zirconia implant a great tool for managing the soft tissue. These characteristics allow for excellent gingival health and even spontaneous growth of soft tissue, which is an advantage for the long-term aesthetics of dental implants.

Bone and soft-tissue level

Just as with any dental implant, the best aesthetics will be achieved when the implant has good bony support on all four walls. Clearly, this is best accomplished with an atraumatic extraction and ideal placement of the implant, but when this is not possible, bone grafting may be necessary. If a significant amount of marginal bone is lost during extraction or there is a vertical discrepancy in ridge height compared with adjacent teeth, an implant restoration will require a longer crown to compensate. This situation should be avoided in the aesthetic zone, particularly in patients with a high smile line. If a one-wall or small-volume defect is present and immediate implant placement is planned for the patient, bone grafting material may be used, which is well-accepted by zirconia implants. For larger defects where a significant volume of bone is missing, a two-stage procedure should be undertaken and implant placement delayed until completion of grafting.

Implant positioning

The ideal emergence profile of an implant will be created by placing the implant in its ideal position. Selecting the proper implant diameter is a vital part of this process. Implant diameters must be properly matched with the size of the interdental space to be restored. Implants must also be placed in their ideal vertical position to achieve proper emergence. For one-piece zirconia implants, there is a range of 1.5 mm in vertical positioning for which ideal aesthetics can be maintained. Necessity of countersinking is situation-specific and depends on operator preference, but in general is necessary when the crestal bone is thin or irregular or soft tissue is very thin. Implants can be countersunk so that the implant neck is partially embedded in crestal bone and the shoulder remains subgingival.

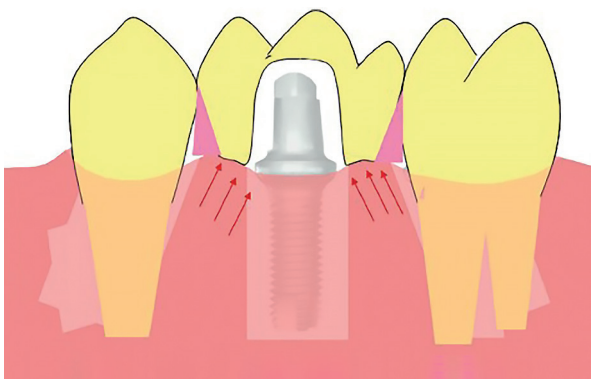

Fig. 5: Illustration of safe 1.5 mm distance from one-piece implant to the interior of an egg-shell provisional during healing process.

Implant preparation

Ideally, implants are prepared after osseointegration and tissue remodelling has been completed. The implant shoulder should be scalloped to match the gingival contour of the tissue and allow for subgingival placement of the crown shoulder. The recommended shoulder design is a chamfer, which can be easily created with a Torpedo ISO 016 bur. The maximum speed of rotary instruments used on zirconia implants is 160,000 rpm with copious irrigation. Other important adjustments include angulation of the abutment portion to match adjacent teeth and creating a common path of insertion for multi-unit prostheses. Narrow neck implants, which are designed without a clear marginal line, may require less or even no intraoral adjustments. When necessary, they can be prepared with the Flame ISO 012 bur for a knife-edge-type shoulder design.

Provisionals

Provisionals should be well adapted and polished so as not to irritate the tissue and hinder the healing process (Fig. 5). Since the implant shoulder will be slightly subgingival, so must the provisional be. It should have good circumferential contact with the shoulder and be wide enough to allow the tissue to heal with the proper contour for emergence and to maintain papillary architecture. The operator should consider changing or rebasing the provisional restoration after approximately three weeks of healing to aid in soft-tissue management. After this time, the tissue will be approaching its final conformation, and additional contouring of the provisional will allow for any necessary adjustments to soft-tissue shape. It is extremely important and necessary, to place no provisionals in any occlusial position during the healing process. Patients must understand and be cooperative avoiding the area during the healing process.

Common mistakes

Incorrect implant positioning

One-piece implants demand accuracy in placement owing to the limited ability to compensate for mistakes compared with two-piece implant systems. It is important to plan properly and use advanced planning techniques such as cone-beam computed tomography, digitally

guided implant placement and surgical guides whenever possible. Improper placement can lead to non-restorable implants, apical exposure, proximity to adjacent roots, or unfavourable forces on the restored implant.

Premature loading

Mastication, cheek pressure and tongue pressure can cause implant micro-movements that may lead to failure in the integration process of the implant. In order to adequately protect the implant, there are a variety of provisional restorations that can be employed, including an Essix appliance, eggshell temporary, re-worked denture, Maryland bridge, posterior adhesive bridge or thermoplastic clasp denture. The success of the implant is highly dependent on adequate protection during the integration period. Therefore, a proper protective device should be fabricated within the first 24 hours. The device should provide 1–1.5 mm of free space circumferentially around the abutment and be out of occlusion during all functional and parafunctional movements. After the osseointegration of the implant and final crown placement, the proper adjustment of occlusion of the final restoration is extremely important, also to avoid fractures.

Improper abutment preparation

Poor abutment preparation may lead to discrepancies in spacing or angulation. If the implant is prepared in such a way that one side of the abutment is trimmed much more than the other, the resulting crown may not be balanced over the implant and deleterious forces may be transmitted.

Incorrect implant width

As with conventional dental implants, the mesiodistal width of the site for implant placement should provide at least 1 mm of bone between the implant and adjacent teeth. In order for the one-piece implants to be placed, including the wider shoulder area, the important area to measure is between the height of curvature of the adjacent teeth. There should be a minimum of 0.5 mm on either side of the implant to allow placement. With less than 0.5 mm of space, aesthetics will be compromised and the patient may have difficulty cleaning the area properly. In addition, ingrowth of papillae may be truncated, which would also negatively impact the aesthetic outcome.

Soft-tissue biotype

For one-piece zirconia implants, one important consideration is that implants should be countersunk in those with a thin and scalloped gingival biotype. The implant shoulder should be inserted into the bone as deep as possible to attain a suitable cervical emergence profile. By misjudging or neglecting to consider the gingival biotype, one may end up excessively grinding the implant shoulder to attempt to place the finishing line in a subgingival location. Often the result is an unaesthetic supragingival finishing line and poor papillary ingrowth.

Summary

Clinical benefits of one-piece zirconia implant systems are as follows:

1. single-stage procedure;
2. decreased chair time;
3. less-complex armamentarium;
4. elimination of laboratory time for abutment fabrication, and no need for healing abutments, screws, analogues or transfer copings;
5. no internal screws, no internal gaps, no micro-gaps, fewer locations for hardware failures;
6. excellent soft-tissue integration;
7. less consequences from gingival recession;
8. no grey gingival show-through;
9. flexural strength;
10. improved gingival health;
11. force distribution; and
12. no metal parts.

Clinical disadvantages of one-piece zirconia implant systems are the following:

1. implant must be protected during healing;
2. less ability to compensate for incorrect implant angulation;
3. necessity for a good patient compliance; and
4. healing process may last from three to six months, depending on bone quality.

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PEEK-based restoration for monotype zirconia implants

Dr Saurabh Gupta, India & Dr Sammy Noumbissi, USA

Introduction

For more than 40 years, the most commonly used dental implants have been commercially pure titanium and titanium alloy implants, and these are still considered to be the best and most reliable in the field of implant dentistry.[1]

The current demands in dentistry for components with no metal alloys, along with the rise in reports of allergies and sensitivity of several patients, have resulted in the development and application of new materials. A good example of non-metal implants is zirconia implants, also known as zirconium oxide implants.[2,3] Their biocompatibility and astonishing mechanical properties make them suitable for several situations.

Zirconia implants are considered to be one of the newest and most exciting developments in dental implantology. Multiple studies have shown that zirconia implants induce little to no peri-implant tissue inflammation and allow for high levels of epithelial attachment. Additionally, these implants are more natural-looking, hence, they provide improved aesthetics. Furthermore, they do not have metal components, which makes them ideal for people with metal sensitivities and patients who prefer their implants to be metal-free.

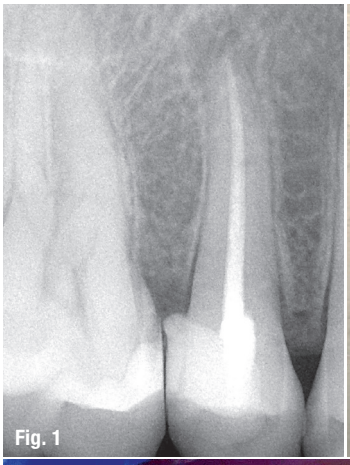
However, zirconia implants lack the flexural strength of metal alloys, and using zirconia or ceramic crowns to restore zirconia implants can potentially lead to complications, such as excessive forces being transmitted to the peri-implant bone or even implant and/or prosthetic failure.

Avoiding underlying bone overload from direct spread of functional forces is important and has thus resulted in the development of materials with the ability to absorb forces. One proposed prosthetic option is the combined utilisation of a composite bonded to a PEEK restoration on zirconia implants not only because of the biocompatibility, but also owing to its mechanical and physical properties.[4,5]

In this clinical report, we propose a solution that could help avoid complications and mitigate the reduced flexural strength of ceramic implants when restored with novel, more elastic prosthetic materials.

Case presentation

A 28-year-old female patient, a non-smoker with no contributing medical history, presented to our practice with a complaint of pain in her right maxillary second premolar. According to her, the pain was intense and the worst when chewing or simply on occlusion. The clinical examination disclosed that there was a periapical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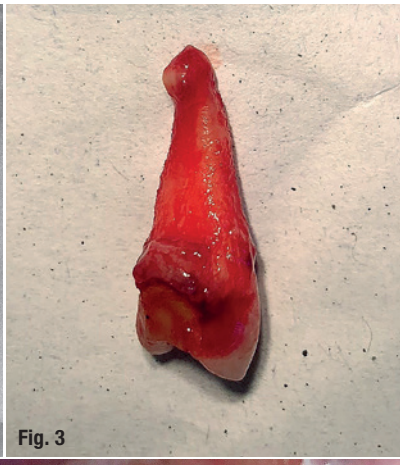
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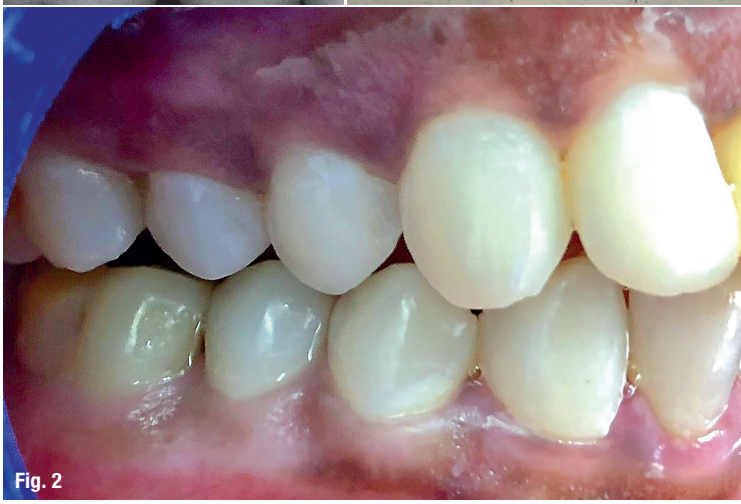
Fig. 2

Fig. 1: Pre-op radiograph. **Fig. 2:** Pre-op clinical photograph. **Fig. 3:** Extracted tooth #15.

pathology above the endodontically failed tooth #15, which was confirmed through a radiographic examination showing a well-defined radiolucency bound by a thin radiopaque line (Figs. 1 & 2).

The patient insisted on the removal of the tooth and was apprehensive about metal implants and crowns, and thus requested an option other than a titanium implant. The extraction of tooth #15 followed by the immediate placement of a zirconia implant (ZiBone, COHO Biomedical) was recommended, along with a composite-bonded-to-PEEK restoration. PEEK-based restorations for dental implant prostheses have the ability to dampen occlusal forces, thus dissipating and cushioning occlusal forces transmitted to the implant and bone during function. The patient accepted the proposed treatment and signed the informed consent agreement.

Tooth extraction was performed as atraumatically as possible (Fig. 3). Curettage and in-depth debridement were also completed while preserving soft-tissue integrity around the extraction socket (Fig. 4). In the next step, the osteotomy was performed as indicated by the implant manufacturer and under profuse irrigation. A ZiBone implant of 4.1 mm in diameter and 13.0 mm in length was inserted into the prepared osteotomy at a speed of 700 rpm and a torque of 35 Ncm (Figs. 5–7).

Fifteen days postsurgery, radiographic and clinical evaluation disclosed the soft-tissue appearance was excellent, without signs of inflammation (Figs. 8 & 9). The patient reported no bleeding, absence of pain and minimal swelling at that time.

Four months postoperatively, no adjustments were made to the implant abutment (Fig. 10). Contouring of the soft tissue and exposure of the restorative margins were performed using a diode laser especially suitable for soft tissue (Epic, BIOLASE). A temporary acrylic crown was installed for a period of two weeks to achieve a proper emergence profile and soft-tissue anatomy (Figs. 11 & 12). The final impression was made using a polyether material (Impregum, 3M ESPE) after placement of retraction cords of size #00 (Ultrapak, Ultradent Products). The final restoration was then produced with the use of a PEEK coping and bonded composite overlay

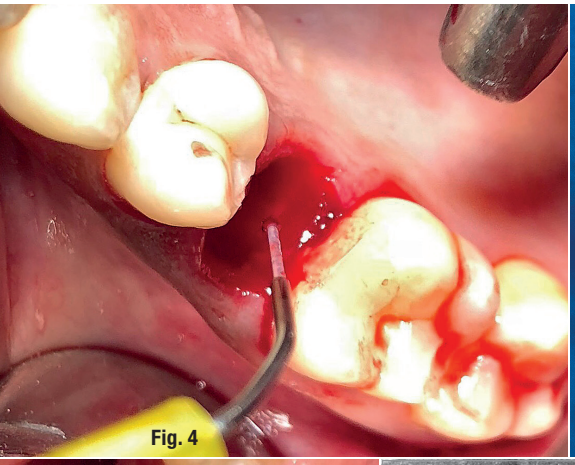
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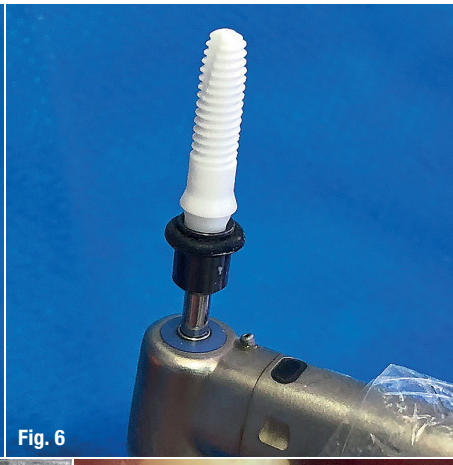
Fig. 5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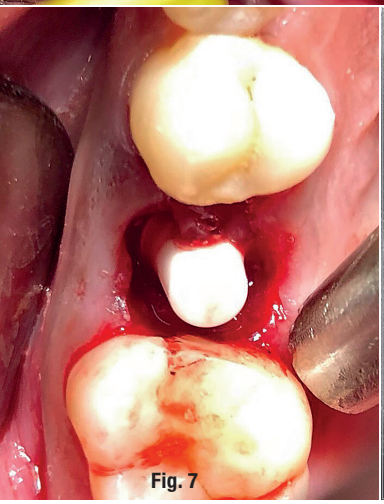
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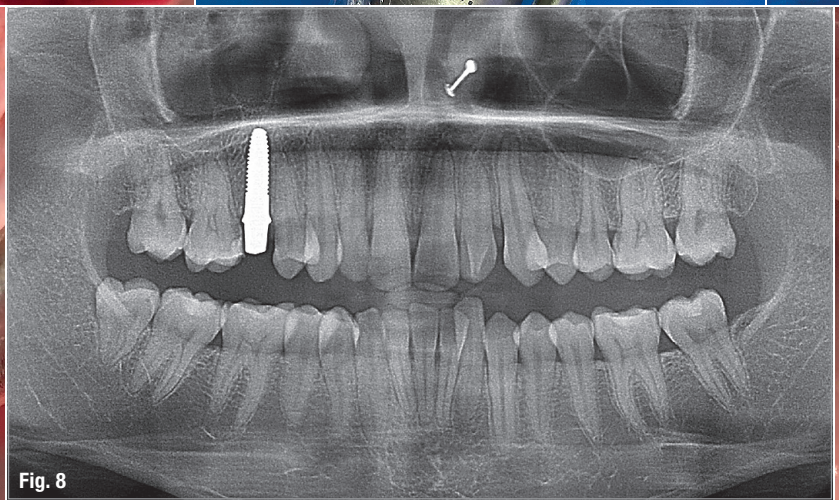
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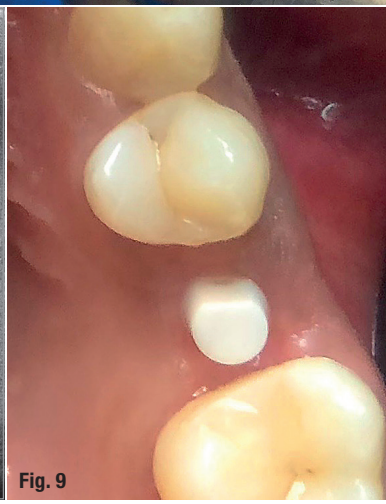
Fig. 9

Fig. 4: Curettage performed with laser. **Fig. 5:** ZiBone drilling bur. **Fig. 6:** ZiBone implant before placement. **Fig. 7:** ZiBone implant *in situ*. **Fig. 8:** Dental panoramic tomogram after implant placement. **Fig. 9:** Post-op situation after two weeks.

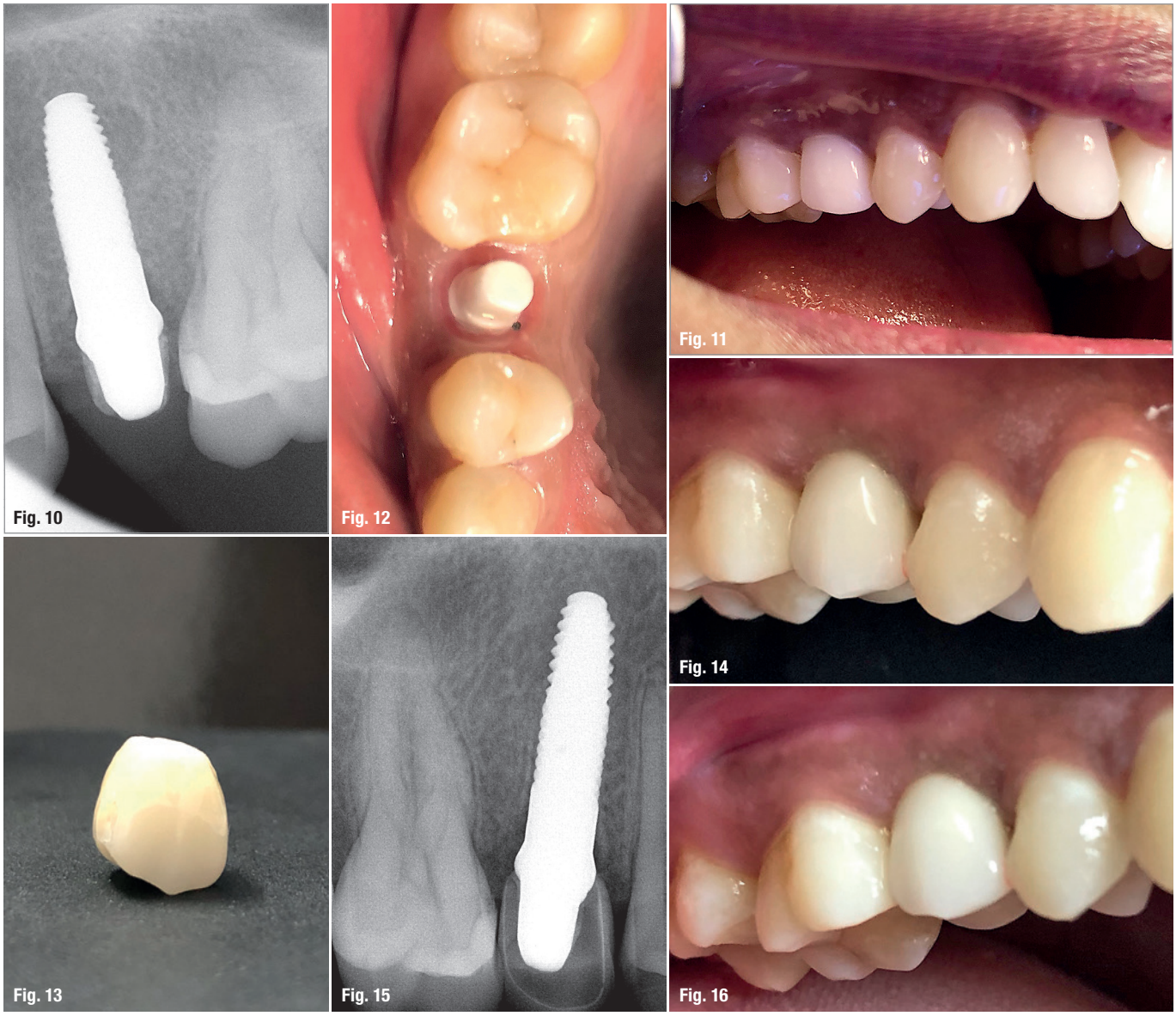

Fig. 10: Four-month post-op radiograph. **Fig. 11:** Temporary acrylic crown *in situ*. **Fig. 12:** Emergence profile. **Fig. 13:** PEEK-based crown with composite veneering. **Fig. 14:** Placement of final crown. **Fig. 15:** Post-op radiograph taken at the one-year follow-up. **Fig. 16:** Clinical situation one year post-op.

(Figs. 13 & 14). A resin-modified glass ionomer cement was used for bonding the crown to the implant.

A radiographic and clinical review were done one year after the first surgery, disclosing a successful procedure based on Albrektsson et al.'s criteria[6], as well as a natural characteristic of the soft tissue surrounding the restoration performed (Figs. 15 & 16).

Discussion

Intraoral factors such as salivary pH, plaque microbiota, diet and fluoride combine to create a harsh environment that poses challenges to metal implants. This is manifested by corrosive attack, which also contributes to metal ion release into the peri-implant tissue and peripheral organs.[7,8]

In recent years, numerous implant manufacturers and investigators have evaluated soft- and hard-tissue behaviour around zirconia implants. Their biocompatibility characteristics, along with their osseointegration being comparable to that of conventional implants, make zirconia implants a better option for dental clinical use.[9–12]

Numerous studies have found that zirconia-based implants present the same healing pattern as titanium-based implants, regarding both the stability of marginal bone and the healing time.[12,13] A recent University of California, Los Angeles, study showed also that osseointegration of the nano-surfaced zirconia-based implants used was higher compared with that of titanium-based products.[14] Other significant factors for consideration include implant–abutment–crown assem-

bly, the restorative material composition and occlusal load transmission by antagonist teeth.[13]

When it comes to the load cushioning capacity of prosthetic elements, using PEEK as prosthetic construction on the implants has improved this recently.[15] PEEK is a thermoplastic high-density polymer with an aromatic linear semi-crystalline construction that has excellent chemical and physical properties regarding elasticity, toughness and hardness. Further, it has a low molecular weight and contains no metal, which makes it an excellent material for biocompatible prostheses. PEEK also has a low Young's modulus of 4 GPa in comparison to other conventional components like titanium with a modulus of 110 GPa or zirconium dioxide with 210 GPa.[16, 17]

Additionally, the bending resistance of metal–ceramic restorations lies between 400 and 600 MPa, in distinction to other composite coatings with a Vickers hardness of around 400 MPa and a 314 MPa bending capacity.[18, 19] Equally, zirconia proves to be three times harder (1,200 HV) and it has a bending resistance of 1,400 MPa. All together, these features prove that using high-rigidity materials results in the direct transmission of masticatory forces to zirconia implants. This probable overload could lead to resorption of bone surrounding the implants, which is referred to as the stress shielding effect and occasionally results in potential implant fracture. There are claims that this connection only exists in cases accompanied by a preceding inflammatory situation of infectious source, wherein bone loss would accelerate.

To prevent going beyond the bone's adaptive limits and to maintain proper mechanical stress stimulation, PEEK components appear to be a workable substitute for gaining a Young's modulus similar to that of cortical bone. This way, bone may be adequately stimulated to allow remodelling instead of resorption. It would focus the load through absorption and distribution. Its load absorption capacity has resulted in its recommendation for people suffering from severe bruxism.[18, 19]

Restricted element study suggests that contact pressure of a maximum level at the titanium implant edge can be expressively reduced with the use of a PEEK-based crown instead of an all-ceramic crown.[20–27] Additionally regarding PEEK, new composite materials or PMMA-based coatings, which integrate ceramic fillings, have been developed, and because of their molecular structure, these new materials have exceptional homogeneity and density. The integrated micro-filling in a polymer matrix increases abrasion resistance while providing optimal elasticity resembling the natural tooth structure.[25, 26] Though these restorations display good colour and shade stability, brightness and texture, they differ considerably from the ceramic coatings, which in contrast have exceptional optical properties, enabling them to accomplish better long-term aesthetics.[27, 28]

Conclusion

Using a PEEK-based restoration on a zirconia implant was found to be a good substitute for an all-ceramic crown. This restoration delivers exceptional elasticity and resembles the natural appearance of tooth structure. The biocompatibility and biostability make PEEK a promising material for tooth replacement. PEEK-based restorations are an effective alternative approach when zirconia implants are to be used because of the Young's modulus and cushioning effect, absorbing occlusal forces and wearing like natural teeth, which in turn could improve and eventually maintain osseointegration.

The clinical case thus suggests that PEEK-based restorations are a restorative option for zirconia implants when there is concern regarding excessive forces being applied and transmitted to the implant and the peri-implant hard tissue. Within the limitations of this clinical evaluation, we endorse the use of zirconia implants restored with a combination of a PMMA coating and PEEK coping. However, further and large-scale investigations are necessary to firmly establish this technique as a reliable and predictable option for restoration of ceramic implants.

Literature

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Elimination of a free-end gap in the maxilla

Application of zirconium dioxide implants

Dr Detlef Hildebrand, Germany

Patient demand for metal-free implant solutions is constantly increasing. While titanium implants are biocompatible and well tolerated, some studies have shown a presence of titanium oxide loads in the body after implantation.[1,2] Inflammatory reactions of varying severity, depending on genetic susceptibility, have been detected in some patients.[3] In comparison, fewer cases of such reactions were observed for zirconium dioxide particles. A further advantage of zirconium dioxide implants is their good tissue compatibility. In the following article, a patient case is presented in which two-piece zirconium dioxide implants were integrated into a free-end gap in the maxilla.

Ceramic implants have been on the market for many years. Their share in the total dental implant market has, however, remained modest, owing to experiences made in the 1980s and 1990s with fractured ceramics—especially with one-piece aluminium dioxide implants, the so-called Tübingen and Munich immediate implants—and owing to the lack of scientifically based data at that time.[4]

Extensive materials research over the past several years has resulted in a newer generation of yttria-stabilised tetragonal zirconium dioxide, defining the new industry standard. Its advantages include its applicability in crown and bridge technology and as an abutment material. As the material's stability for implants thus no longer poses a challenge, the focus has turned to the internal surface quality of zirconium dioxide, which was identified as a potential source of osseointegration issues, and to a reversible screw-retained two-piece implant.

Newer, high-tech manufacturing processes, such as injection moulding, aiming to achieve a surface structure for zirconium dioxide implants that is well tolerated in bone, are now considerably increasing confidence in this technology.[5] If one interprets the current developments correctly, owing to these new materials, we will soon be able to offer long-term implant treatment and stability for patients with special, partly medically justified needs.

Examination and treatment planning

A 38-year-old female patient came to our practice with a free-end gap in the second quadrant. As the rest of the

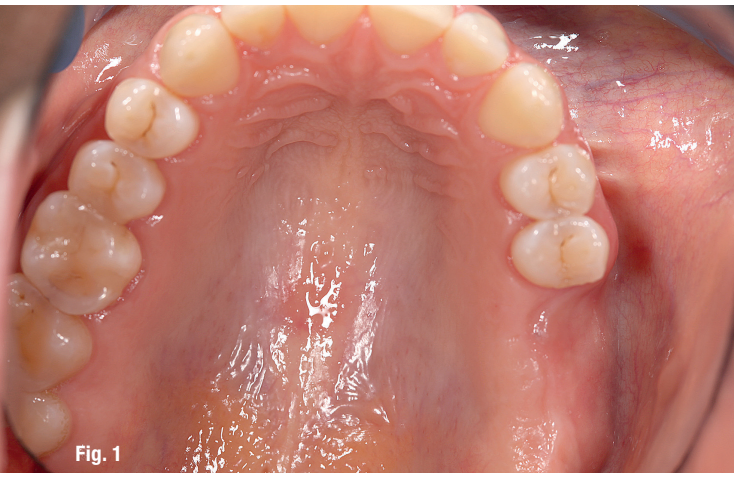


Fig. 1

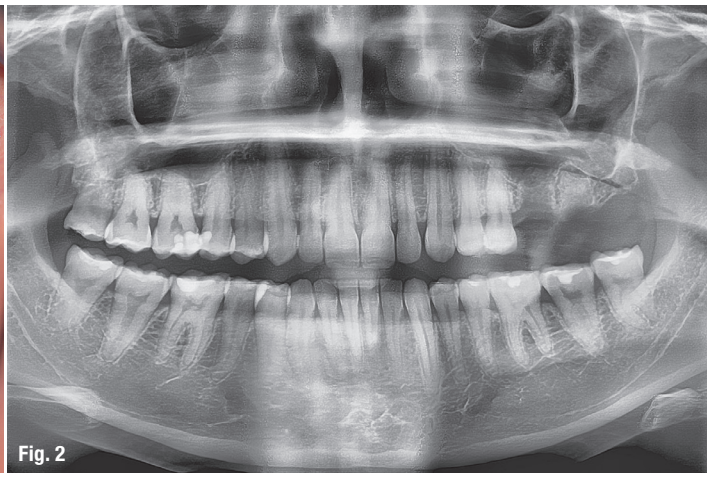


Fig. 2

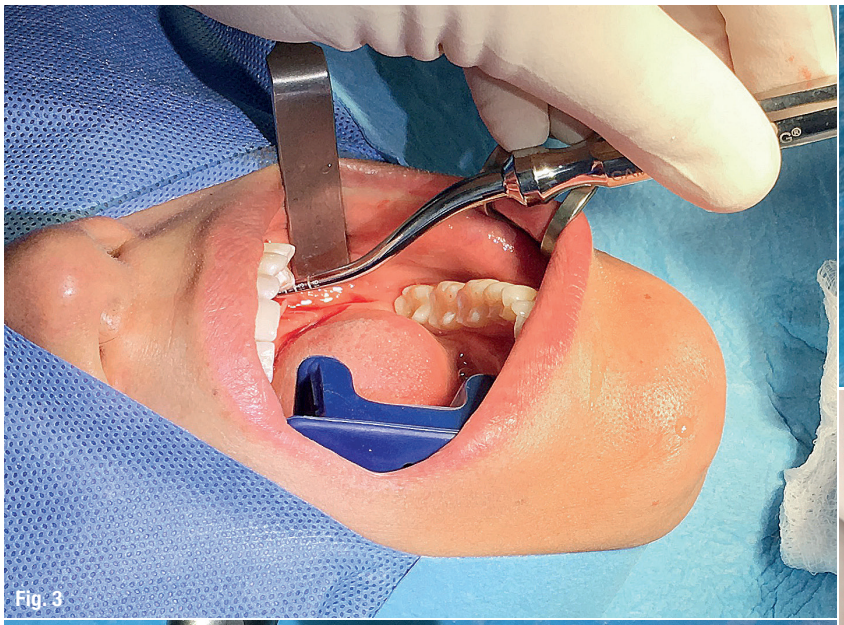
Fig. 1: Initial situation: free-end gap in the left maxilla (teeth #26–28 were missing). **Fig. 2:** The radiograph demonstrated sufficient bone height in the maxillary sinus area for insertion of two implants.

teeth were completely intact, she desired a fixed, metal-free restoration to replace the two missing molars. After in-depth consultation regarding implant treatments, including advising her of the limited documentation regarding research on zirconium dioxide implants, restoration with two-piece implants (CERALOG Hexalobe, CAMLOG) was planned. The radiograph showed sufficient alveolar bone height to insert two 10 mm implants without having to lift the sinus floor (Figs. 1 & 2).

Implant bed preparation by bone condensation

After ridge incision and preparation of a mucoperiosteal flap, the implant position was marked with a round bur. A pilot drill (2 mm) was used to position the implant axis to an approximate depth of 6 mm, and the implant position was checked with a paralleling pin. As the bone quality in the distal maxilla proved to be very soft, the bone site was prepared using osteotomes, thus achieving primary stability by condensing the bone. An additional advantage of using osteotomes was that the Schneiderian membrane was not penetrated, which might otherwise have occurred when carelessly operating with burs. The implant sites were prepared with osteotomes according to the implant diameter of 4 mm. As one implant was to be placed in almost epi-crestal position, the implant bed was drilled to the complete implant length of 11.5 mm in this case (Fig. 3).

After preparation of the implant sites had been completed, the implants were removed from the sterile packaging with the insertion tool and prepared for insertion (Figs. 4 & 5).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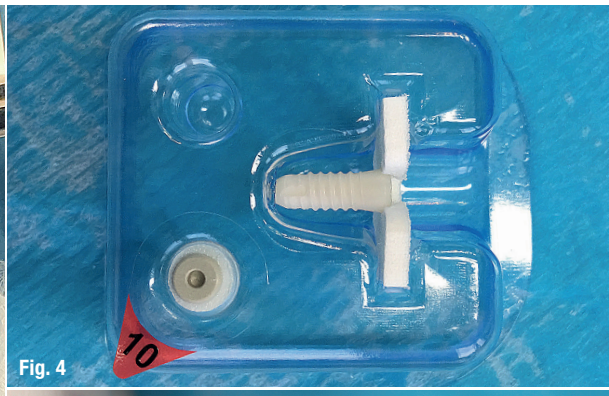

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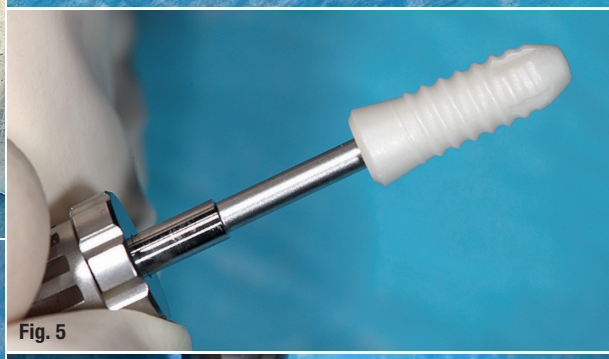
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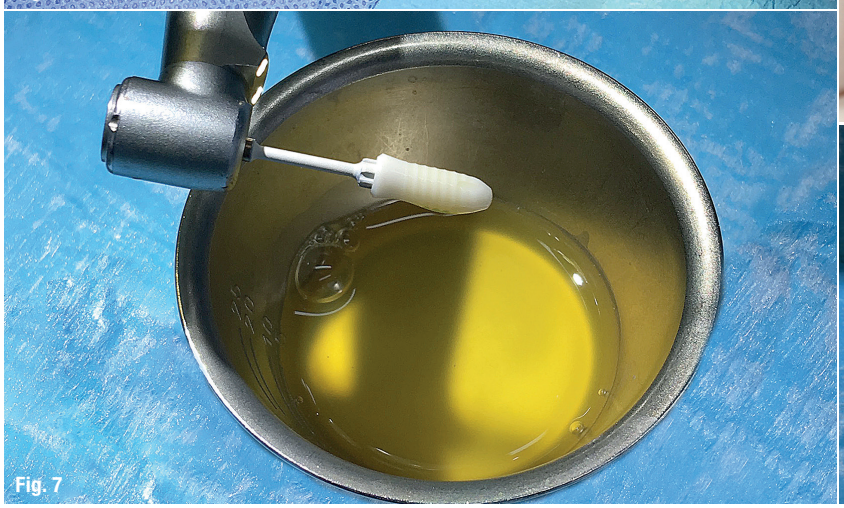
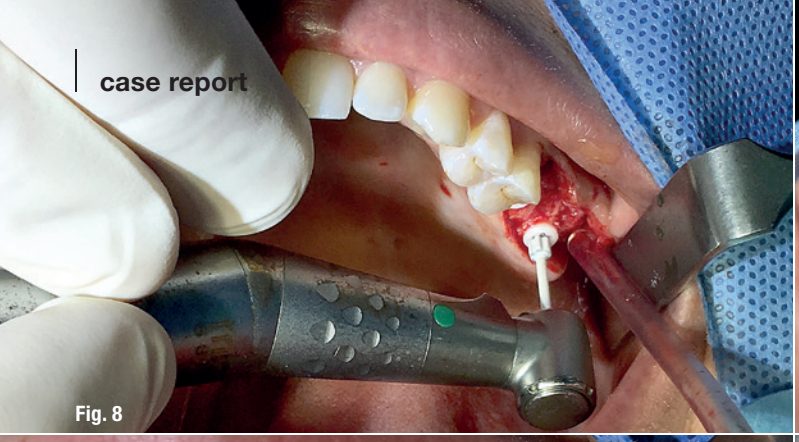


Fig. 7

Fig. 3: The bone site was prepared with osteotomes in order to condense the soft bone in the distal maxilla. **Fig. 4:** An implant in its sterile packaging. **Fig. 5:** The insertion tool connected to the interior of the all-ceramic implant. **Fig. 6:** The mechanical option for implant insertion. **Fig. 7:** Before insertion, the implants were wet with growth-promoting PRGF liquid.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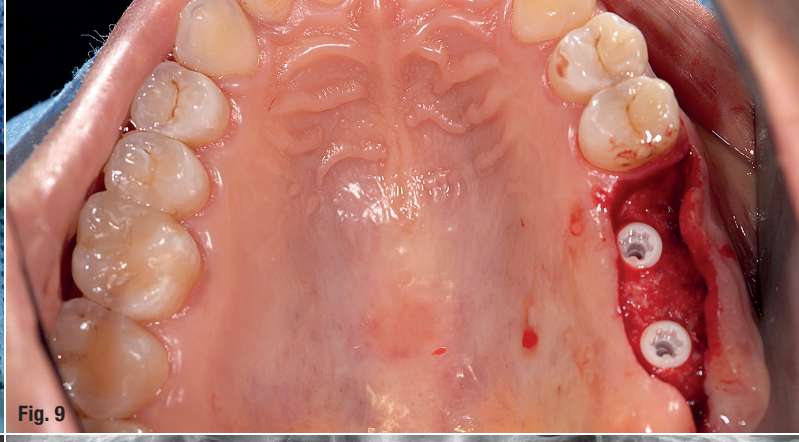
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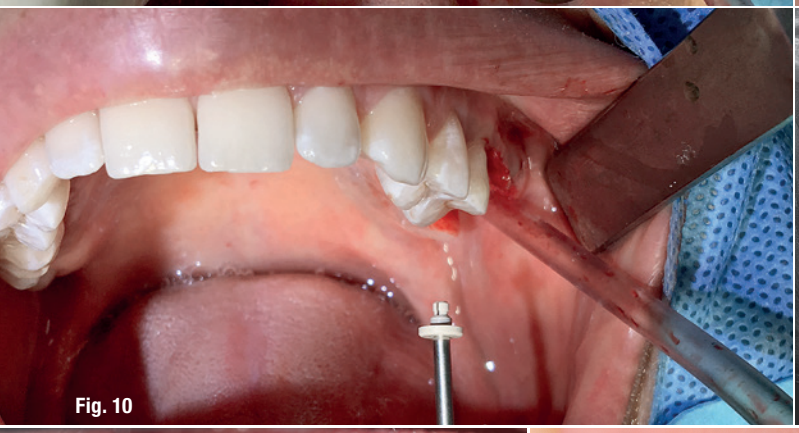
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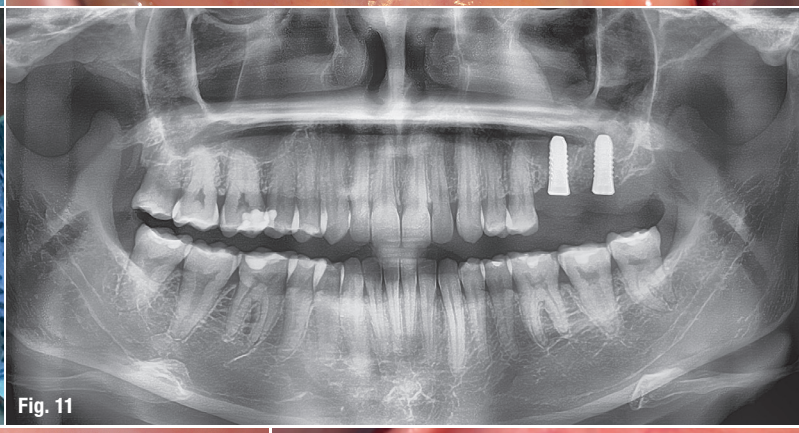
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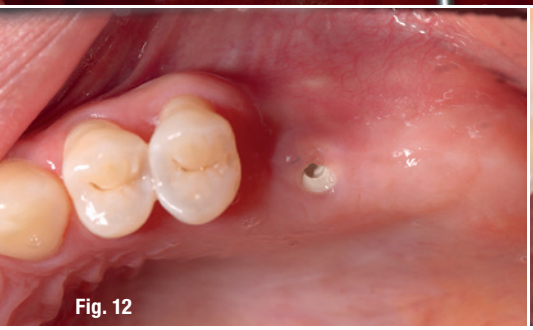


Fig. 12

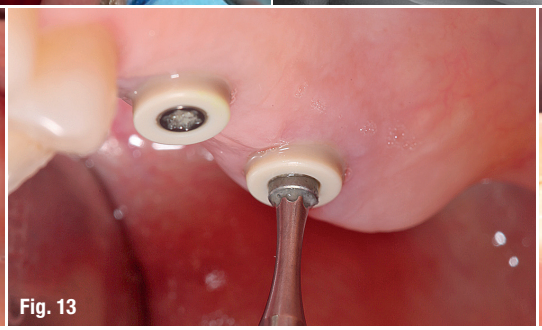


Fig. 13

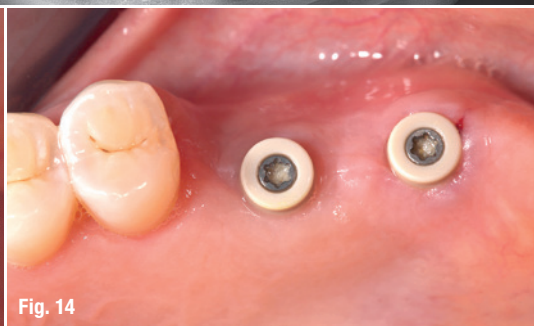


Fig. 14

Fig. 8: Too great an insertion torque must be avoided when inserting zirconium dioxide implants. **Fig. 9:** The correctly positioned and stable implants prior to wound closure. **Fig. 10:** The implants were sealed with the healing caps. **Fig. 11:** The post-op radiograph showed the position of both implants in regions #26 and 27. **Fig. 12:** At the time of implant uncovering, the implant in region #26 was already partially exposed. **Fig. 13:** Gingiva formers were inserted to shape the soft tissue. **Fig. 14:** Occlusal view of the two gingiva formers directly after the implant uncovering surgery.

Epicrestal implant positioning

Prior to inserting the implant, the surface was wet with the bone-activating cells of the PRGF (plasma rich in growth factors) liquid. At the author's practice, the innovative PRGF procedure, which uses the patient's own growth factors to accelerate the healing process and to reduce complaints and the risk of complications, is applied in all implantations, independent of the material characteristics (Figs. 6 & 7).

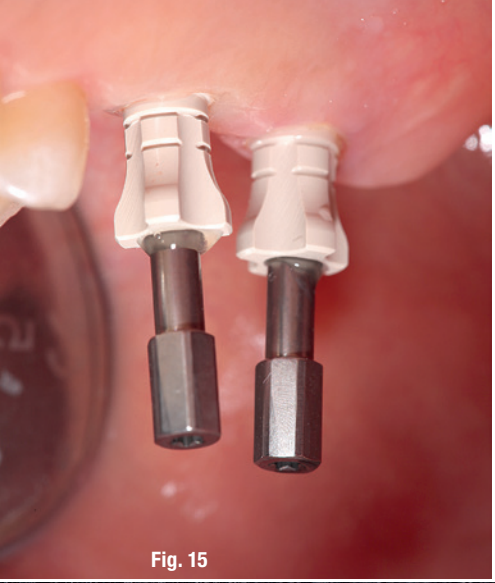
As zirconium dioxide is a poor heat conductor, it is important to insert zirconium dioxide implants slowly and without pressure. The implantation was carried out at a defined maximum torque of 35 Ncm and 15 rpm. The implants were positioned minimally supracrestally, placing the implant shoulder approximately 0.5 mm above the alveolar bone (Figs. 8 & 9).

The healing caps were clicked into the implant interface as protection from the ingrowth of bone and soft tissue. The mucoperiosteal flap was repositioned tension-free and sutured over the healing cap in order to prevent saliva entering. Subsequently, a control radiograph was taken (Figs. 10 & 11).

Regions #26 and 27 being in the non-visible area of the maxilla, it was decided not to place an interim restoration in order to protect the implants. The healing of both implants occurred without complaints. The patient did not show any atypical symptoms. The healing duration of ceramic implants is still a topic of discussion. In comparison with titanium implants, however, longer healing periods are suggested.

Minimally invasive uncovering

The implants were uncovered after 14 weeks. In addition to physical and visual examination, a radiograph was taken to control implant healing. Owing to soft-tissue resorption, the healing cap of the implant in region #26 had become partially exposed (Fig. 12).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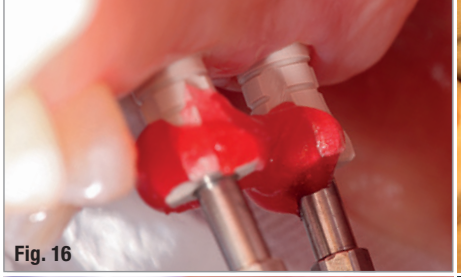
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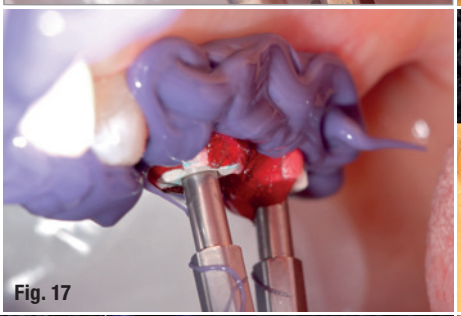
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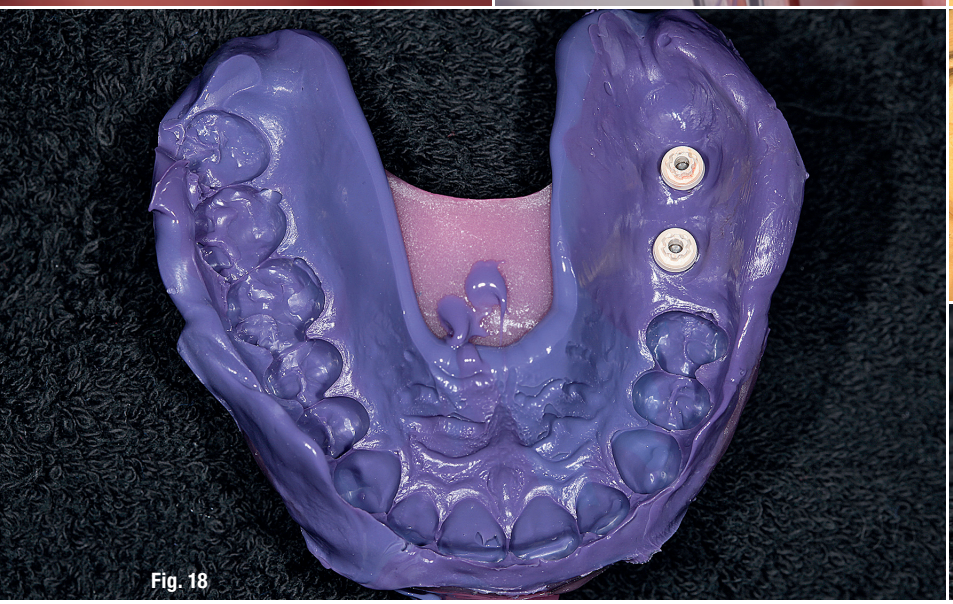
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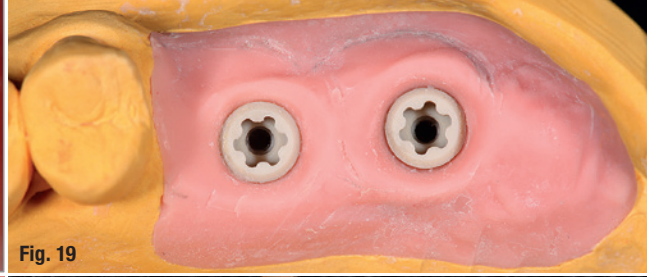
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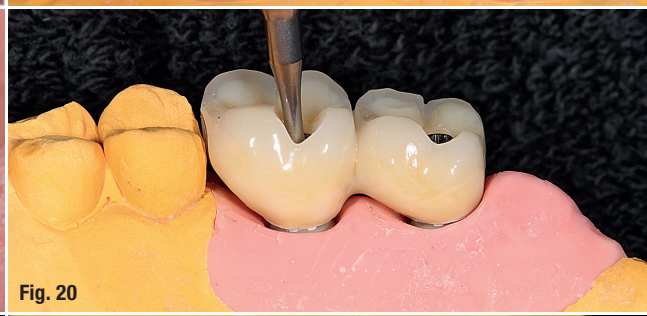


Fig. 20


Fig. 21


Fig. 22

Fig. 15: Posts for the open-tray technique were chosen for impression taking. **Fig. 16:** The impression posts were intraorally splinted with pattern resin to ensure the accurate transfer of the implant positions. **Fig. 17:** The screw length of the impression posts enabled easy intraoral uncoupling. **Fig. 18:** The impression taken of both implants using the open-tray technique and precision impression material. **Fig. 19:** The master model with the removable gingival mask. The shape of the soft tissue is clearly discernible. **Fig. 20:** The milled, interlocked crowns were glued to the PEKK abutments. **Fig. 21:** The accurately positioned screw access channels. **Fig. 22:** The accurate transition of the crowns to the PEKK abutments.

The implant uncovering was performed in a minimally invasive manner, without using the flap technique. Access to the healing caps was obtained via stab incision. They were then removed and 2.5 mm high gingiva formers were inserted to shape the peri-implant soft tissue (Figs. 13 & 14).

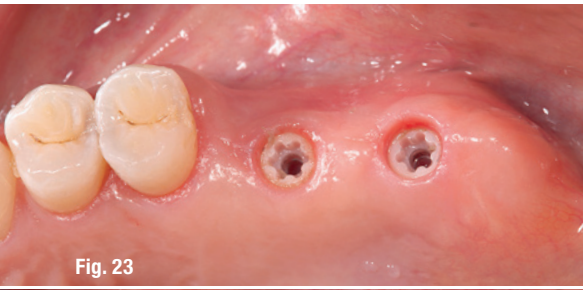
Only one week after implant uncovering and mucosal healing, impressions were taken using impression posts for the open-tray technique. According to the Berlin concept, connecting the impression posts is recommended in cases of planned prosthetic splinting with several implants located next to one another. Pattern resin (GC) was used for splinting during impression taking in order to avoid any transfer errors (Figs. 15 & 16).

In the subsequent workflow, a conventional impression taking method with an individual tray was selected. This procedure guarantees highly precise transfer of the implant positions to the dental laboratory. This highly precise impression technique may be time-consuming to perform, but it guarantees reliable, results-oriented further processing in the laboratory, ensuring the quality required for CAD/CAM processing technology (Figs. 17 & 18).

Prosthetic reconstruction

The exact transfer of the position of the implants and the surrounding soft tissue is absolutely paramount when creating a model in the laboratory. After the laboratory analogues had been unscrewed, the material for the detachable gingival mask was injected and after it had cured the impression was cast in plaster (Fig. 19).

The master model of the maxilla and the opposing model of the mandible were mounted in the articulator using a facebow and a bite register, and both PEKK abutments were shortened according to the occlusion. The crowns should be interlocked and screwed in directly. The situation was scanned, and the crowns digitally designed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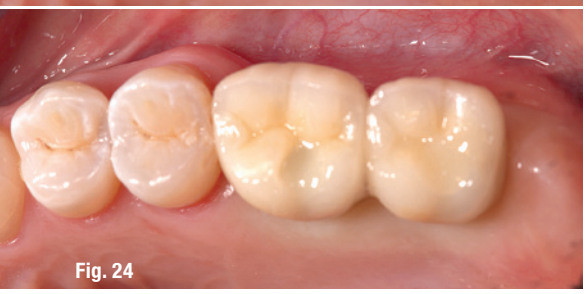
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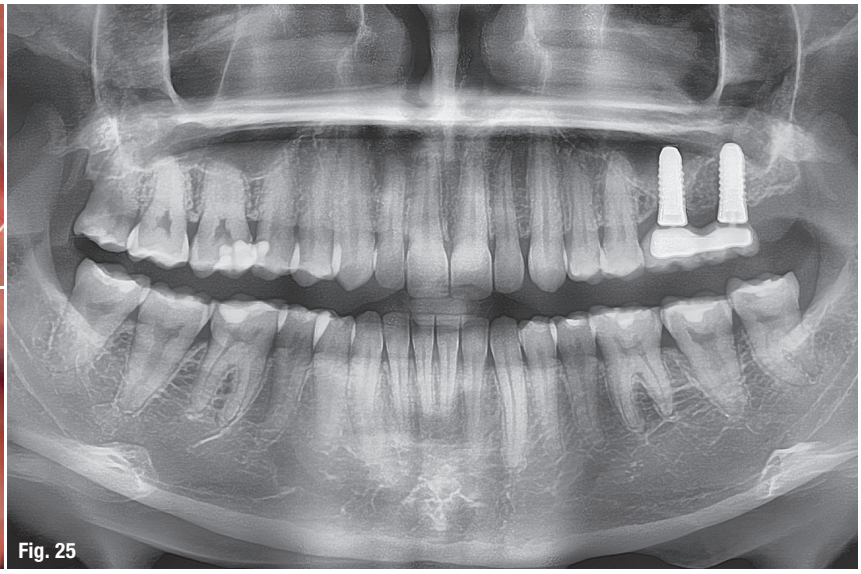
Fig. 25

Fig. 23: Stable soft-tissue situation before the crowns were inserted. **Fig. 24:** After insertion and functional and aesthetic control, the screw access channels were sealed. **Fig. 25:** As PEKK is not radiopaque, some time and experience are required to analyse the control radiograph.

and produced from zirconium dioxide. The crowns were finalised after glaze firing. Both the crowns and the PEKK abutments were activated and subsequently glued to the model. Ensuring easy hygienic care of the implant crowns was of particular importance (Figs. 20–22).

Overall, the production of the two occlusally screw-retained crowns was achieved without any difficulties. In spite of the new materials and system parts, this case was also treated proficiently and routinely by the dental technician.

Subsequently, the crowns were inserted into the patient's mouth. A very well-healed intraoral situation was apparent. The crowns were inserted and screwed in with titanium abutment screws at a defined torque of 15 Ncm. After the final functional and aesthetic control, the screw access channels were sealed using cotton pellets and a composite (Sinfony, 3M ESPE; Figs. 23–26).

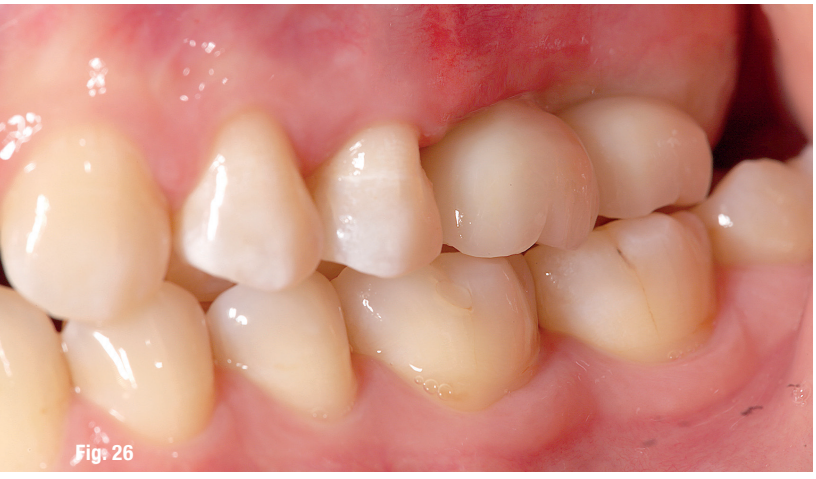
Fig. 26

Fig. 26: Final inspection of the inserted crowns at regions #26 and 27.

Conclusion

Throughout the entire treatment process, no problems occurred in the application, performance and handling of this implant system. Also, from the executing master dental technician's perspective, the system was successful and user-friendly.

This two-piece implant provides implantologists with a scientifically well-documented and easily applicable alternative to conventional titanium implants. The user-friendly system creates confidence in this new choice of material in the implant market. One of the advantages of ceramic implants is the material's good tissue compatibility regarding osseointegration, gingival adaption and low plaque accumulation.

Acknowledgement: My special thanks go to Timo Jäkel, master dental technician at Dental-Concept Berlin, Germany, for his support and the successful fabrication of the superstructures.

Literature

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Bone management and ceramic implants

Dr Karl Ulrich Volz, Germany

Bone formation is a complex biochemical process of endogenous regeneration that is influenced by a broad variety of factors. Scientific studies and everyday experience in dentistry practices confirm that the vitamin D3 level and the LDL level impact significantly on healthy bone formation. A patient with a vitamin D3 level below 70 ng/ml and an LDL level above 1.4 g/l will scarcely be able to form entirely healthy bones, no matter how much effort is invested in the procedure. A notable fact in this respect is that 85 per cent of all Germans return a D3 level below 30 ng/ml.[1–4] This article addresses the issue of bone management for ceramic implants and outlines a protocol designed to stimulate and preserve healthy bones.

It is reasonable to consider the D3 and LDL levels to be reliable indicators, as vitamin D3 in its metabolised form of $1,25(OH)_2D_3$ calcitriol is one of the most important human hormones. In this capacity is responsible not only for controlling the transcription of more than 1,000 specific genes, but it also has the following capacities that are of significant interest to dental medicine. Namely, to increase osteoblast activity, to reduce osteoclast activity, to participate decisively in cellular repair and cell division mechanisms, to stimulate intestinal absorption of calcium and phosphorous, to stimulate resorption of calcium and phosphorous in the kidneys, to raise the number of circulating immunoproteins, to elevate the cytotoxicity of macrophages, to increase the level of endogenous GcMAF (group compound macrophage activating factor), to strengthen the immune system overall, and much more. An elevated LDL level is indicative of an increased susceptibility to infection, a condition that obviously needs to be avoided in connection with implants, bone grafting and sinus augmentation.

The aforementioned studies point to the significant influence that the actual D3 and LDL levels have on bone formation. The author's practical experience has also shown that even the most complex procedures will encounter fewer complications if these values are within the stipulated range. Patients experience negligible swelling and pain is kept to a low level. Complications and failures most usually occur among patients with levels outside of the stipulated range (vitamin D3 level below 70 ng/ml and

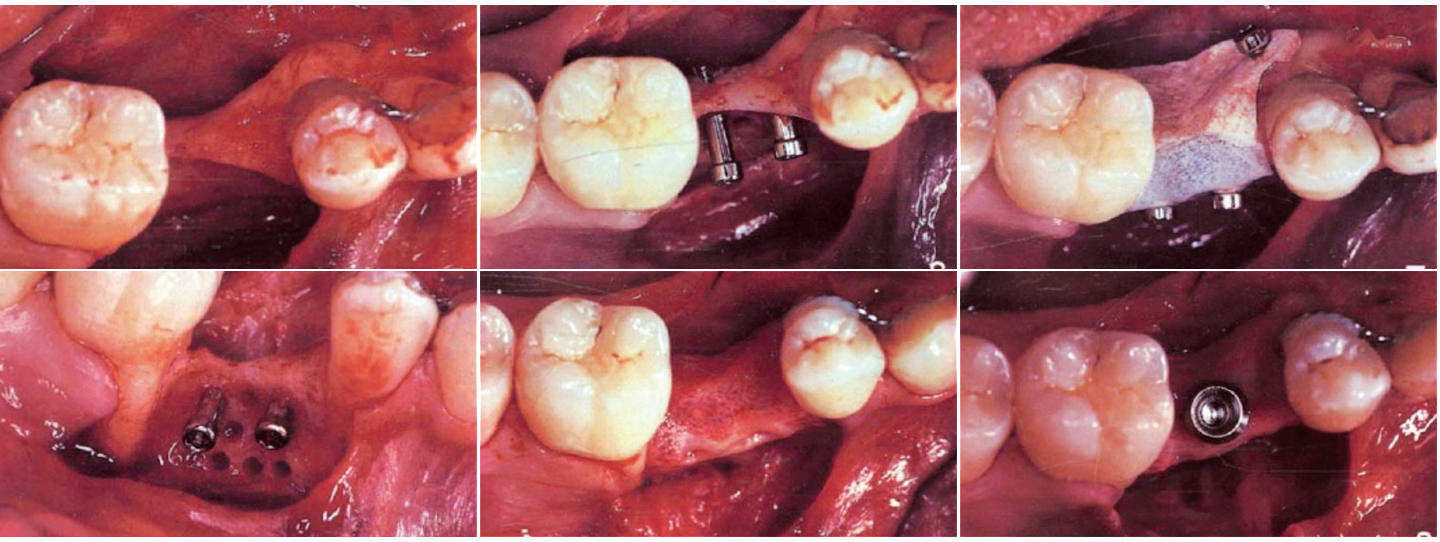


Fig. 1: The Memfix system by Straumann demonstrated that bone can be created by cavity formation alone.

LDL level above 1.4 g/l). Moreover, the author holds that outliers in these two metrics are causative in periodontal diseases, and that the consequent inflammation of the gingiva and the associated pain are the reasons why the patient invests less in dental care, instead of the poor care itself leading to gingivitis or periodontitis. This proposal is substantiated by the fact that even severe periodontal diseases improve in line with a normalisation of these levels, which is induced by a change in dietary habits and the introduction of supplements. Additional research will be necessary to clarify with greater certainty whether a deficient supply of vitamins and minerals may encourage the emergence of periodontal diseases.

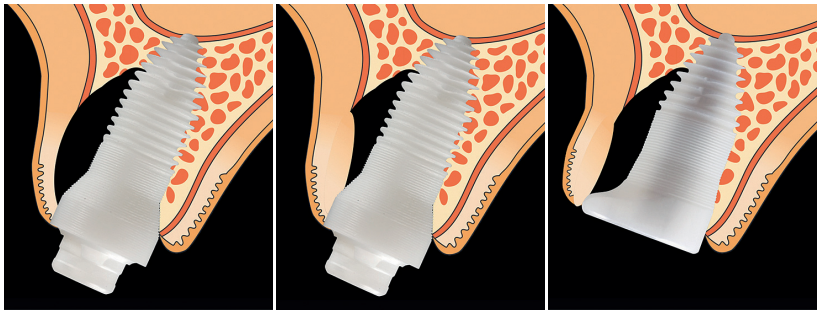


Fig. 2: The broad tulip supports the soft tissue, which grows onto the zirconium oxide inside of a few days. There would be a sufficiently large cavity for bone to grow, even if the soft tissue collapses slightly.

Positive side effects

Patients in the author's clinic are given extremely high-dosage vitamin and mineral supplements from four weeks before, until four weeks after their surgical procedure. The composition of these supplements has positive effects on bone formation and the immune system. Moreover, these patients observe a special diet that is also designed to strengthen the immune system and curtail susceptibility to inflammation. This pre-operative prepping of the immune system for the operation ensures that almost all patients experience an improvement in their general well-being once the harmful interference fields (ishaemic osteonecrosis, displaced wisdom teeth, infected root canal-treated teeth, foreign bodies, etc.) have been eliminated. Photographic records from before and after surgery, measurements of heart rate variability and the validated Medical Symptoms Questionnaire are used to substantiate this subjective perception.

The combination with special ceramic implants, designed for immediate fitting (SDS, Swiss Dental Solutions),

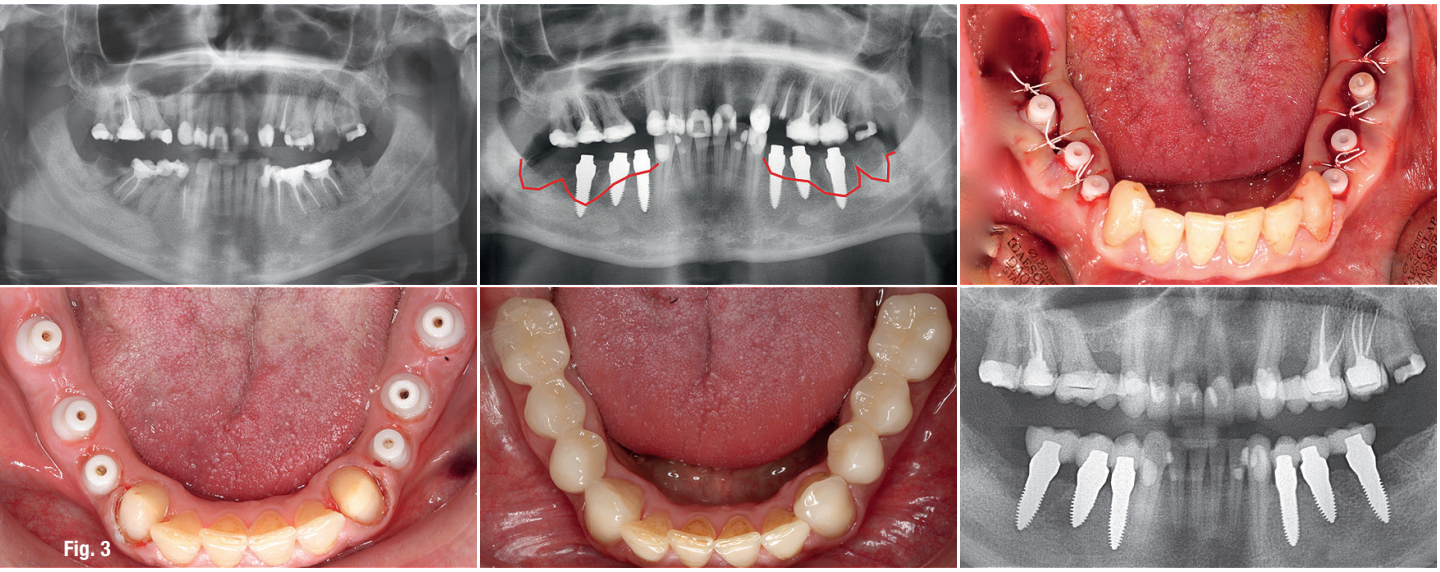
allows complete restoration of the patient's dental situation and even final prosthetics inside of just three appointments and with a high degree of predictability (all-in-one concept).

Intelligent Bone Management: Building and preserving bone

There are clearly defined and reproducible rules on the formation of bones and their lifelong preservation.

1. Systemic conditions
   a. Strengthen the immune system
   b. Strengthen the capacity to form bone
   c. Activate the parasympathetic nervous system, inhibit the sympathetic nervous system
2. Local conditions
   a. Reduce bad inflammation (giant cells)
   b. Activate good inflammation (monocytes, granulocytes, macrophages)
   c. Reduce contamination (breath, saliva, etc.)
   d. Stimulate bone formation
   e. Improve the extracellular matrix
   f. Preserve blood flow (Mammoto's Law)

A reasonable summary might be: Besides a robust immune system that is compatible with bone formation, we require a stable and hermetic cavity that fills with blood in order to produce osseous material. Whether the bone goes on to survive a lifetime will depend exclusively on whether it is supplied with sufficient blood and whether this supply can be maintained (Mammoto's



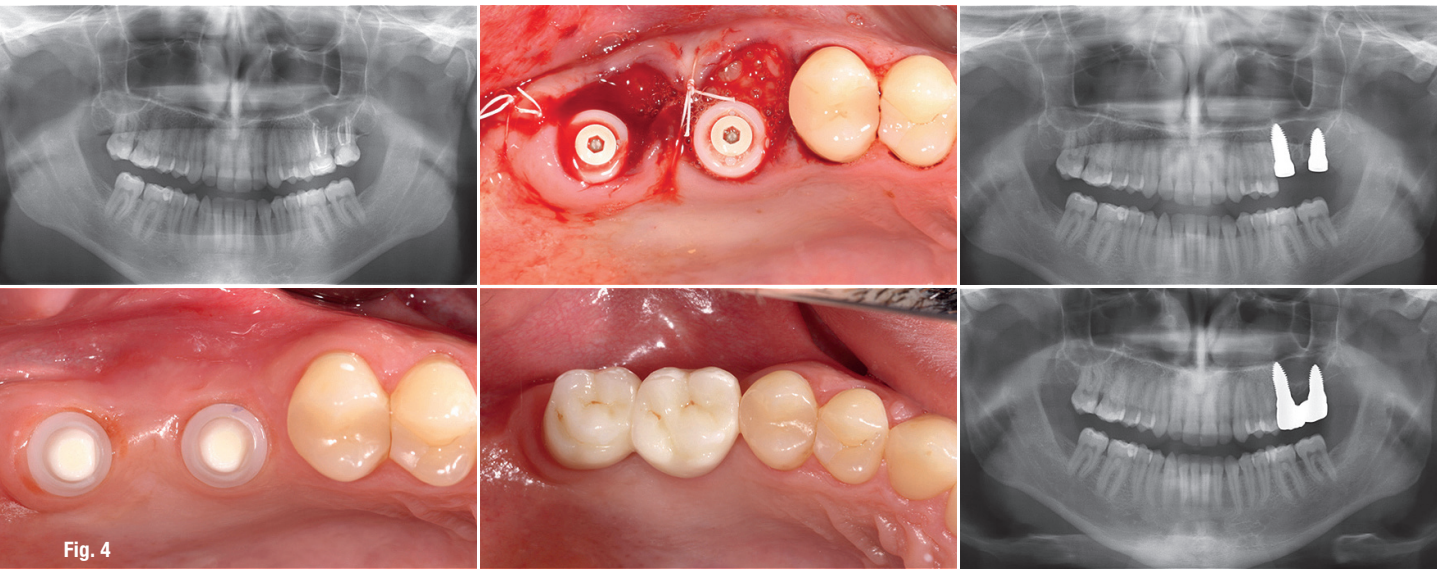


Fig. 3: Removal of the destroyed teeth 34–38 and 44–48, immediate implants 36–34 and 44–46, stabilisation of the attached gingiva onto the implant tulip using the "tent pole" technique. Crown treatment after just three months. Complete vertical bone regeneration. **Fig. 4:** Typical vestibular bone loss with immediate implantation in the palatal root.

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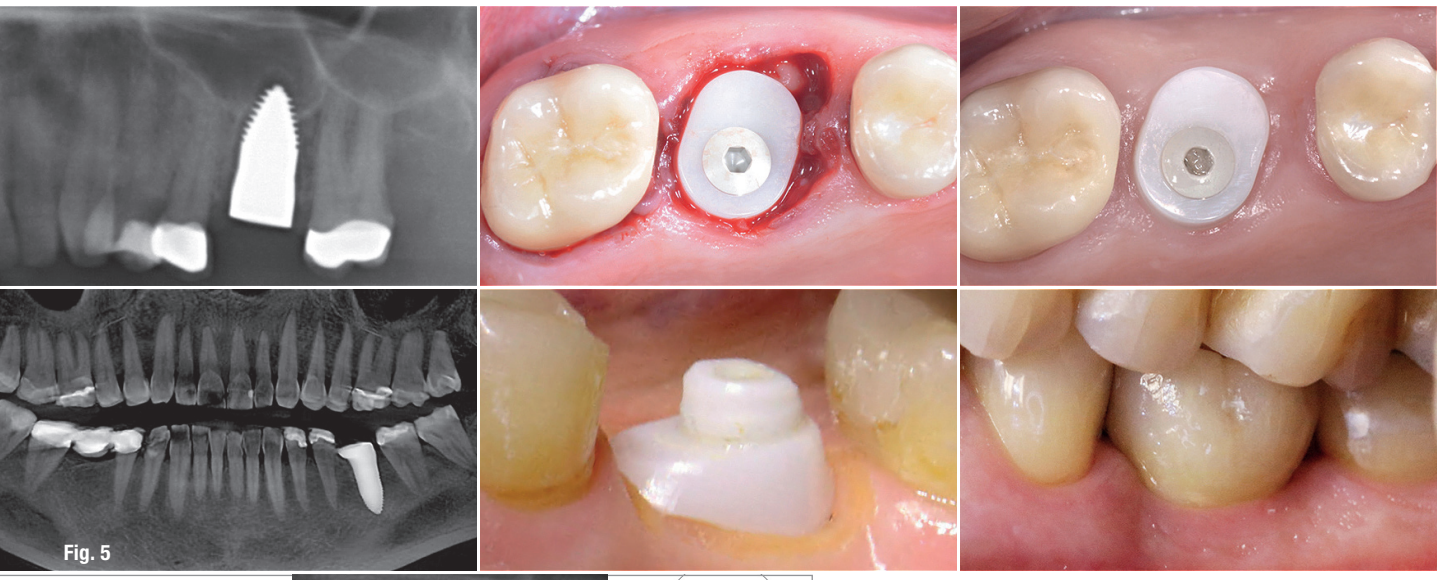


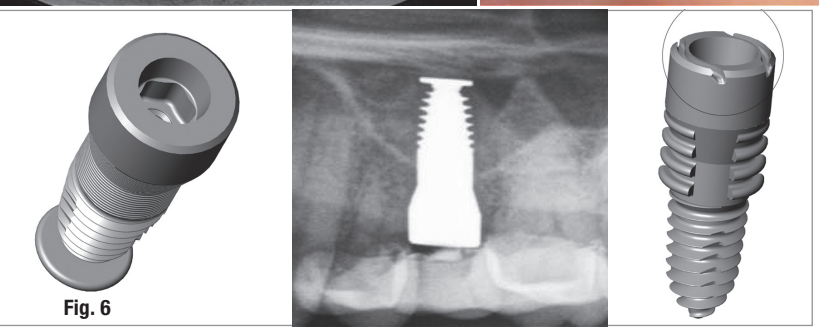


Fig. 5: The use of balcony implants can also preserve the volume in the region of the non-implanted root of the lower jaw. **Fig. 6:** Sinus implant with the "parasol effect". The disc implant is on the far right.

Law). Here, bone blocks and bone replacement materials are only responsible for keeping the cavity stable. Their disadvantage is that the procedure requires an additional intervention with additional costs, greater morbidity and increased risk. Apart from that, these bone blocks will never be able to acquire the same quality of blood supply as a lamellar bone that has just recently grown into a cavity.

In 1998, Hämmerle and Thorkild published an article about the Memfix system by a company named Straumann, which was able to generate significant quantities of bone simply by forming a stable cavity: It is a mystery why this intelligent system has slipped into obscurity (Fig. 1).

Bone Growing Implants

Using zirconium oxide as an implant material now means that for the first time, we have a material that can

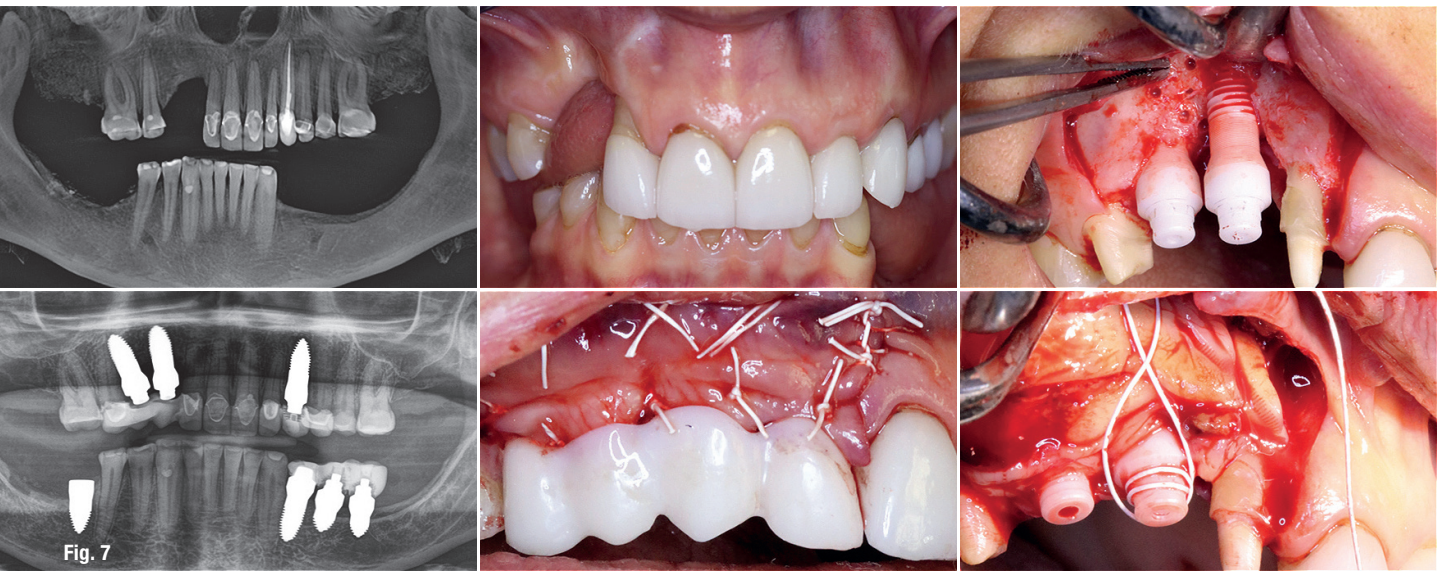
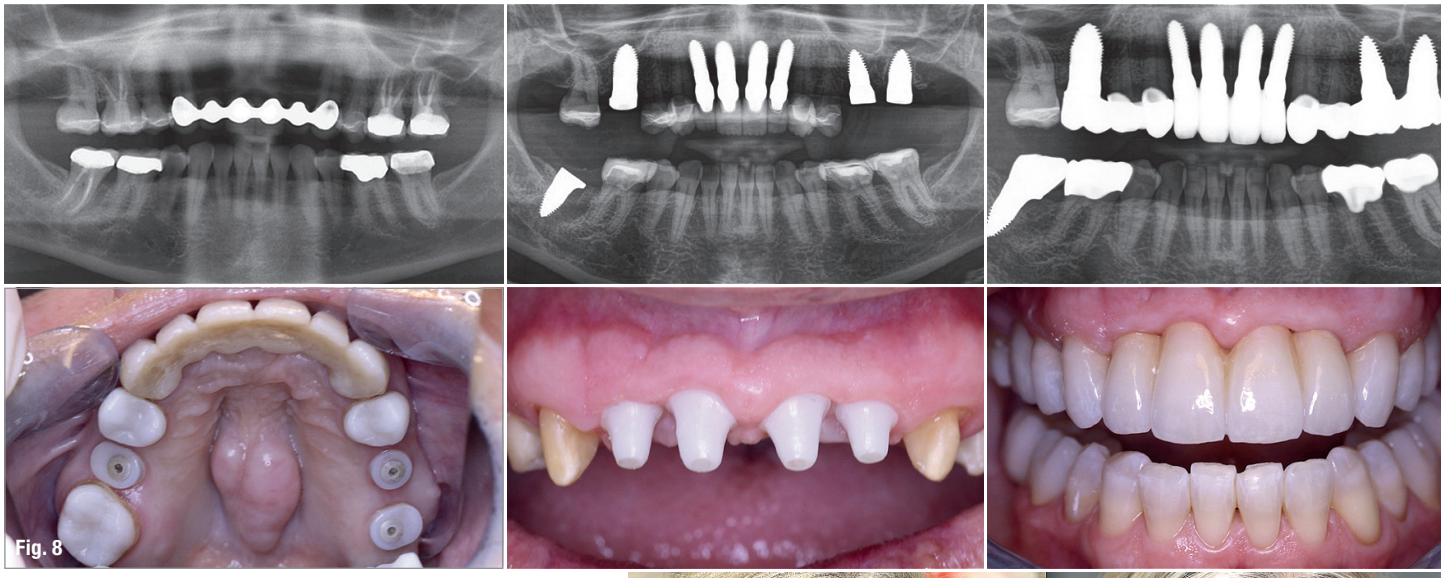


Fig. 7: Implant acting as a "tent pole" with "parasol effect" thanks to the broad tulip. "Brace sutures" to fix the soft tissue firmly in place.



Figs. 8 & 9: Finished procedure that demonstrates the complete restoration in just three appointments with two longer residencies according to the all-in-one concept.

be used as a base for the growth of bone and soft tissue as well. The logical consequence—and the challenge—was to build additional "space-makers" onto the implants in the form of balconies or discs in order to then use the implants themselves as "tent poles" (Fig. 2). Implants designed in this way are able to stimulate growth of several millimetres of bone in a vertical direction (Fig. 3). When used with immediate implants, balconies in particular can prevent the otherwise common volume depletion in the alveoli that do not carry implants (Fig. 4), as the "parasol effect" provides support for the volume (Fig. 5).

Lateral support plays an important role, especially for immediate implants in the molar area. Here, the sinus implant serves not only as a "tent pole". The shielding effect of its apical disc also provides a particularly large cavity for bleeding, while simultaneously minimising the risk of perforation of the Schneiderian membrane (Fig. 6). The disc implant shown on the right has discontinuous spacers (discs), which are used to keep the periosteum at the necessary distance so that the bone can grow into the cavity. The implant has grooves on the prosthetic plateau to ensure secure placement of apical mattress sutures according to the "braces" principle, and to hold the attached gingiva firmly in place until it has grown onto the ceramic. Until now, it has been necessary to attach the brace sutures onto the posts of the single-piece implants (Fig. 7).

This method permits the performance of standardised dental restorations based on a recurring algorithm in as little time as possible, with maximum comfort and minimal incidences of complications: removal of ishaemic osteonecrosis, removal of all metals and root canal-treated teeth, integration of metal-free ceramic implants and fixed long-term temporaries (Figs. 8 & 9).

Interested colleagues are warmly invited to attend a procedure and observe the concept in the author's clinic at no cost.

Literature

contact

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“All that glitters ain’t gold”

Can ceramic implants meet higher expectations?

Dr Dirk U. Duddeck, Germany

When Prince wrote his song “Gold”, of which the headline of this article quotes the refrain, he tried to explain the problem of having exaggerated expectations in a relationship. Presumably, he was not thinking about an ideal material for dental implants. Zirconium dioxide may have some advantages in comparison with titanium or titanium alloys. Better aesthetic appearance in case of significant bone loss and low plaque affinity are benefits of this material. As the production process differs from titanium implants, one might expect that the surface cleanliness of zirconia implants further makes a difference.

Implant surfaces determine the initial phase of the biological response to the inserted implant and affect its ability to integrate into the surrounding tissue. Unfortunately, the majority of dental practitioners only receive limited non-biased information about the surface quality of implants used in their daily practice. Impurities on sterile-packaged implants, in particular organic particles from the production or packaging process, are highly suspected of being responsible for incomplete osseointegration of dental implants, inducing a foreign-body reaction, leading to early peri-implantitis or even loss of bone in the initial healing period.

Four consecutive studies over a period of more than ten years, conducted in close cooperation with the University of Cologne and the Charité–University Medicine Berlin, both in Germany, have shown that neither the CE (French: Conformité Européenne) marking nor U.S. Food and Drug Administration clearance can provide a reliable indication of the cleanliness of zirconia or titanium implants. Scanning electron microscopy (SEM) imaging and elemental analysis (EDS) revealed an increas-

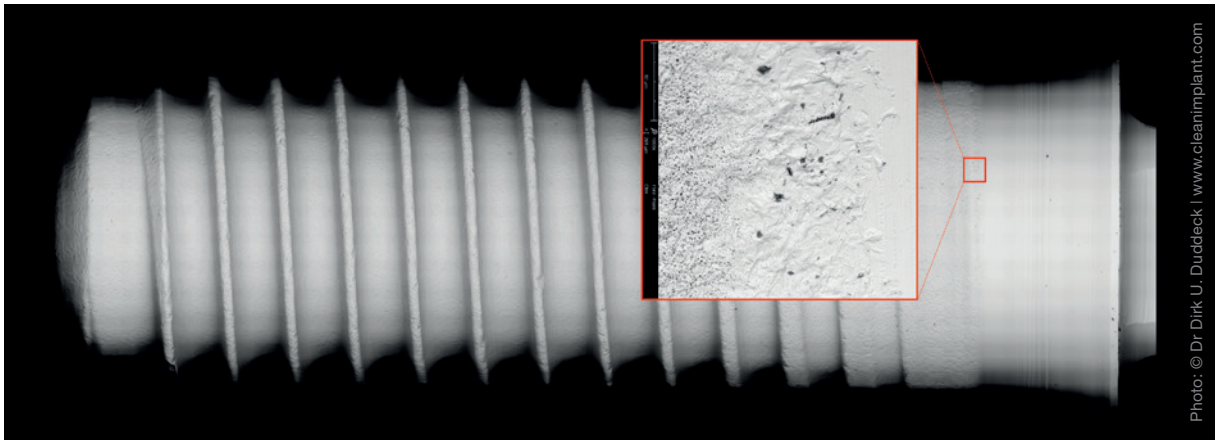
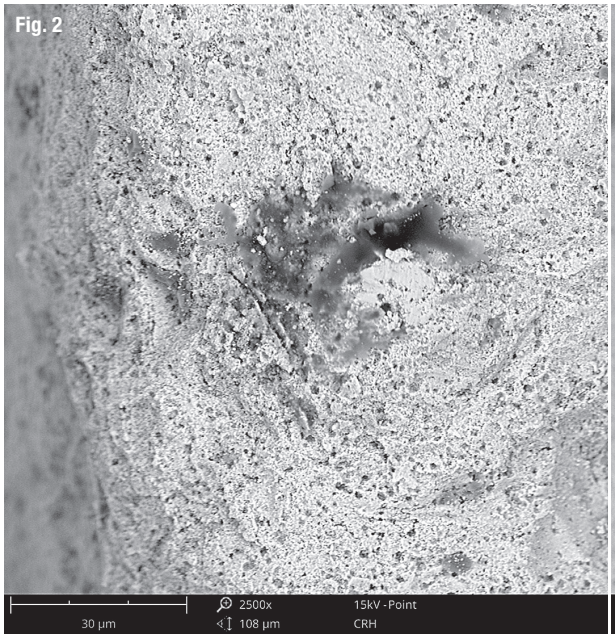


Fig. 1: Mapping image of a zirconia implant (assembled from 546 SEM images at 500x, detail enlargement at 1,000x).



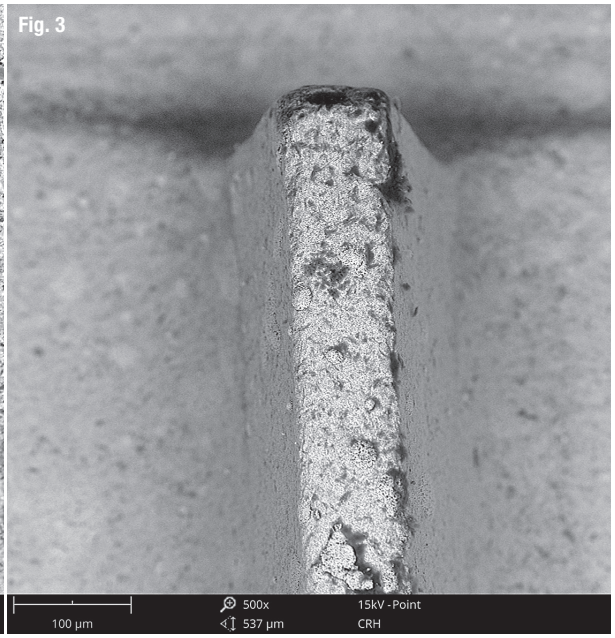


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Fig. 2: Organic contamination on zirconia implant (SEM image at 2,500x). **Fig. 3:** Organic particles on outer thread of zirconia implant (SEM image at 500x).

ing number of dental implants with impurities. Intermediate results of the current Implant Study 2017–2018, performed by the CleanImplant Foundation and Charité, have given cause for concern. The study showed zirconia implants with clean surfaces, as well as others with remnants of aluminium oxide (Fig. 1) and samples with significant organic impurities (Figs. 2 & 3), thus indicating that any expectations of superior cleanliness of all zirconia implant systems may not be fulfilled.

CleanImplant, an independent non-profit organisation, carries out periodical quality assessments and is supported by a scientific advisory board. The board is chaired by renowned scientists and practitioners, such as Prof. Tomas Albrektsson (Sweden), Prof. Ann Wennerberg (Sweden), Dr Michael Norton (UK), Prof. Hugo de Bruyn (Netherlands), Prof. Florian Beuer (Germany), Dr Scott D. Ganz (US), Dr Jaafar Mouhyi (Morocco) and Dr Luigi Canullo (Italy).

The foundation established a thorough and accredited testing procedure that not only is being used for the Implant Study 2017–2018, but also builds the basis for a new, globally accepted quality seal for dental implants: the Trusted Quality Mark. All implants have to be unpacked and analysed by SEM under cleanroom conditions according to ISO Class 5 (DIN EN ISO 14644-1). The testing laboratory is accredited for this analysis according to DIN EN ISO/IEC 17025 and audited regularly by external, independent accreditation bodies. To avoid any possible cherry-picking, up to 600 single SEM images of each implant are digitally composed to one large image with an extremely high resolution, providing a perfect overview of the implant cleanliness.

The final results of the comprehensive Implant Study 2017–2018 with SEM/EDS data on zirconia and titanium implants will be presented at the 2019 IAOCI (International Academy of Ceramic Implantology) World Congress in Tampa, Florida, USA. The comparison regarding the cleanliness of titanium and ceramic implants may probably surprise some participants and may show, that “all that glitters ain’t gold”; that is, all that is white, is not necessarily clean. In other words, dentists should not only rely on the given marketing information to make a conscientious decision on a titanium or zirconia implant system.

When it comes to the question of implant production quality, we all should act according to a Lenin quote: “Trust is good, but control is better.”

More information and a corresponding newsletter can be found on the project’s website www.cleanimplant.com.

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Ceramic implant vs endodontic treatment

Dr Dr Johann Lechner, PhD, Germany

Introduction

Where are the evaluation criteria to determine the success of endodontic treatment? Why are there no additional tools to determine local painlessness versus a systemic toxicity focused approach? How can patients be convinced to get their root fillings replaced with immediate ceramic implants? In the following, scientific based arguments will be given from an author having 16 years of experience in ceramic implants. His scientific based publications are being released in international PubMed indexed medical journals and the research on this topic was published in the *International Journal of General Medicine* ("Stimulation of pro-inflammatory cytokines by volatile sulfur compounds in endodontically-treated teeth", Lechner, von Baehr).

New methods to reduce risks

Researchers in the field of modern dental endodontics are well aware of the problem of bacterial colonisation in the tubules of root-filled teeth (RFT), and new methods for reducing these risks are constantly being developed. A control X-ray image is standard practice and considered to be the only method used for the diagnostic assessment of RFT. However, X-ray scans are insufficient, since chemically defined toxins cannot be visually identified. Even though X-rays of root canal treatment do not show anomalies, these areas often contain bacteria, as well as inflamed or necrotic tissue, which proves that not all periradicular inflammations can be diagnosed with the help of X-rays[1]. Anaerobes are sulfate-reducing bacteria and are most frequently isolated from primarily and secondarily infected root canals. Persistent microorganisms in endodontically-treated teeth are the main producers of methyl mercaptan, dimethyl sulfide and diethyl sulfide (Merc/Thio)[2]. In the past, there was no process available to reliably identify RFT, using the suspected outgas of Merc/Thio produced by bacterial degradation products and biogenic amines in the form of volatile sulfur compounds (VSC). Thus, we expanded our investigation to develop an additional evaluation criterion in order to semiquantitatively determine the presence of VSC, using a volatile sulfur hydrogen compound indicator (VSHCI).

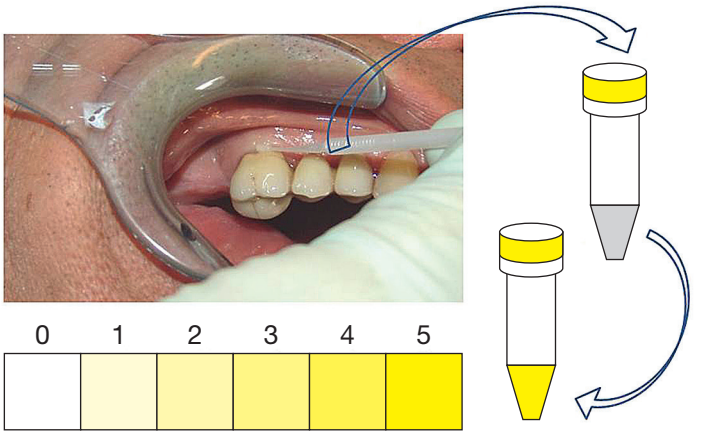

Fig. 1: The semi-quantitative chairside test; colour change indicates higher concentration of sulfhydryls.

The chairside test

Hydrogen sulfide can be displayed by utilising the chairside test called OroTox®. The procedure is painless and simple to perform: A nonsterile paper tip—or alternatively, a small sponge, is inserted into the sulcus of the suspected tooth. After one minute it is removed and the sample from the sulcus fluid is inserted into the volatile compound reagent container. After five minutes, the staining of the reagent is examined: The more hydrogen sulfide compounds are present in the sample, the more the indicator liquid turns yellow. The VSCI detects the elevated discharge of bacterial toxins in the sulcus of the suspected teeth, based on six gradings (0 = zero; 1 = moderate; 2 = evident; 3 = clear; 4 = strong; and 5 = extremely strong). The degree of colouration of the reagent may be used to semiquantitatively determine the amount of toxin that can be resorbed in the sulcus (Fig. 1).

The chairside test helps dentists to decide whether RFT should be viewed as critical for a patient with immunological diseases, due to a high Merc/Thio content[4], even if X-rays of the root tip do not indicate signs of change. We have evaluated the *ex vivo* immune response of peripheral blood mononuclear cells (PBMC) to VSC in 354 patients with systemic diseases. The findings correlate with semi-quantitative values of a volatile sulfur compound indicator (VSCI) applied directly to the RFT. Our data elucidate the role of VSC in patients with immunologic diseases and the role of the chairside test OroTox® in correlation to IFNg and IL-10 sensitisation in PBMC. The connection between

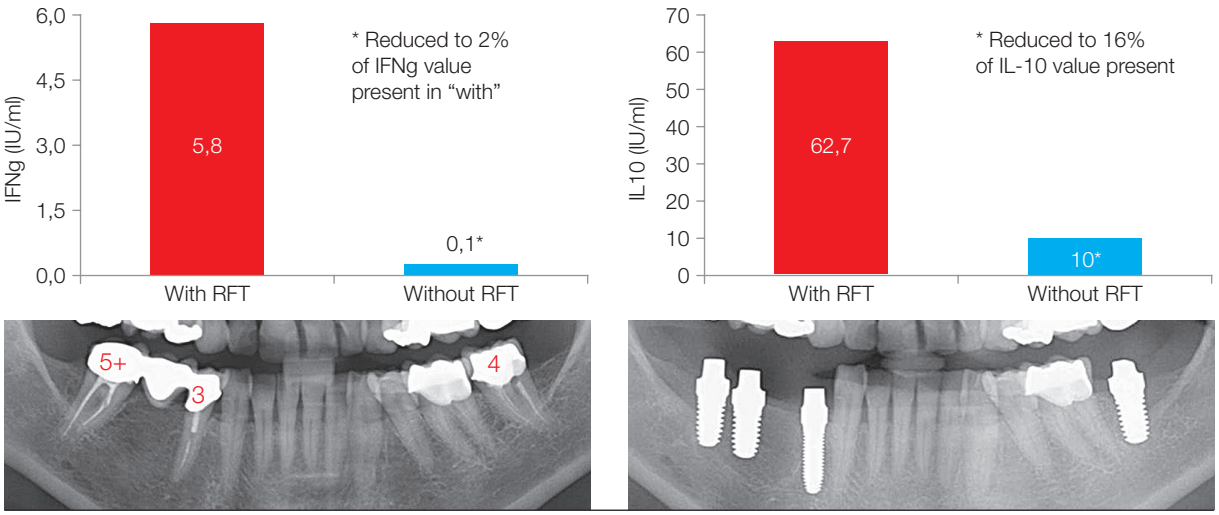

Fig. 2: An example of a clinical sample tested for IFNg and IL-10 sensitisation to Merc/Thio exposure before and after the removal of RFT.

ex vivo-stimulated cytokines and endodontically-derived sulfur components is supported by the fact that the number of interferon gamma and/or interleukin-10 positive sensitised patients declined significantly three to eight months after the extraction of the corresponding teeth. Figure 2 shows a patient with dramatically lowered levels of IFNg and IL-10, after the exchange of RFT with high levels of VSC, with regard to the OroTox® test.

Identifying disease correlations

Scientific research finds that diabetes correlates significantly with a higher prevalence of periapical radiolucencies in endodontically treated teeth.[5] In contrast, critics of root canals believe that they may contribute to immunological diseases and consider X-ray imaging to be insufficient for the purpose of determining possible systemic effects of toxins that derive from root fillings. Apical periodontitis (AP) is a chronical inflammatory disorder of the periradicular tissues caused by bacterial invasion at the apex of the tooth root.[6] There are epidemiologic studies proving the correlation between AP and various diseases. For example, AP is associated with increased rates of myocardial infarction (with acute coronary syndromes occurring 2.7 times more frequently in patients with such infections[7]), as well as clinical depression, increasingly severe depression and a reduced quality of life.[8] Moreover, AP is also associated with an increase in the translocation of gram-negative bacteria.[9–10] A study on a total of 248 patients with acute myocardial infarction, as well as 249 healthy controls underlines that patients, who have experienced a myocardial infarction, had a higher risk of developing inflammatory processes—especially of endodontic origin—than healthy patients.[11] Patients presenting lesions of endodontic origin or pulpal inflammation had an increased risk of developing a coronary heart disease.[12] Bacterial DNA that is typical for an endodontic infection, mainly oral viridans streptococci, was measured in 78.2 % of thrombi, and periodontal pathogens were measured in 34.7 %. Dental infections and oral bacteria, especially viridans streptococci, are associated with the development of an acute coronary thrombosis. There is also a significant correlation between periodontitis and depression.[13]

However, there is no data showing a correlation between VSC levels in the root canals of patients with AP and systemic and immunological diseases. We presented a study, which is one of the first to statistically link a group of patients to multiple systemic and immunological diseases (SyD) with endotoxin levels originating from AP (*Dentistry*, Volume 8, Issue 3; "Impact of Endodontically Treated Teeth on Systemic Diseases"; Lechner, von Baehr). The study indicates there is a significant increase in root canal endotoxin levels in patients with AP, in comparison to healthy controls (HC) without AP. The comparison made between the HC and SyD groups provides the first indication of the possible connections between RFT and SyD. It indicates that endodontically treated and root-filled teeth may enhance immunological and systemic disturbances on the one hand and may be involved in the development of SyD on the other hand. Vice versa, the presence of SyD may influence, in some way, local inflammatory reactions such as AP. High local H_2S values with the reagent, as well as a high frequency of immunosensitisation to biogenic amines in patients with SyD amplify this correlation. With regard to the increasing prevalence of immune system diseases, widespread endodontic measures should be assessed more critically. For practitioners, the local measurement of VSC, using the OroTox® test, draws attention to the correlation between the outcome of endodontic treatment and systemic diseases. For more than 15 years, we offer ceramic implant replacements as an alternative to RFT in order to help successfully avoiding SyD in our patients.

Literature

contact

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Why choose a zirconia implant?

Zirconia dental implants are increasing in popularity. More and more companies are offering zirconia implants as part of their portfolio. High aesthetics, increasing cases of titanium sensitivity along with clear health advantages are indicating zirconia as material of choice for dental implants. The main reasons for choosing zirconia include:

Outstanding aesthetics

The beautiful white tooth colour of zirconia looks natural and cannot be seen through mucosal tissue.

Optimal osseointegration

Results of clinical studies demonstrate that osseointegration of zirconia implants is comparable with titanium implants.

Allergies and sensitivities

Some patients may be allergic to metal. Zirconia implants, made of a non-metal, ceramic material, have not been documented to cause any allergic reaction in patients.

Low plaque affinity

Zirconia implants have low plaque affinity creating an oral environment that promotes healthier mucosa, low amounts of inflammatory infiltrate and good soft-tissue integration resulting in a lower risk for peri-implant disease.

Strength

Zirconia shows superior biomechanical properties like high fracture toughness and bending strength, giving zirconia implants the ability to withstand masticatory forces.

Health conscious patients

Nowadays, patients are more health conscious than ever before. Zirconia implants address these patient needs. They are white, coloured like a natural tooth and provide a highly-aesthetic and metal-free alternative to implants made of titanium.

Biocompatible

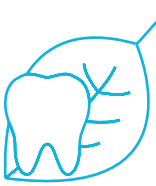
Zirconia is a biocompatible material, which was FDA approved and thus considered to be safe. This means that implants made of zirconia interact favourably with the human body and are non-toxic.

Scientifically proven

In Europe zirconia implants have been in use since the late 1980's and in US since 2007 with very promising results.

No release of titanium ions

Recent studies are indicating that increased levels of dissolved titanium, which are released into the surrounding tissue by titanium implants, are associated with peri-implantitis.[1]



Closer to nature

Blood flow in tissue surrounding zirconia is similar to that in soft tissue around natural teeth.[2]

Changes for the better

Dental ceramic is one of the most preferred materials in modern fixed prosthodontics. Metal amalgam fillings are hardly in use in dentistry anymore and the next step will be for dental professionals to adopt zirconia implants as material of choice in their practices.

contact

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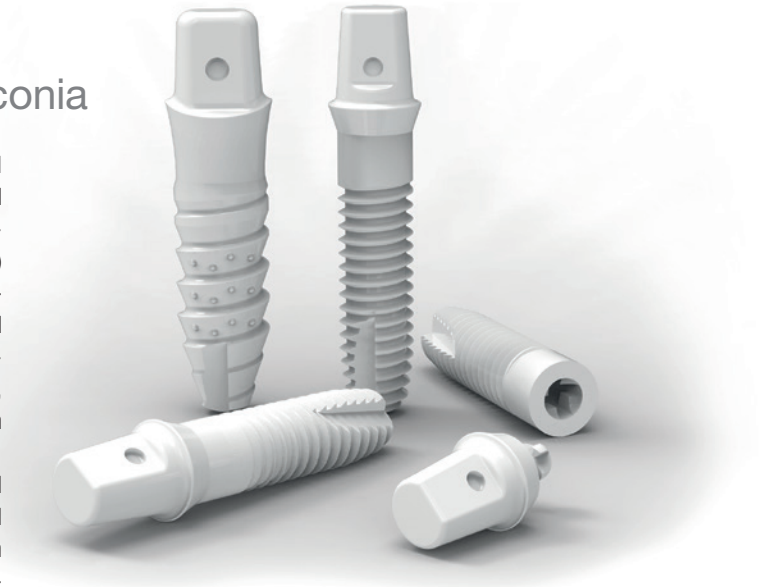
CE

COHO Biomedical Technology

Applying the uniqueness of zirconia



COHO offers various one- and two-piece ZiBone systems, as well as the Zircasso implant system with different screw patterns and abutment designs for the dentist to apply depending on the patient condition. There are three different sizes (3.6/4.0/5.0 mm) with five different lengths (8/10/11.5/13/14.5 mm) in the one-piece ZiBone system. Abutments with different heights and angles are also available for the two-piece system. Novel implant surface processing technology is continuously developed, adopting the plasma film treatment to enhance the integration efficiency of the implant.

The design and functionality for Zircasso have been developed over a 10-year-period to reach the results in functionality and aesthetics desired for a new dental implant. The unique design was developed to reduce the most commonly known complications and to maintain and improve the good characteristics from previous dental implants. Zircasso is a concept in which all stages and parts have been included in the development to achieve the highest possible results in surgery, prosthetics, dental technology and, in particular, patient satisfaction. The implants have a modern design suitable for a digital flow in the clinic.

With more than 20 years of experience in medical device production, design and development, the COHO R&D team continues developing surgical tools for dental implants. In the meantime, we have applied the uniqueness of the zirconia material to improve the convenience and safety of surgery.

COHO Biomedical Technology Co., Ltd.
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Straumann

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Institut Straumann AG
Peter Merian-Weg 12
4052 Basel, Switzerland
www.straumann.com

Z-Systems

World's first 100 % ceramic bone level implant to be launched

Z-Systems is about to launch the world's first 100 % ceramic screw-retained two-piece bone level implant: The Z5-Bone Level (Z5-BL). The Swiss based company specialises in manufacturing ceramic dental implants made from zirconium oxide, with implants being available worldwide.
The Z5-BL is the first full ceramic screw-retained two-piece implant. With its ceramic screw, the implant offers practitioners a full ceramic two-piece screwed implant–abutment connection. The implant development makes use of the enossal shape of its tissue-level predecessors: Since 2004, almost 60,000 tissue-level implants produced by Z-Systems have delivered great results in osseointegration and stability. Moreover, the new implant features the company's proprietary, patented and proven SLM® surface. The implant will be released with a variety of prosthetic options and next-generation surgical kit. In addition to the new ceramic screw, the Z5-BL will also be available with a titanium screw option.

Z-Systems AG
Werkhofstr. 5
4702 Oensingen, Switzerland
www.zsystems.com

CAMLOG

Metal-free aesthetic restorations from implant to crown

CAMLOG's full range of ceramic implants and prosthetic components supports metal-free aesthetic restorations from the implant to the crown. CERALOG implants offer high predictability and exceptional aesthetic properties.
The range includes ivory-coloured one- and two-piece zirconia implants and reversible screw-retained abutments. In the application they are close to the common standard of titanium implants. Outstanding features of the system are the biocompatibility of the high-performance material, the reversibility of the screw-retained prosthetic components and the achievement of highly aesthetic restorations. CAMLOG has established a close interface to DEDICAM and thus to individual CAD/CAM prosthetic solutions. The expansion of the product range opens new patient-oriented treatment options for clinicians. Once again emphasizing the company's innovative strength.

CAMLOG Biotechnologies AG
Margarethenstr. 38
4053 Basel, Switzerland
www.camlog.com

TAV Dental

State-of-the-art zirconia dental products

Zirconia healing caps and locators, multi-units with zirconia ring and last but not least zirconia implants are just some of the special products TAV Dental is manufacturing using the advanced ceramic injection technology. The passion behind developing zirconia products for dental implantology is to provide patients with products which are much healthier for their body along with the advantage of uncompromising aesthetic results.
TAV Dental zirconia products are designed by a highly professional dedicated team and manufactured using high-end ceramic injection molding technology, thus resulting in state-of-the-art products to improve the patient's quality of life.
The team vision is to redefine, better than ever, the quality of zirconia dental products and its performances and to make this premium zirconia line common worldwide.

TAV Dental
Shlomi, Israel
www.tavdental.com

Dentalpoint

Bolt-in-tube—the simple and strong ceramic connection

ZERAMEX® XT abutments are screw retained. The key component of the connection is the VICARBO® screw which acts as a bolt by firmly fixing the abutment to the implant. It is a fitting screw and safely absorbs occlusal forces. Thanks to its soft surface, the screw precisely conforms to the thread profile of the ceramic implant upon tightening.
The abutments are available in straight and angular versions. All abutments are fitted with a "four merlon"-platform which offers four positioning options.

The VICARBO® screw seals the implant hole, and thus prevents the exchange of potentially bacteriologically contaminated liquids between implant and oral cavity caused by micromovement. The ZERAMEX® XT implant offers high prosthetic flexibility as it is placed supracrestally with a variable placement depth ranging from 0.6 to 1.6 mm.

Dentalpoint AG
Bodenäckerstr. 5
8957 Spreitenbach
Switzerland
www.zeramex.com

SDS Swiss Dental Solutions

Ceramic implant forms with osteogenic functionality

While SDS ceramic implants were being applied routinely at the Swiss Biohealth Clinic of Dr Volz, the experience and knowledge that were gained there led to the development of a new kind of implant. The improved biocompatibility of zirconium dioxide implants, together with the bone and soft-tissue growth associated with it have provided new options for implantation wherever pronounced oval alveoli need to be treated, or multiple rooted teeth must be replaced. To this end, the implant ranges "oval" and "balcony" were developed, available in different diameters and lengths, both as single pieces and in two parts, and which were able to optimally close the alveoli, especially with emergency implantations.

The new SDS "sinus implants" (Fig.) were developed specifically for sinus lifting. Due to the increased biocompatibility of ZrO_2, bone growth is also optimally exploited for this indication. In the apical area of the sinus implants, a plate is introduced, which on the one hand spares damage to the Schneiderian membrane upon sinus lifting, and on the other forms a large cavity under the plate due to an umbrella effect. The actual implant serves as a tent pole in this cavity, which creates optimal conditions for inward bleeding and the bone regeneration which results from this. Bone graft material is not necessary in almost all cases. The sinus implants are also available in various diameters and lengths.

SDS Swiss Dental Solutions AG
Konstanzerstr. 11
8280 Kreuzlingen, Switzerland
www.swissdentalsolutions.com

Champions-Implants

Ceramic implant now available

In releasing its new ceramic implants BioWin!, available as both one-piece and two-piece versions, Champions-Implants is breaking new ground. Without having a screw connecting the implant body and the abutment, the two-piece option is entirely metal-free. Since the glass fibre abutment is being glued, there is no space that is vulnerable to paropathogenic germs or bacteria, as it might happen in two-piece implant systems. The roughness of the surface is created using a one-of-a-kind patented process resulting in a faster osseointegration. Scientific studies (Prof. Becker, University Düsseldorf, among others) find osseointegration to be at 95.8 per cent. The implants are available in three different lengths (9, 11, 13 mm) and diameters (4.1, 4.5, 5 mm). Moreover, there is a free and user-friendly software available, with which individual implants having individual emergence profiles can be developed. BioWin! implants can be inserted using either a minimally invasive approach or a classic full-flap one.

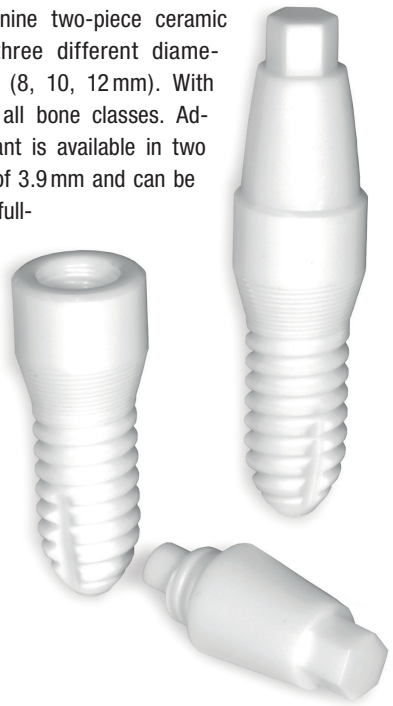
Champions-Implants GmbH
Champions Platz 1
55237 Flonheim, Germany
www.championsimplants.com

WITAR

Biocompatible ceramic implant

Metal-free, biocompatible and aesthetic: Ceramic implants have gained popularity among dentists and patients. Building upon this trend, WITAR offers a new AWI implant system for transgingival healing. With this, the company promises an implant treatment that is safe, cost-efficient and simple. The two-piece system that has been developed and patented recently is made from Y-TZP ceramic and offers a reliable and easy handling. Treatment steps had been optimised for an increased safety and biocompatibility. At the same time, treatment costs and time could be reduced.

The implant system consists of nine two-piece ceramic implants that are available in three different diameters (3.9, 4.5, 5 mm) and lengths (8, 10, 12 mm). With this, the system is indicated for all bone classes. Additionally, the one-piece AWI implant is available in two sizes (10, 12 mm) with a diameter of 3.9 mm and can be used in the anterior mandible. Four full-ceramic abutments of which two are straight and two are angled by 15 degrees, belong to the system as well. Furthermore, the system includes a sterilisation box, surgical tray with milling machines made from ATZ high-performance ceramics, and turning tools.



WITAR Consulting GmbH
Rodenkirchener Straße 148
50997 Cologne, Germany
www.witar.de

A new splash of life

Numerous innovative restorative and aesthetic dental solutions, which are considered an industry standard today, have been brought to market by Nobel Biocare. Recently, the company expanded its product portfolio of dental implants and is now offering a complete metal-free, two-piece screw-connected option with NobelPearl. The new ceramic implant system was first introduced at EuroPerio9 in Amsterdam, the Netherlands. In this interview with *ceramic implants* Prof. Stefan Holst, Vice President Global Research, Products & Marketing at Nobel Biocare (Fig. 1), discusses the new product line and what makes it stand out from other systems available on the market.

With NobelPearl, Nobel Biocare is now at the forefront of modern ceramic implant systems. What has been the response so far to this new product line?

We have been pleased with the very positive response to this new product in our implant range. The market launch was announced at the end of last year and we recently presented NobelPearl to the public in the German-speaking regions in June and to international markets at the EuroPerio9 congress in Amsterdam. We are currently midway through the market launch. The interest in our innovative two-piece metal-free screw-connected ceramic implant is continuously growing, and we are sure that it will further increase with approval in new markets.

Fig. 1: Prof. Stefan Holst, Vice President Global Research, Products & Marketing at Nobel Biocare.

In your opinion, what should be the key features of a modern ceramic dental implant system?

Aesthetics and material compatibility are very important features for ceramic implants, but they should not come at the expense of primary stability. Modern ceramic implant systems such as NobelPearl are now capable of meeting our quality requirements in terms of strength, rigidity, and fracture toughness. For these reasons, among others, we decided to permanently add it to our product portfolio.

What are the main indications for your system?

NobelPearl was designed to support a natural soft-tissue appearance (Fig. 2). Its zirconia material is especially beneficial for patients with a very thin mucosa, as studies have shown that microcirculatory dynamics in peri-implant mucosa around zirconia are comparable with those around natural teeth. The material has further demonstrated low affinity to plaque.

> “We are seeing growing demand for metal-free implant solutions.”

Is it possible to achieve multi-piece restorations and even fixed total prostheses with NobelPearl?

The two-piece, reversible screw-connected concept allows us to cover many indications. Therefore, the NobelPearl implant can also be used for bridges and even in edentulous jaws.

What role does the “metal-free” feature play in this?

Nowadays, patients are much more conscious about their health and therefore carefully choose products and treatments. That is why we are seeing growing demand for metal-free implant solutions, among other developments.

While ceramic implants can still be considered a niche, their market share is expected to increase in the coming years. The movement and innovation that can be seen in this area at the moment is a clear indication for this trend.

A special feature of the new system is the metal-free carbon-based VICARBO screw. Experts still seem to argue about the biocompatibility and long-term stability of this type of material in the moist environment of the mouth. What would you tell them?

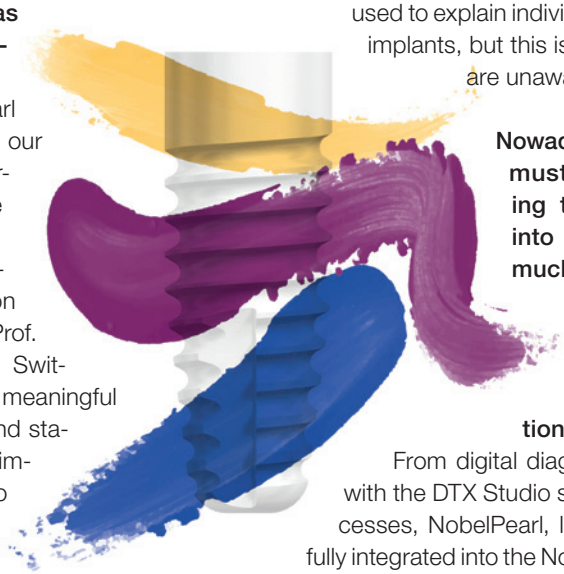
Fig. 2

Fig. 2: The NobelPearl two-piece ceramic implant solution. *Photos © Nobel Biocare*

Carbon fibre-reinforced PEEK (Polyether ether ketone) has been used in orthopaedics for some time, and therefore has been tried and tested in clinical use. The same holds true for dental applications such as temporary restorations. The material exhibits very good biocompatibility and is also highly resistant to corrosion.

There are still not many long-term studies available on modern ceramic implant systems. Do you see a problem there and how well has your own system been scientifically validated?

We decided to base NobelPearl on an implant body design that our partner Dentalpoint from Switzerland has had successfully on the market for five years, so there is relevant experience and data available in a clinical setting. In addition to five-year follow-up studies by Prof. Andrea Mombelli from Geneva, Switzerland, there have already been meaningful mechanical studies conducted and statistics compiled from over 15,000 implants. As usual, we are going to start our own clinical studies in the coming months.



The claim that modern dental ceramics are biocompatible seems to be sufficiently proven, but what influence does the quality of the implant surface has on successful tissue and bone integration?

Similar to titanium implants, the hydrophilic surface of the NobelPearl implant is acid-etched and sand-blasted. The resulting micro- and macroroughness allows good osseointegration, which was confirmed by two recently published studies from the universities in Innsbruck in Austria and Bern in Switzerland.

Is there something we still do not know about ceramic implants, e.g. looking at inflammation-free but failed osseointegration?

As with all innovations, of course, there is still little long-term experience. In other words, there are not many studies available with 5, 7 or even 10 years of follow-up. However, there is no "big unknown". We based NobelPearl on the latest available knowledge, and the current products have been extensively tested and scrutinised.

The "aseptic loosening" you mentioned, is an observation from the field of orthopaedics, which is now being used to explain individual cases involving ceramic implants, but this is certainly not something we are unaware of.

Nowadays, an implant system must be "modern", meaning that it can be integrated into the digital workflow. How much progress have you made in that regard? After all, Nobel Biocare only recently presented a dynamically guided navigation system.

From digital diagnostics to implant planning with the DTX Studio suite or CAD/CAM work processes, NobelPearl, like our titanium implants, is fully integrated into the Nobel Biocare digital workflow. Therefore, clinicians who want to offer that treatment option should not have any difficulties with the transition. The X-Guide system, you mentioned, which will soon be available in all key markets, will be supported as well.

Prof. Holst, thank you very much for the interview.

contact

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www.nobelbiocare.com

Fig. 1: The crowded auditorium of the fourth annual ISMI meeting.

The patients' demand for ceramic implants is growing

Today, there is an increasing focus on ceramic implants. In future, there will barely be any dental implant suppliers who are able to do without metal-free alternatives. Both the material and the designs have become quite sophisticated and there is plenty of practical experience with respect to tens of thousands already placed implants. Being praised by only a few enthusiasts in the past, the fourth annual meeting of the International Society of Metal Free Implantology (ISMI) has shown that ceramic implants have already changed the market. The event was held in the Empire Riverside Hotel in Hamburg, Germany, on the penultimate weekend of July, inviting over 200 participants out of 12 countries. The general topic being "the future of implantology—ceramic and biology", international speakers and participants were discussing practical experiences and current trends. The wide variety of topics touched on nearly every area of ceramic implantology. Moreover, the broadcasting of live surgeries, which were held in German and Swiss competence centres, as well as the already legendary white night were considered definitive highlights. The ISMI was created with the goal to promote metal-free implantology as particularly innovative trendsetter in the field of implantology. Within this context, the ISMI supplies their members with education programmes, as well as expert and market information on a regular basis. With regard to public relations, the ISMI aims to widely establish metal-free implantological treatment concepts. Mark your calendars: The 5th annual meeting of ISMI will take place in Constance, Germany, on 10 and 11 May 2019. ISMI members will be granted a 20 per cent discount on the congress fee.

Fig. 2: Martin Lugert, general sales director of CAMLOG Germany, Jürgen Isbaner, member of the managing board of OEMUS MEDIA AG, and Dr Karl Ulrich Volz, founding member of ISMI und scientific head of the congress (from left to right).

contact

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5TH ANNUAL MEETING OF ISMI

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Ceramic Implants—game changer in implantology

Scientific Director:

Dr Karl Ulrich Volz/Kreuzlingen (CH)

Organisation/Registration:

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Stamp

CI 2/18

Fig. 1: The ESCI council: first row, from above and left to right: Jens Strohm, Jonny Wanda, Dr Dr Michael Gahlert, Thomas Bosshard, Rubino Di Girolamo, Prof. Dr Ralf Kohal; middle row: Michael Hotze, Birgit Renggli, Prof. Corrado Piconi, Isabella Moser, Dr Curd Bollen; front row: Prof. Jerome Chevalier, Dr Stefan Röhling, Dr Jens Tartsch.

First European council for ceramic implantology held

Ceramic implant dentistry is currently one of the fastest growing, most innovative, but often controversial discussed areas in dentistry. Intensive research and development, especially in the areas of material properties, surface design and restorative care, have led to ceramic implants of zirconium oxide being a credible factor in dental implantology in addition to titanium implants. Scientific data are already available, but need to be evaluated correctly. Remaining open questions must be discussed and answered with an evidence-based approach. In the interests of the dental practice and the concerned patients, an independent, non-profit-oriented, scientific and evidence-based society is required. This society was recently founded as the European Society for Ceramic Implantology—ESCI.

As a strong community, ESCI creates the link between science, practice and industry. It forms a Europe-wide, active network for all involved groups: scientifically recognised, experienced and renowned experts, interested and motivated users from practice and university, as well as competent and quality-oriented manufacturers and research institutions.

Specialists and leading manufacturers met

The first important step in this direction has now been done: The first European council for ceramic implantology of ESCI took place on 5 October 2018 at the Swiss Re “Centre for Global Dialogue” in Rüschlikon, Switzerland. As part of the first council, specialists with the highest expertise in ceramic implantology met representatives of the leading manufacturers at the “round table”. The ESCI board and Scientific Advisory Board discussed scientific topics related to dental implantology with ceramic implants and defined the future tasks of the ESCI. The results were subsequently presented to the invited company partner of ESCI.

Participants for the ESCI were Prof. Dr Ralf Kohal (Germany), Dr Dr Michael Gahlert (Germany), Prof. Jerome Chevalier (France), Prof. Corrado Piconi (Italy), Dr Curd Bollen (Netherlands), ESCI President Dr Jens Tartsch (Switzerland) and ESCI Vice President Dr Stefan Röhling (Germany). Prof. Dr Dr Michael Payer (Austria), Prof. Dr Dr Werner Zechner (Austria) and Prof. Dr Mutlu Özcan (Switzerland) were connected by videocon-

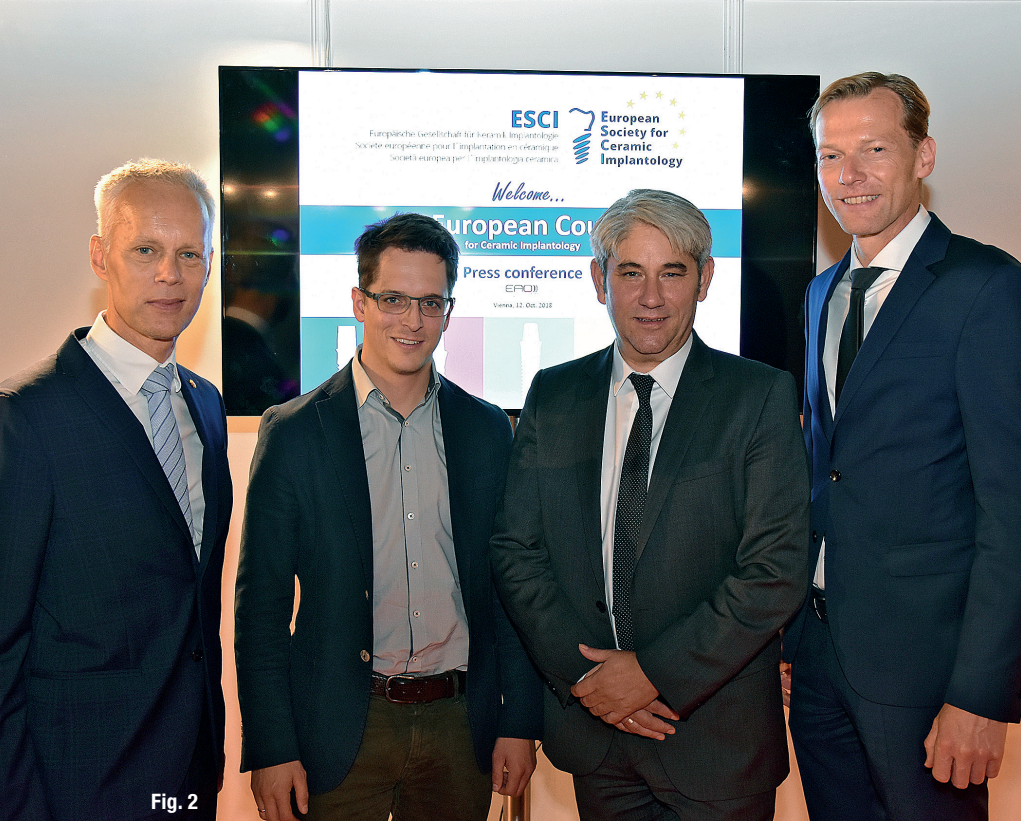

Fig. 2: From left: Prof. Dr Dr Werner Zechner, ESCI Vice President Dr Stefan Röhling, ESCI President Dr Jens Tartsch and Prof. Dr Dr Michael Payer at the ESCI press conference during the EAO meeting in Vienna in October 2018.

ference. The companies Straumann, Nobel Biocare, CAMLOG, Dentalpoint and Z-Systems were represented by high-ranking delegates.

A hub for scientific activities

ESCI is committed to promote dental implant ceramic implantology. It will form a hub for scientific activities, assess them correctly and provide comprehensive information. In future, members will not only be offered the usual added value, such as price reductions at events or web presence, but also concepts for direct and individual support in the use of ceramic implants in daily practice will be developed. In particular, this includes offers such as support forums, advanced training in treatment centres or literature summaries with direct practical reference. In October 2019, the first European congress for ceramic implantology of the ESCI will be planned. Details will follow.

A joint statement

However, as a special success of the first ESCI council it can be stated that for the first time it was possible to formulate a joint statement of science and industry on the current state of dental implantology with ceramic implants, which was supported by all stakeholders and adopted by the council: Ceramic implants are an addition to the treatment spectrum in implant dentistry. They are a "hot" topic in implant dentistry and need a sound scientific and clinical approach. Moreover, the request for ceramic implants is increasing. Micro-rough zirconia implants show similar osseointegration rates as titanium implants. Furthermore, clinical investigations on zirconia implants report comparable results to titanium implants up to 5 years. Zirconia implants are recommended for clinical use. However, long-term results are currently missing to confirm the promising short-term and mid-term data. Optimised manufacture processes and standardisation of testing is needed.

ESCI video

contact

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Safe and biologic teeth replacement methods with

Ceramic implantology as new frontier

In February 2019, the International Academy of Ceramic Implantology (IAOCI), which was formed in 2011, will be hosting their 8th Annual Congress in Tampa, Florida, USA. Since their 7th World congress in San Diego in 2018, the Academy has grown in size, popularity and notoriety. Moreover, they have increased their membership by an average of twenty per cent each year. The Academy's yearly world congress and their events have grown in size and the interest both from doctors and sponsors has followed the same trend. For the IAOCI, ceramic implants are a viable alternative and they see ceramic implantology as a new frontier in the pursuit for safe and biologic methods of teeth replacement.
Being present and well represented in over thirty events around the globe, the IAOCI has been able to establish strategic partnerships with many organisations, societies, universities and dental education institutions. For one thing, the Academy participated at the DGOI and Digital Dental Society Congresses in Germany. In addition, the IAOCI was a partner to the "Académie de Chirurgie Guidée" in Paris, France, this past spring, where a presentation was made on the use of guided surgery with ceramic implants. Apart from that, the Academy was invited at the Alexandria Oral Implantology Association Stars Meeting in Egypt where ceramic implantology was introduced for the first time. In the city of Kigali, they were introducing and conducting a ceramic implant workshop at the Pan-African Dental Congress.
The Academy has set itself the task to promote science-based education and practice of ceramic implantology: They created the international Zirconia Implant Research Group (ZIRG) which brings together well-known clinicians and scientists in the field of bioceramics and ceramic dental implants. Since zirconia bioceramics are putting the established paradigms of titanium implants into question, the Academy's objective is to initiate and conduct clinically applicable and relevant research aiming to broaden and improve the understanding of zirconia and other implantable bioceramics. Furthermore, the IAOCI has entered in an affiliation partnership with the American Ceramic Society (ACerS) this year which includes an endorsement of the upcoming 8th World Congress by ACerS. Additionally, the Academy was invited to host the first ceramic dental implant workshop at the ACerS 4th International Conference on Innovations in Biomaterials, Biomanufacturing and Biotechnologies (Bio-4), to be held in Toronto, Canada, next July. In close collaboration with their education partner INFINITO Advanced Dental Education Group, the IAOCI endorsed the first ever Latin America ceramic implant congress in Bogota, Colombia, in October 2018. As the next step, the Academy will be co-hosting the first ceramic implant symposium ever held in Brazil. Looking to the year ahead, the IAOCI is expecting a continued growth and reach across countries and continents.
Join us in Tampa, Florida, USA, this February 14–17, 2019 by registering at the www.iaoci.com/iaoci2019.

Dr Sammy Noumbissi, Founder and President of IAOCI.

Source: IAOCI

Acupuncture could reduce

Dental anxiety

Fear of the dentist is something some people suffer from more than others. With multiple reasons for dental anxiety, there is, however, limited research on its impact and possible treatment methods. In this regard, researchers from the University of York, UK, have recently reviewed a number of studies on treating dental anxiety with acupuncture. For the systematic review and meta-analysis, six trials with a total of 800 patients were chosen from almost 130 eligible trials. In the studies included, anxiety was shown to be reduced when dental patients were given acupuncture treatment. According to Dr Hugh MacPherson, Professor of Acupuncture Research at the University of York's Department of Health Sciences, the scientific interest in the effectiveness of acupuncture both as a stand-alone and as an accompanying treatment to more traditional medications was increasing. "If acupuncture is to be integrated into dental practices, […], then there needs to be more high-quality research that demonstrates that it can have a lasting impact on the patient. Early indications look positive, but there is still more work to be done," summarised MacPherson.

Source: DTI

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IAOCI | International Academy of Ceramic Implantology

Congresses, courses and symposia

8th IAOCI World Congress

14–17 February 2019
Venue: Tampa, FL, USA
www.iaoci.com/iaoci2019

AO Annual Meeting

13–16 March 2019
Venue: Washington DC, USA
www.osseo.org/annual-meetings

Giornate Veronesi

3–4 May 2019
Venue: Verona, Italy
www.giornate-veronesi.info

5th Annual Meeting of ISMI

10–11 May 2019
Venue: Constance, Germany
www.ismi-meeting.com

EAO Congress 2019

26–28 September 2019
Venue: Lisbon, Portugal
www.eao.org

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