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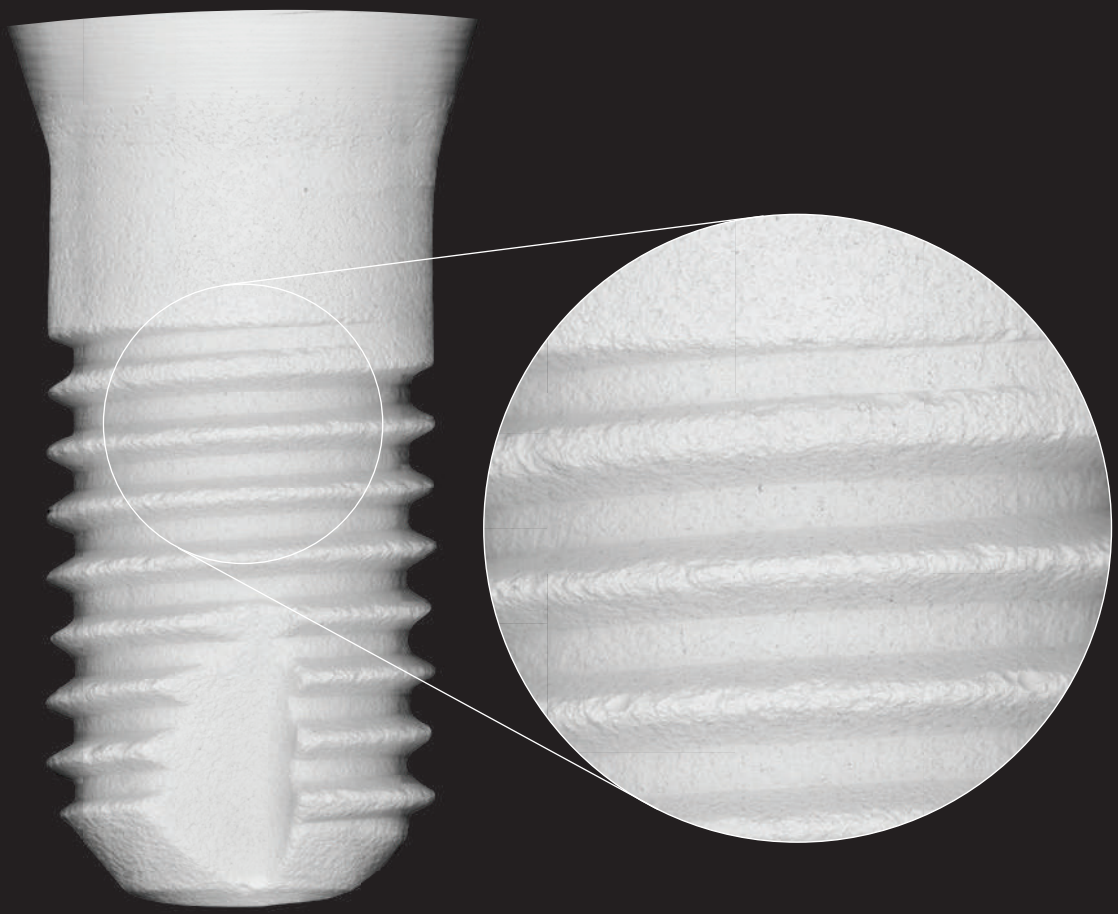
ceramic implants

international magazine of ceramic implant technology



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case report
Creating natural emergence profiles in the aesthetic zone

interview
A revolution in dental implantology

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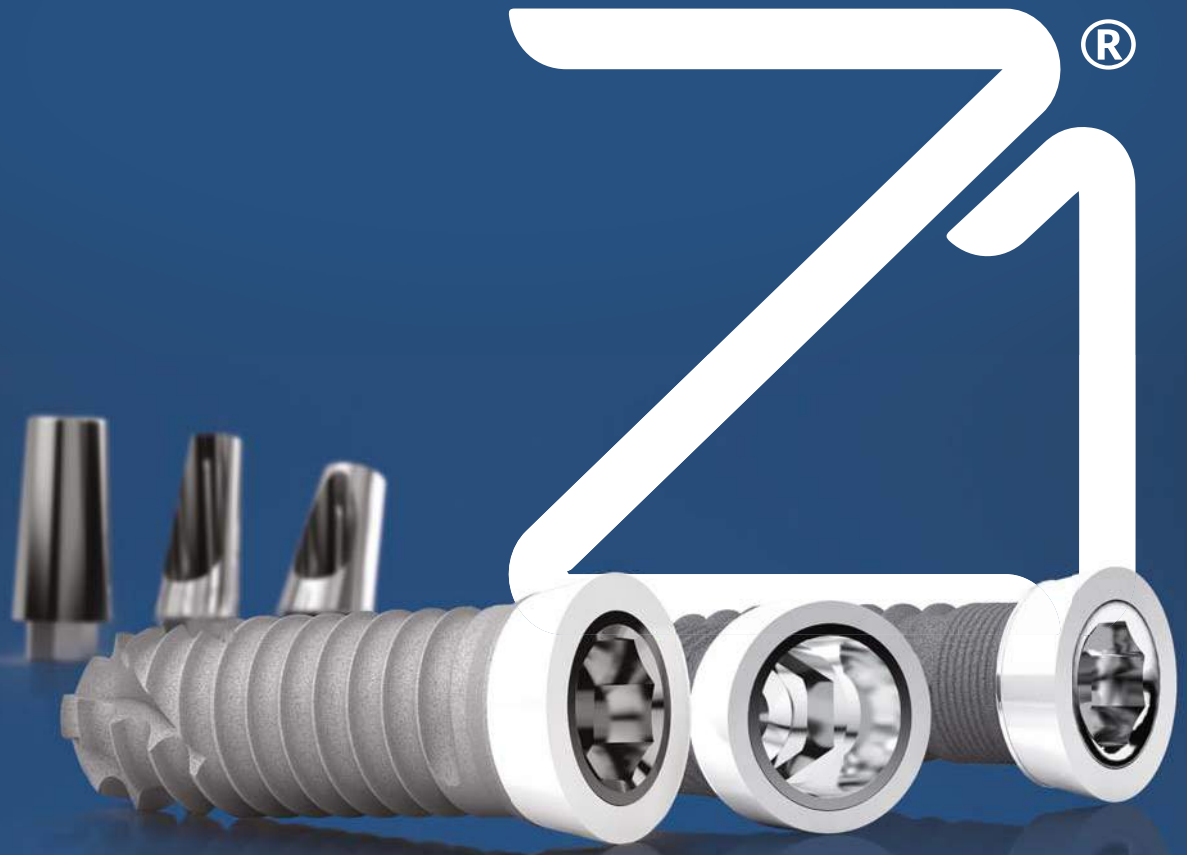

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Georg Isbaner

Managing editor

Keeping up the momentum of ceramic implants

Dear friends,

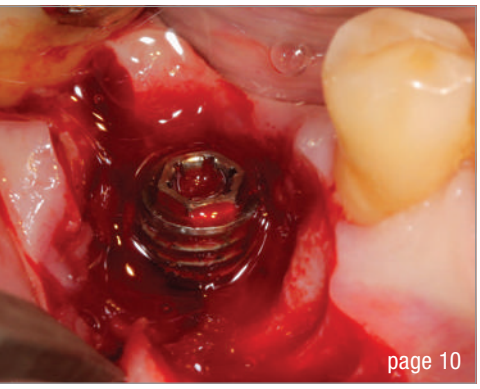
Around the world, fresh initiatives regarding ceramic implants technologies are being launched. In this issue of *ceramic implants*, we introduce two start-up companies from Poland and Spain which are developing entirely new ceramic systems and will be establishing them on the market in the months and years to come. We spoke to Dr Jarosław Pospiech, implantologist, engineer and inventor of the Polish implant system OriCera, about its novel screwless, detachable connection that requires neither adhesive nor cement. From Lidia M. Goyos Ball, medical devices division manager at Nanoker, we learn how the Spain-based company utilises two specific materials for its original ceramic implant system: a bioceramic composite on the one hand and a specific bacteriostatic bioglass coating on the other. The endeavours of these two companies prove that there is a continuing evolution of ceramic implant systems from being mere titanium copycats to becoming independent, customised solutions that respect the physical properties of the materials employed.

This trend towards independence is also reflected in the work of scientific expert societies. The incredibly active ceramic societies in the US and Europe—IAOCI (US), ISMI (Germany, Europe), ESCI (Europe) and EACim (France, Europe)—are joined by initiatives by Dr Enrique Reinprecht (SADIC) in Argentina and Dr Rodrigo Gomes Beltrão (ABICeram) in Brazil, who will be supporting implantologists in their respective regions with information and further training opportunities regarding ceramic implantology in the near future. We are excited about news from these energetic organisations and we look forward to fruitful collaborations. Furthermore, it is no secret that there is another ceramic system heading for market approval in Argentina, the US and Brazil (approvals for Asia, Europe and Africa are to follow): Z7. This zirconia implant system draws on the expertise and the components of a start-up company, MABB Biomaterial, that advances crucial ceramic implant technologies. Founded by Daniel Miguez in Buenos Aires, MABB aims to make the manufacturing processes of modern, highly precise ceramic systems both faster and more cost-effective by utilising ceramic injection moulding and nanotechnology, with triple impact purposes and a global mission to fulfill.

In short, we are in the early stages of a seismic shift in dental implantology, which is primarily being shaped by modern ceramic implant systems. If one takes into consideration that health-conscious and sophisticated patients with high aesthetic demands especially will only consider therapeutic options employing ceramic systems, we know exactly where the future is headed.

But for now, enjoy the read. Stay tuned. We will keep you posted!

Georg
Managing editor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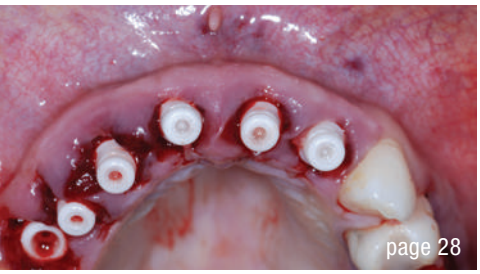
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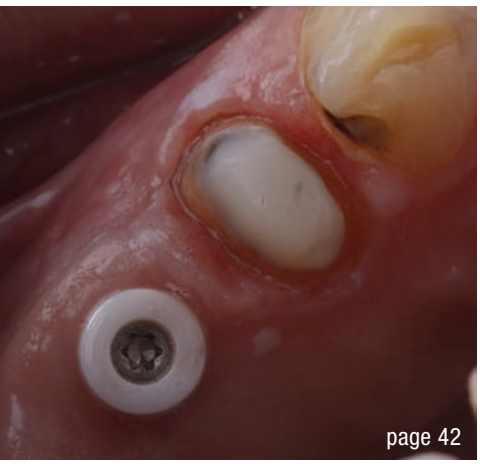
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Hard tissue augmentation

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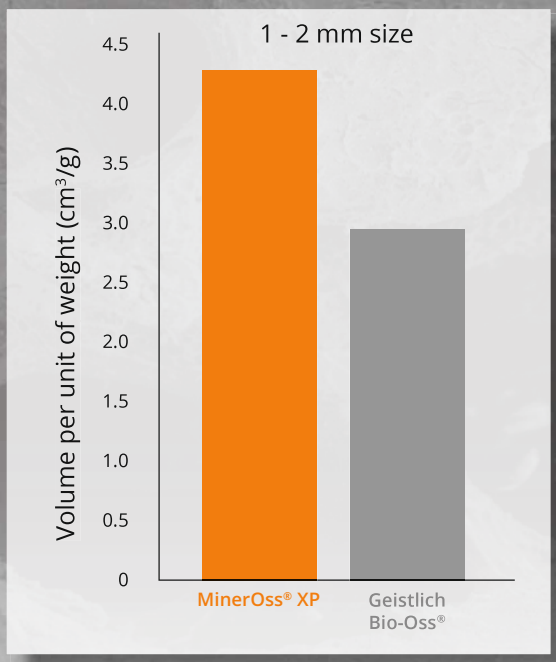

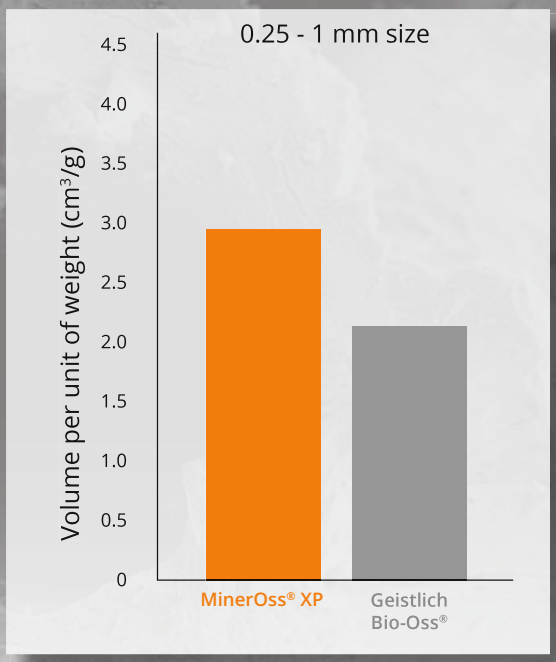

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Promoting osseointegration of ceramic implants

Optimised diet and targeted intake of micronutrients

Dr Dominik Nischwitz, Germany

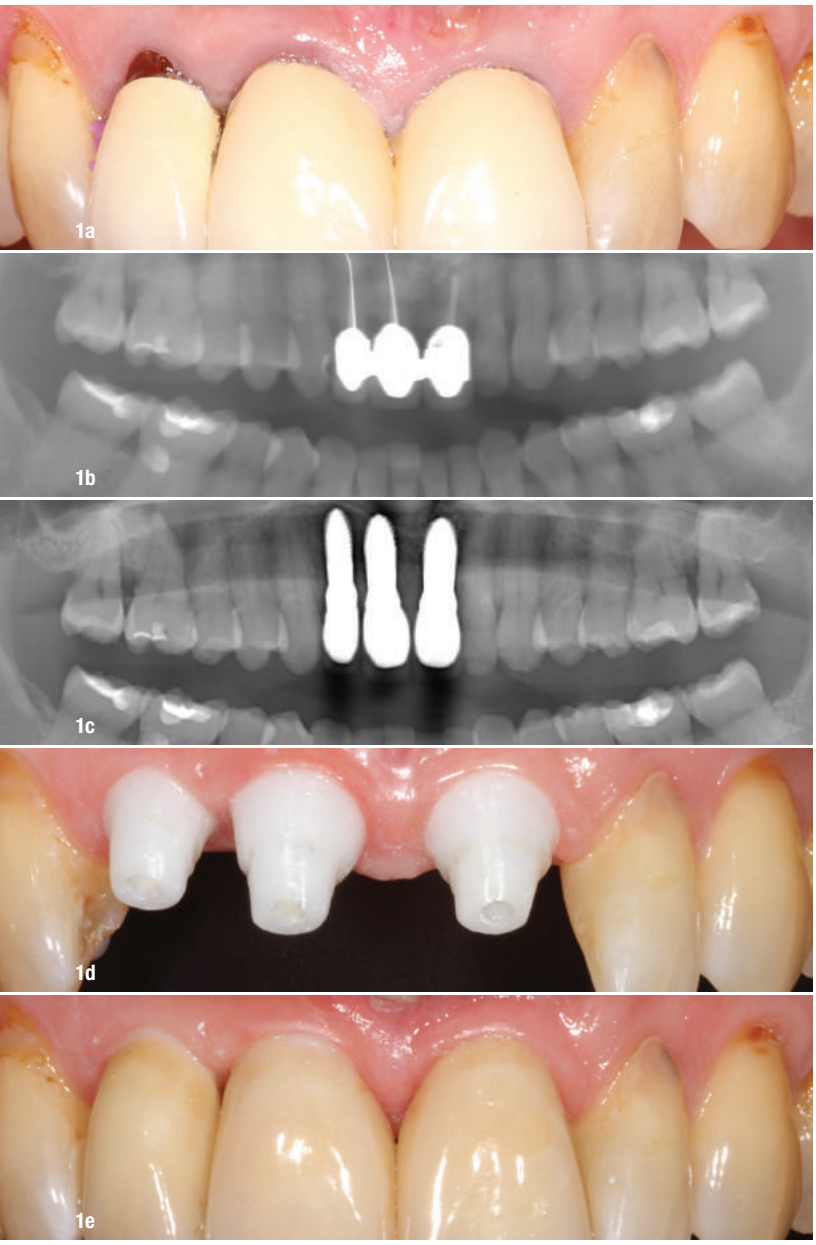

Fig. 1: A clinical case example of a multiple tooth replacement with ceramic implants: initial clinical situation **(a)**, panoramic radiograph pre-op **(b)**, panoramic radiograph after healing **(c)**, view of the inserted implants after healing **(d)**, view of the definitive restoration **(e)**.

In traditional oral surgery and implantology, the focus lies mainly on the healing of an implant and the local factors that are necessary to preserve or grow bone and soft tissue. However, the view is still rather confined to the oral cavity. Classically, four methods of bone augmentation are considered: osteoinduction (growth factors), osteoconduction (bone grafting material as space holder), distraction osteogenesis and guided tissue regeneration by means of membranes or the shell technique, among others. In biological dentistry, we utilise the experience and the knowledge from functional medicine and nutritional science and conduct targeted therapies with micronutrients in order to create optimum systemic conditions for a scheduled surgery and to promote subsequent bone and soft-tissue regeneration.

Local factors

There are different local factors of intelligent bone and soft-tissue regeneration to be considered. Among them are the decontamination of a surgical site (from breathing or saliva), the activation of local growth factors such as insulin-like growth factor-1, osteoblasts and plasma proteins by drilling and creating bleeding spots for refreshening bone and for stimulating osteoblastic activity, and the application of intelligent biomaterials such as platelet-rich fibrin membranes in order to improve the extracellular matrix and to optimise bone and soft-tissue conditions. In addition, the use of microinvasive techniques such as piezo-surgery, ozone therapy, technologies for guided implant surgery and improved imaging by CBCT has elevated our medical profession in terms of both dental skill and technical expertise.

There is a clear trend towards aesthetics and general health. Dental implants made of ceramics are no longer a controversial subject, but rather the future of implantology. However, as of today, only 1% of all oral surgeons are placing ceramic implants. Based on ten years of experience and placement of over 4,000 ceramic implants personally, I would argue that further surgical and systemic information is required in order to elevate the success rate of ceramic implants. Ceramic implants heal with

the surrounding tissue without initiating inflammatory processes, which is actually the crux of the matter, since hardly anyone of us dental professionals have comprehensive knowledge about the biochemistry of the entire human body. In ceramic implantology, it is vital to integrate the knowledge obtained from functional medicine and nutritional science and on micronutrients in order to prepare the body for a transitional phase. Hence, we put an overarching focus on the lifestyle of our patients. In this context, the systemic preparation for the day of surgery and targeted postoperative care are equally important.

Preparation for surgery: Change of diet

Following an unhealthy diet that includes the intake of sugars, wheat products, refined edible oils and conventional dairy products and other foods that can trigger possible intolerances leads to a general inflammation susceptibility of the body, as well as to macro- and micronutrient deficiency. Proteins and amino acids, fat-soluble vitamins A, D3, E and K, water-soluble vitamins B and C, minerals like zinc and magnesium, and healthy omega-3 and omega-6 fatty acids are lacking for the formation and the regeneration of soft tissue and bone.[1] It is our goal to prepare patients as effectively as possible for surgery. In this context, the focus is on the supply of the vital macronutrients as well as the avoidance of as many stressors as possible. The four core dietary ills mentioned earlier in this paragraph should be avoided at all costs. Over 100 years ago, Dr Weston Price conducted research on different peoples and tribes all around the world. He documented his findings in his book *Nutrition and Physical Degeneration*,[2] in which he states that people who maintain a species-appropriate diet are virtually immune to dental caries. Their descendants, who had already come into contact with industrially processed foods and liquids, started to develop typical signs of degeneration, since they were lacking nutrients. The most vital macronutrient for the formation of human tissue such as bone, soft tissue and muscular tissue is protein.

Proteinogenic amino acids—building bricks of life

Based on my personal experience, I would argue that more than 90% of our society has a protein deficiency and, as a result, an amino acid deficiency. Although 20 proteinogenic amino acids exist, only seven of these are obtained through dietary intake. These essential amino acids are isoleucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine. From these seven amino acids, the human body is capable of creating every protein, given that enough resources are available in the body for doing so. Numerous studies have shown a link between deficient bone formation, reduced bone density and the delayed healing of bone fractures, and protein and amino acid deficiency. The older the patient, the more significant the connection.
Already in 2006, Dayer et al. presented their findings from an animal study in which they reported reduced osseointegration of titanium implants in rats with a protein deficiency (< 1 g/kg of body weight). The force necessary to explant an implant from the bone after six to eight weeks was 43% less in rats with a protein deficiency compared with rats with sufficient protein in their diet (1 g/kg of body weight).[3] In addition, based on the data of 391 women and 224 men over the course of four years, obtained from the Framingham Osteoporosis Study, Hannan et al. suggested a significant connection between a deficiency in animal-based protein in a diet and bone loss. The greater the protein deficiency, the great the loss of bone quantity of the femur and spine. A negative effect of a protein surplus and bone healing could not be detected.[4] As a logical consequence, our overriding focus is on adequate supply with protein. Since there should not be macro- and micronutrient deficiency in the phase of acute regeneration, we recommend a daily protein intake of 1.5–2.0 g/kg of body weight. In order to alkalise the body, one serving of vegetables is additionally recommended. Healthy fats like omega-3 fatty acids as well as a variety of monounsaturated and polyunsaturated fatty acids are vital in this context. Collagen powders, essential amino acids, bone broths and protein

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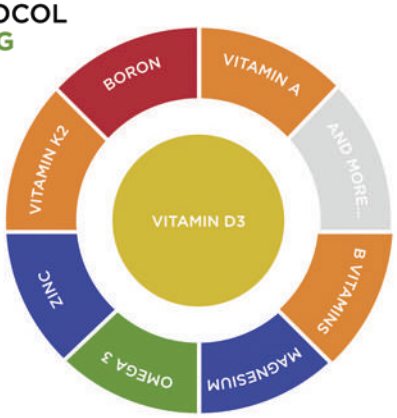

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Fig. 2: The author puts an overriding focus on the systemic support of his patients by means of a targeted diet rich in protein, healthy fats and vegetables in order to alkalise their bodies and to promote their autologous bone healing mechanisms. (© Dr Dominik Nischwitz) **Fig. 3:** Vitamin D3 in high doses is the basis of the Bone Healing Protocol (BHP®) according to which patients are prepared for implant surgery through the targeted intake of micronutrients in the practice of the author. (© Dr Dominik Nischwitz)

shakes are great tools for patients to easily reach the desired protein intake. In our practice, the systemic support of patients by means of a targeted diet (Fig. 2) and supplementation of the important nutrients has established itself as a standard in the field of oral surgery.

Micronutrients

Vitamin D3 in high doses is the basis of the bone healing protocol (Fig. 3). Ahead of surgery, we evaluate the vitamin D3 levels in the blood of our patients. In order to be able to treat them in the best possible way, we target a preoperative value of at least 60 ng/ml.[5] A myriad of studies indicate that vitamin D3 is a decisive factor for the regeneration of bone and teeth.[6–10] Vitamin D3 activates two enzymes that are vital for the mineralisation of bone: osteocalcin and matrix Gla protein. In order for calcium not to calcify the arteries, these enzymes are activated by another important co-factor: vitamin K2 (Subtype MK-7).[11] A further important co-factor is magnesium, which contributes to over 400 metabolic processes in the human body.[12] Zinc contributes both to maintaining the immune system as well as to activating the vitamin D3 receptors as a co-factor.[13] Apart from that, the trace element boron doubles the half-life period of vitamin D3.[14] Since micronutrients operate in a synergetic way, sufficient vitamin B and C, digestive enzymes and omega-3 fatty acids need to be present in the organism throughout the postoperative phase.

Summary

In addition to the traditional, rather fine surgical craft that is dentistry, we utilise knowledge from functional medicine and nutritional science. In doing so, we support the endogenous healing capabilities of patients and enable improved tissue and bone healing and, as a consequence, improved healing of ceramic implants as well. The result is fewer failures and even healthier and happier patients.

References

about the author

Tübingen-based **Dr Dominik Nischwitz** is a specialist in Biological Dentistry and ceramic implant dentistry. He is a founding member and the current Vice President of the International Society of Metal Free Implantology (ISMI). Together with his father, he founded the DNA Health&Aesthetics – Center for Biological Dentistry in Tübingen, Germany, in 2015. Dr Nischwitz is frequently invited as a speaker to dental conferences around the globe. In addition, he recently published his first book titled *It's All in Your Mouth: Biological Dentistry and the Surprising Impact of Oral Health on Whole Body Wellness.*

contact

Dr Dominik Nischwitz
DNA Health&Aesthetics
Tübingen, Germany
+49 7071 975977
info@dnaesthetics.de
https://tap.bio/@DrDome

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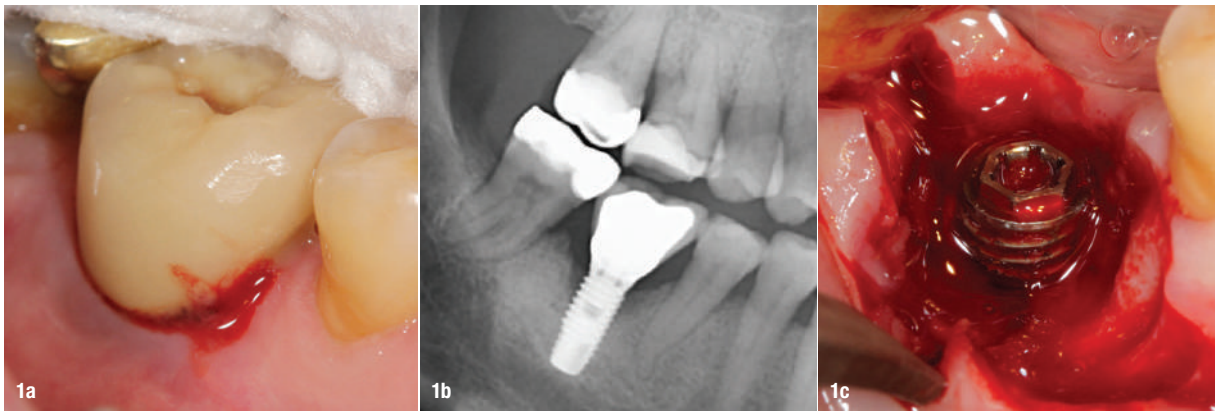
Zirconia implant: Close to the natural root?

Dr Fabrice Baudot & Dr Giancarlo Bianca, France; Dr Pascal Eppe, Belgium

Titanium (Ti) implants are generally used to restore function and aesthetics following tooth loss.[1] Numerous studies have demonstrated their excellent biocompatibility and high success rates.[2, 3] However, the prevalence of peri-implantitis (PI) around Ti implants, should be a daily clinical concern due to their high incidence (Figs. 1a–c; resolution of the case shown in Figs. 8a & b).[4] Recent studies have reported the presence of Ti particles around implants with PI compared to a healthy peri-implant environment.[5, 6] Galvanic corrosion phenomena in the oral cavity could be related to the physiopathogenesis of PI.[7] This issue takes up a large part in most of our conferences, and questions the reliability of our long-term implant treatments.[8] The qualities of zirconia (ZrO_2) ceramics as a prosthetic restorative material show us in daily use an extremely low bacterial colonisation, and allow soft tissues to act as a barrier to the underlying infection.[9] This material is not a thermal nor an electric conductor, and, thanks to its high inertia, it has excellent chemical stability with almost no ionic release:[10] this greatly contributes to its biocompatibility observed with periodontal cells, and could explain the absence of allergy or hypersensitivity to ceramics.[11] ZrO_2 implants may be considered as a real alternative to Ti for our patients, especially those with allergies, autoimmune diseases, periodontal risk factors and metal intolerances.[12, 13] We must also consider the current trend in dentistry towards metal-free restorations, and the long-term aesthetic outcome of our restorations.

Osseointegration of zirconia compared to titanium

Successful integration of implants is based on osseointegration (in the hard tissue), and the formation of a peri-implant mucosal seal (in the soft tissues).[14] As for the hard-tissue level, the key parameters to evaluate osseointegration include the measurements of the bone-to-implant contact (BIC) and the implant removal torque values (Fig. 2).[15] Most of the studies show no significant differences between Ti and ZrO_2 implants.[16, 17] Several reviews of the literature mention the osseointegration capacity of ZrO_2,[18] including a 2016 review, which selected 14 articles out of 1,519 publications, with a cumulative success rate at one year representing 92%. In all these reviews, the authors concluded that ZrO_2 implants do represent an alternative to Ti, but that further long-term studies are needed to confirm this.[19] Different surface treatments have been proposed. For example, a laser-machined surface allows to achieve an increase of the BIC surface due to an increased micro- and macro-roughness. This technique considerably reduces the time



Figs. 1a–c: Peri-implantitis around an implant in position 46 and the metal-ceramic crown **(a)**, panoramic radiograph showing the type of bone defect **(b)**, bone destruction with granulation tissue around the Ti implant; after attempting periodontal debridement and GBR, it was decided to remove the implant **(c)**.

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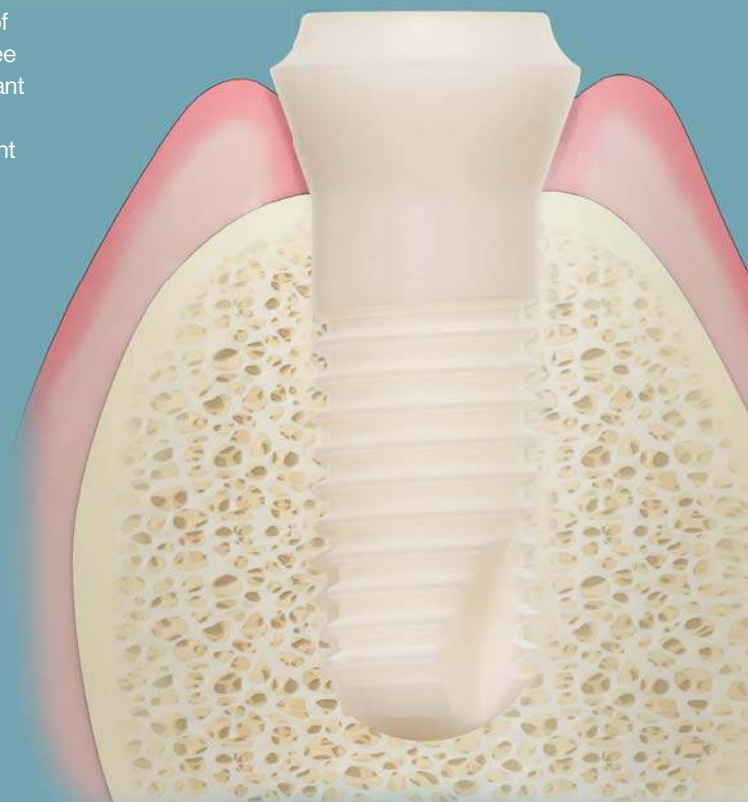

[1] Becker J, John G, Becker K, Mainusch S, Diedrichs G, Schwarz F. Clinical performance of two-piece zirconium implants in the posterior mandible and maxilla: a prospective cohort study over 2 years. Clin. Oral Impl. Res. 28, 2017, 29 – 35 doi: 10.1111/clr.12610

Patent

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Bone-to-implant contact

Weeks	Titanium (%)	Zirconia (%)
4	23.5 ± 7.5	27.1 ± 3.5
8	55.3 ± 27.6	51.9 ± 14
12	58.5 ± 11.4	57.1 ± 12.4

Days	Titanium (%)	Zirconia (%)
14	36	45
28	45	59

Fig. 2: Evidence of ZrO_2 osseointegration.

for osseointegration. The survival rate currently exceeds 98%, and is comparable to that of new generation Ti implants. In regard to the soft-tissue level, the qualitative and quantitative dimensions of the peri-implant mucosa around ZrO_2 implants are similar to those of Ti implants (Fig. 3).[20, 21] Under these conditions, immediate implantation protocols can also be implemented as for Ti implantology (Figs. 4a–h).

Soft-tissue behaviour towards zirconia

A protective anti-microbial, anti-inflammatory barrier

Our implant restorations are inserted on the long-term, in a very septic and aggressive environment. The interface between this environment and the underlying structures (bone, vascular network) is provided by the peri-implant soft tissues. There is a real difference in terms of quality of this interface between a tooth and an implant. In 1991 and 1994, researchers described a fibre-free epithelial junction attachment around transmucosal Ti compared to the Sharpey's fibres present around teeth, and concluded that the peri-implant soft tissues are more fragile.[22, 23] They offer less mechanical strength, but are also less vascularised and more immune-sensitive.[24–26] The long-term stability of peri-implant soft tissues is a key issue both in the fight against PI, and in the aesthetic and functional outcome of implant-supported prosthetic restorations. The quality of the mucosal seal around the transmucosal part of the implant restoration is crucial. In 2006, a list of the important and influential soft tissue factors for implant integration was published.[27] This study revealed, among other things, that tissue-level implants behave better than bone-level implants; Ti and ZrO_2 are preferable to gold or feldspathic ceramics for the transmucosal components; smooth surfaces are preferable to rough surfaces; in the case of bone-level implants, disconnection and reconnection of the prosthetic abutments should be avoided. It therefore appears logically that tissue-level implantology is better with respect to soft-tissue integration of implants (Fig. 5) in that issues such as gap problems, hermeticity of the subgingival prosthetic parts, the platform switching concept to reinforce the soft tissue seal no longer exist. Ti and ZrO_2 seem to be the best materials for the transmucosal integration of our restorations. Integrating biological and aesthetic parameters, what is the best material to choose between ZrO_2 and Ti at the soft-tissue level? This is a legitimate issue to question. The peri-implant mucosal seal

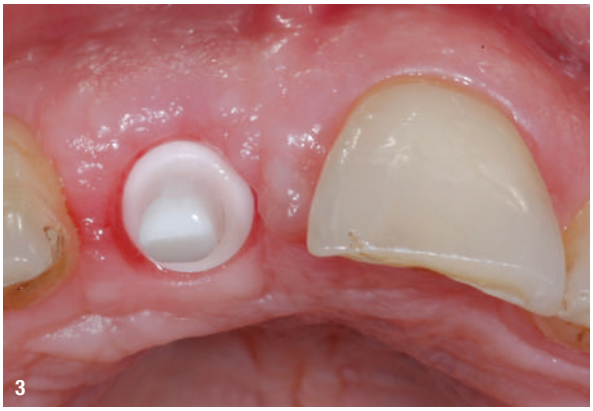
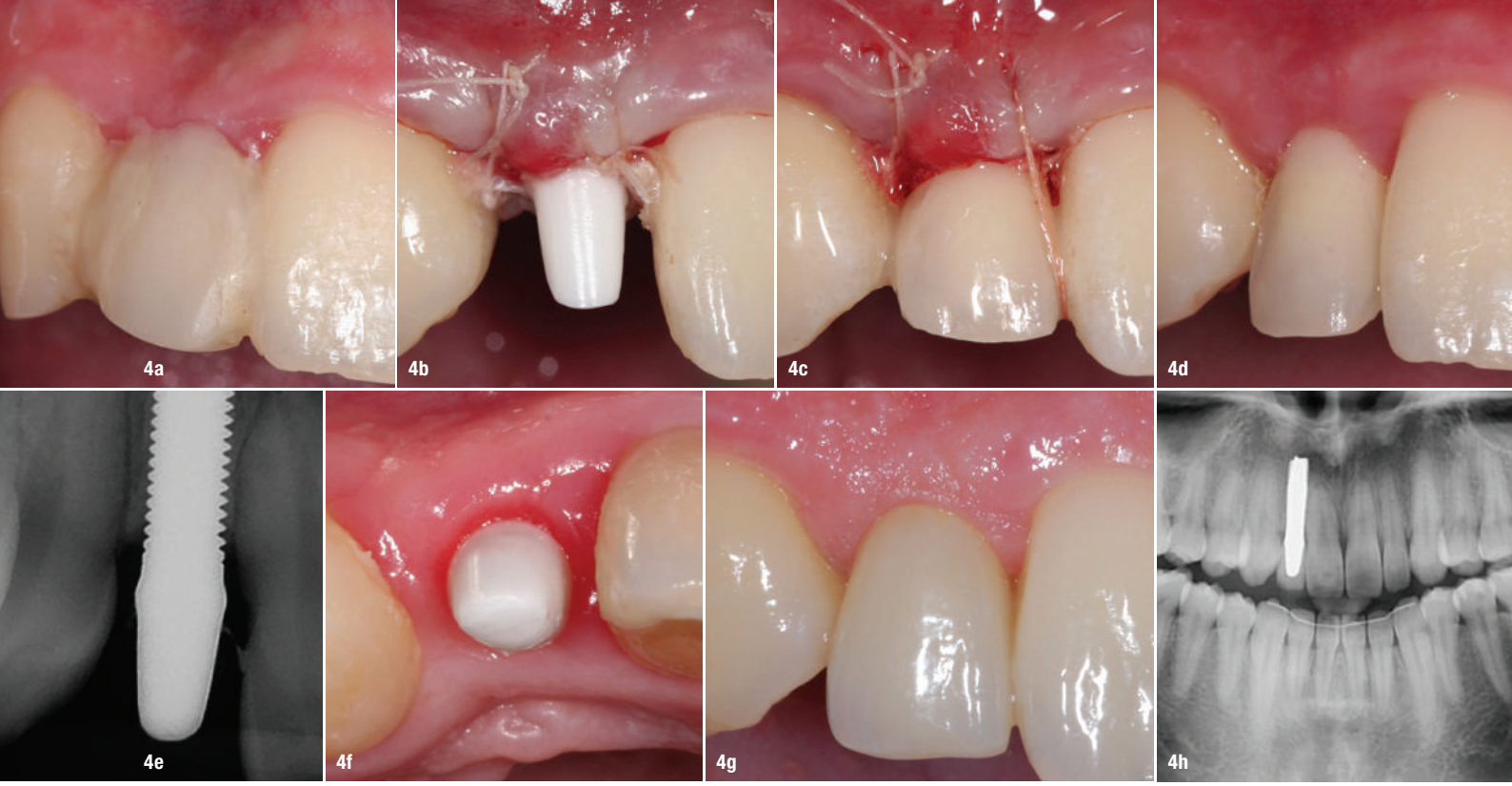


Fig. 3: On the day of impression taking: clinical case of a one-piece implant (Z-SYSTEMS) in site 11 showing perfect soft-tissue integration.

acts as a protective barrier towards the underlying structures. There are three fundamental aspects to be considered: the microbiological aspect, the biomechanical aspect related to cell adhesion and proliferation around transmucosal implant structures, as well as the potential release of metal ions that disrupt local immunity.[28]

Microbiological behaviour of zirconia

In a 2002 *in vitro* and *in vivo* comparative study on Ti, researchers described the transmucosal ZrO_2 interface as an anti-microbial shield.[29] This observation was confirmed by further studies. In 2014, researchers conducted an *in vivo* study based on the use of split casts worn for 24 hours, comparing ZrO_2, smooth Ti and rough Ti.[30] Analyses of the pathogenic and non-pathogenic flora revealed less microbial adhesion on ZrO_2 than on the other two Ti surfaces. Consequently, bacterial colonisation is lower on ZrO_2 than on Ti. This was confirmed again in 2016 by the same author, and later on by another researcher in 2018 in a 6-month follow-up study comparing transmu-



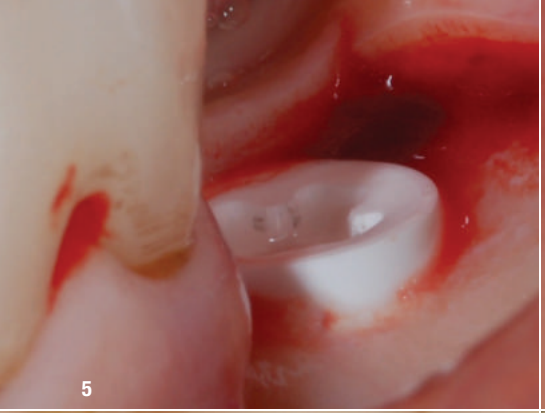
Figs. 4a–h: An 18-year-old patient with agenesis of an upper right lateral incisor **(a)**, a 3.6 mm diameter one-piece implant is placed with an abutment correction using a red ring diamond bur; a pedicled soft-tissue graft is performed using a roll technique **(b)**, placement of an immediate provisional crown out of occlusion; sling sutures for the coronally advanced flap **(c)**, tissue healing around the immediate provisional crown **(d)**, periapical radiograph showing implant osseointegration at three months following immediate temporisation **(e)**, occlusal view of soft-tissue healing with preparation of the one-piece implant prosthetic abutment (15° axis adjustment) **(f)**, aesthetic result at ten years (in this 28-year-old patient) **(g)**, panoramic radiograph at ten years **(h)**.

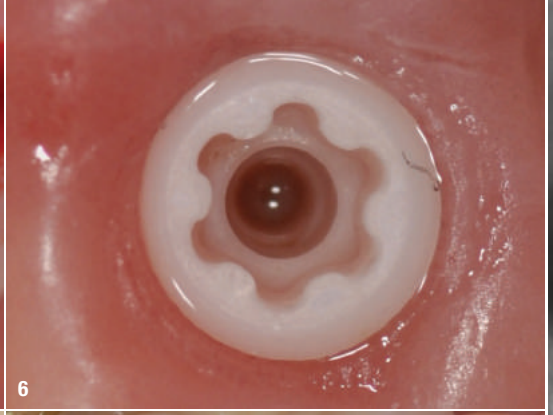
cosal ZrO_2 and Ti abutments they observed more pathogenic bacteria on Ti.[31, 32] This difference in microbial behaviour towards Ti compared to ZrO_2 exposes Ti to an increased risk of PI, as was pointed out in a review article in 2014.[33] Microbial colonisation causes an inflammatory infiltrate within the tissues in response to this microbial presence. The tissue defence barriers are weakened and more permeable to biofilms. A chronic inflammatory wound then develops within the peri-implant soft tissues which disturbs bone metabolism, thus constituting a risk factor for PI: a phenomenon very similar to periodontitis. Around transmucosal ZrO_2, researchers showed in 2015 that inflammation level decreased compared to Ti.[34] The risk of alteration of the soft tissue barrier effect therefore lower with ZrO_2 than with Ti.

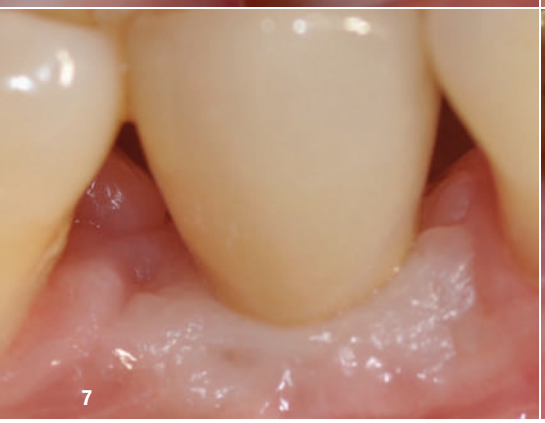
A recent study from 2017 confirms the positive influence of transmucosal ZrO_2 on the level of pro-inflammatory cytokines present in the peri-implant sulcus.[35] In this publication, the authors compared the behaviour of the transmucosal ZrO_2 and Ti abutments using split-mouth *in vivo* study. They showed that the pro-inflammatory cytokine levels were significantly higher around Ti compared to ZrO_2. As often reported in the medical literature, some controversies exist. In 2015 researchers published, in the very serious *Journal of Clinical Oral Implant Research*, a meta-analysis comparing the effect of Ti and ZrO_2 on the soft tissues.[36] The inclusion criteria were strict: 11 studies were selected including only prospective randomised controlled studies on the same patient. They concluded that Ti and ZrO_2 behaved similarly. The only difference in favour of ZrO_2 was aesthetics. However, very recently in 2018, in the same Journal a review article and meta-analysis on the effect of transmucosal abutment characteristics on peri-implant soft tissue health was published: the authors concluded that the risk of PI is increased with Ti compared to ZrO_2.[37]

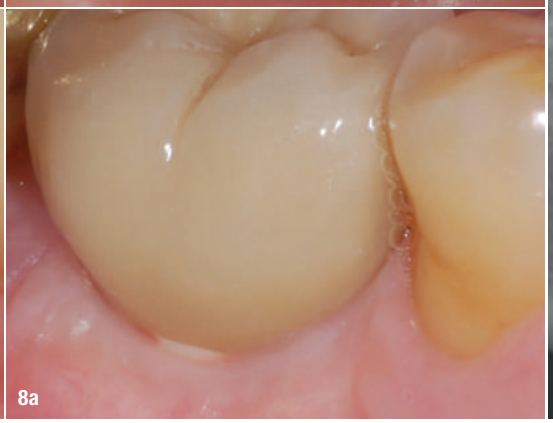
Tissue and cell behaviour towards zirconia

In addition to the "antimicrobial" effect of ZrO_2 mentioned earlier, the literature describes a favourable behaviour of ZrO_2 on the peri-implant soft tissues. The interaction with soft tissues and transgingival ZrO_2 generates a mechanical antimicrobial barrier effect that protects the underlying structures (Fig. 6). In a 2004 study on the cell behaviour around transmucosal ZrO_2 implant necks compared to Ti, the authors observed better fibroblast adhesion and cell proliferation around ZrO_2.[38] In another study from 2009 on animal histological sections, the authors showed collagen fibres orientated perpendicular to the ZrO_2 surface as opposed to Ti where they were parallel.[20] This fibre orientation reinforces the peri-implant mucosal joint and may partly explain the "creeping attachment" phenomenon which is clinically observed around ZrO_2 necks. In 2019, a Korean team carried out a comparative *in vivo* and *in vitro* animal study on the behaviour of peri-implant tissues with respect to ZrO_2, Ti and hydroxyapatite.[39] In particular, they evaluated the quality of the mucosal joints around these three implant surfaces. ZrO_2 obtains the best results on the histological sections and *in vitro* cell levels; ZrO_2 also promotes better prolif-









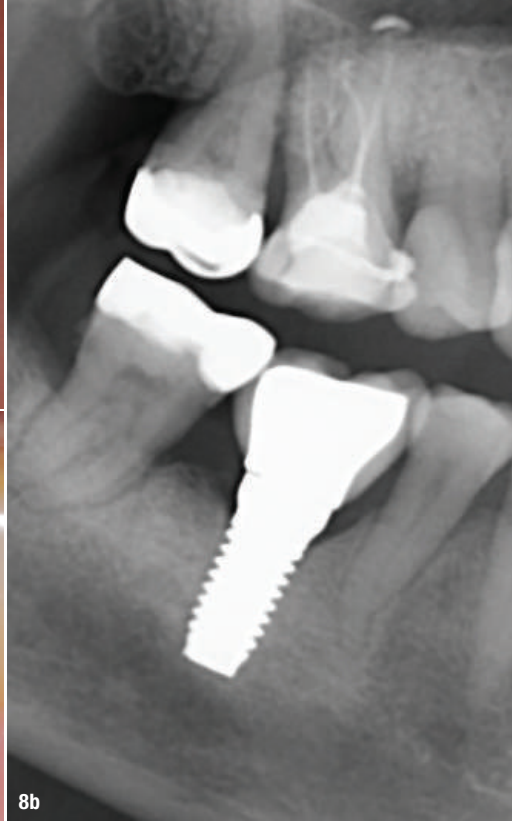


Fig. 5: A 5.5 mm diameter implant, placed "supracrestally" 1.6 mm above the bone crest (NobelPearl, Nobel Biocare). **Fig. 6:** The quality of peri-implant soft tissue achieved with transmucosal ZrO_2 provides an antimicrobial barrier effect (CERALOG, BioHorizons Camlog). **Fig. 7:** Tissue integration of a ceramic-to-ceramic restoration on a ZrO_2 tissue-level implant. The stability of the soft tissues favours papillae preservation. **Figs. 8a & b:** Soft-tissue quality and quantity around a one-piece implant Z-SYSTEMS zirconia crown **(a)**, peri-implant bone level stability at five years **(b)**.

eration of human fibroblasts (HPLF and HGF) and extracellular matrix cells (IhCEM) compared to Ti and hydroxyapatite. Due to its properties, transmucosal ZrO_2 appears to behave more like natural teeth with respect to soft tissues. This can be illustrated by a 2015 study which shows that blood flows around transmucosal ZrO_2 abutments are similar to those around natural teeth (Fig. 7).[40] ZrO_2 appears to be a biomimetic material around which the quality of the peri-implant mucosal joint is better than around Ti. The reduction to biofilm proliferation and the quality of soft tissue integrity which have been demonstrated around ZrO_2 provide a double protective barrier for the underlying tissues to chronic inflammatory infiltration and microbial invasion which is probably the main risk factor for PI. Thus, the use of the ZrO_2 implant to establish a high quality peri-implant mucosal seal can be considered a preventive approach in the strategy to control PI.

Conclusions

ZrO_2 implants have been around for 20 years, and if at first glance their interest may seem limited to pure aesthetics tdue to their colour. Today we realise that, thanks to their exceptional mechanical properties and optimal biocompatibility and immuno-compatibility, they certainly represent the future of implantology. Placing ZrO_2 implants in our patients is part of a preventive approach to peri-implantitis, because the quality of the peri-implant tissues achieved around these implants is an anti-microbial barrier which protects the underlying structures. The absence of oxidation reactions around the ZrO_2 implants and the reduction of bacterial plaque are real assets for their long-term stability in the particularly aggressive environment of the oral cavity. The latest currently available generations of ZrO_2 implants offer mechanical, biological and aesthetic qualities close to those of natural teeth.

Dr Fabrice Baudot
Author details and CV

Dr Giancarlo Bianca
Author details and CV

Dr Pascal Eppe
Author details and CV

contact

Dr Fabrice Baudot
Saint-Gély-du-Fesc, France
+33 4 99060060
dr.baudot34@orange.fr

Literature

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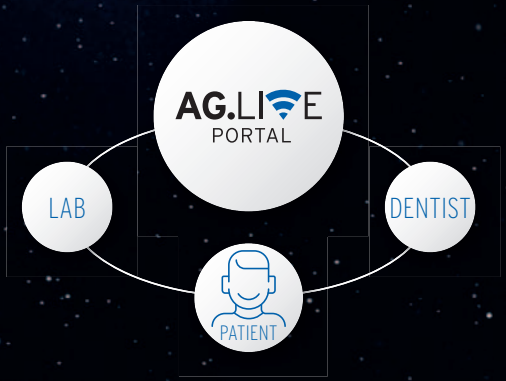

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Quality assessment of ceramic implants

Does white also necessarily mean clean?

Dr Dirk U. Duddeck, Germany

When it comes to aesthetics, ceramic implants are undoubtedly the better choice compared with titanium implants. Compared with titanium or titanium alloys, zirconium dioxide has some indisputable advantages. For example, for many users and patients, it is not only the fact of metal-free restoration that speaks in favour of this material but also the comparatively lower plaque affinity and high mechanical load-bearing capacity, combined with the better aesthetics. However, are zirconium dioxide implants cleaner than those made of titanium and titanium alloys when they leave the manufacturing facilities? Are the ceramic implant systems currently available on the market actually free from foreign particles? In order to clarify these questions, random samples of a total of 100 sterile-packaged implants were examined for residues under a scanning electron microscope (SEM). Fourteen of these were made of zirconium dioxide and the remaining 86 were made of titanium or titanium alloys. This recent, not yet published, study by the CleanImplant Foundation, conducted in cooperation with Charité—Universitätsmedizin Berlin in Germany and the University of Gothenburg in Sweden, came to sobering conclusions.

Considerable analytical effort

The analyses were performed in a testing laboratory accredited according to DIN EN/ISO IEC 17025:2018 to ensure the exact performance of the particle analyses according to DIN ISO 22309:2015, that is, elemental determination by energy-dispersive X-ray spectroscopy. The implants were unpacked in a particle-free environment (clean room Class 5 according to DIN EN ISO 14644-1) and subsequently scanned in the same clean room to exclude any laboratory contamination of the test samples. For a scientific study, this is a comparatively huge effort to analyse sterile-packaged implants for factory contamination. However, it was necessary due to the fact that the lead organisation, the CleanImplant Foundation, a non-profit organisation that has been promot-

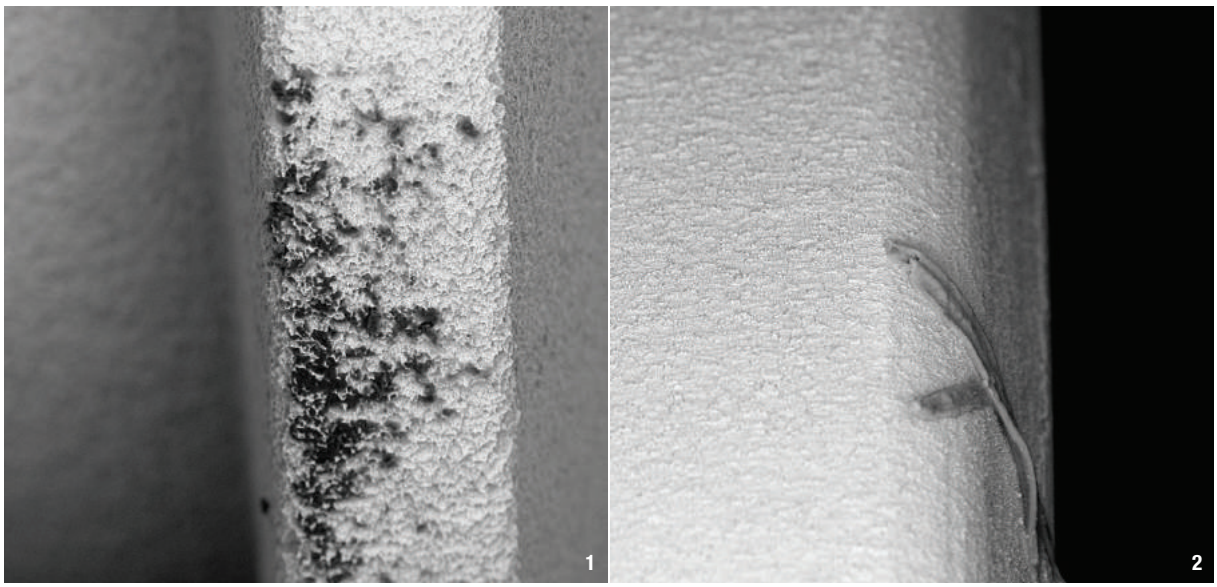


Fig. 1: Significant residues from production, handling or the packaging itself were identified under the SEM on almost every third titanium implant analysed in the study. **Fig. 2:** Considerable impurities were found on titanium implants that stemmed from processing errors in relation to wet-chemical cleaning.

ing the cleanliness of medical devices for many years with its quality assessment studies, has already been threatened several times with legal action by implant manufacturers whose implants revealed significant impuries in the analyses. This is why information about the respective manufacturers and the name of the conspicuously contaminated implants are excluded in this article. In order to protect the project from unjustified attacks, verifiable objectivity and the greatest possible validity and reliability of the implant analyses were indispensable prerequisites for this study, as they also had been for the previous pilot study.[1] The interim results of the current study give reason for concern, as significant impurities were revealed on several implant samples of the same type from different production periods.

Good and bad news for titanium

The good news is that, in the current study, the majority of the titanium implants analysed showed relatively clean, largely particle-free surfaces under the SEM. The bad news is that, at the same time, significant residues from production, handling (manual assembly and inspection) or the packaging itself were identified under the SEM on almost every third titanium implant analysed (Fig. 1). For example, considerable impurities were found on titanium implants that can be traced back to processing errors in relation to wet-chemical cleaning (Fig. 2).

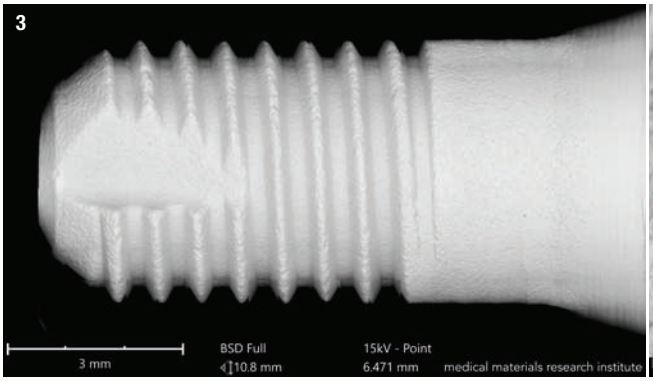
How do ceramic implants compare?

Since the manufacturing processes of ceramic and titanium implants are fundamentally different, one would expect there to be significant differences in the surface cleanliness of sterile-packaged implants that are made of these two materials too. This was not the case in the current series of investigations. In the smaller comparison cohort of 14 ceramic implants, surfaces were found to be largely free of residue in eight samples (Fig. 3). In six samples, however, larger amounts of predominantly carbonaceous, organic residues were detected (Fig. 4). Thus, although these ceramic implants are metal-free, they are not always plastic-free, since undesirable and undeclared foreign materials, such as polyoxymethylene, were identified. Undoubtedly, this colourless, semi-crystalline polymer originated from the packaging material, and it was detected in significant quantities and in the area of the very first threads in particular (Fig. 5).

It is safe to say that these avoidable contaminations of the implant surface do not contribute to a successful healing process—regardless of whether they are found on ceramic or titanium surfaces. At the time of approval, these implants may have met the requirements of the regulatory authorities. Obviously, however, one cannot be certain that all implants once approved for being marketed will continue to meet high manufacturing quality on a sustained basis thereafter. Despite the current data that suggests that, purely statistically, there is a greater than 50% chance of removing a residue-free implant made of titanium or zirconium dioxide from the sterile packaging, rightly concerned practitioners currently find no information about possible residues either on the packaging itself or on the package information leaflet. Several manufacturers that have been asked about this kind of quality deficiencies have stated that contaminations of sterile surfaces are harmless according to their own assessment. Despite this apparent reassurance, however, the patients are the ones who ultimately bear the clinical consequences of these preventable residues, and, at the same time, practitioners have to bear the legal risk of possible malpractice.

Clinical relevance

The question of the clinical relevance of particle contamination on sterile-packaged implants has recently attracted increasing attention—especially since more than 250 journalists from an investigative network have been reporting worldwide on the so-called “Implant Files” through popular media channels. Years ago, Trindade et al. already reported that a disturbed individual foreign-body



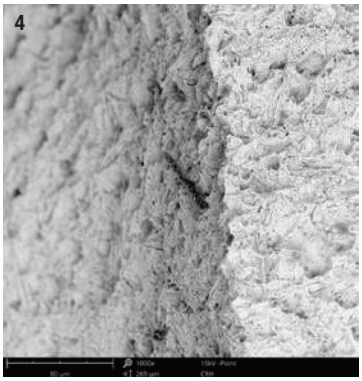


Fig. 3: In eight of the 14 ceramic implants analysed, surfaces were found to be largely free of residue. **Fig. 4:** In six of the ceramic implants analysed, larger amounts of predominantly carbonaceous, organic residues were detected. **Fig. 5:** Polyoxymethylene, a colourless, semi-crystalline polymer that originated from the packaging material, was detected in significant quantities and in particular on the first threads of some of the ceramic implants analysed.

balance was suspected to be a possible main cause of peri-implantitis.[2, 3] Particularly early cases of peri-implantitis can possibly be explained as being a consequence of increased exposure to foreign bodies, which already starts during insertion of an implant with residues from manufacturing, handling or packaging. In the literature, organic foreign materials especially are associated with initial bone loss or even peri-implantitis.[4] Foreign particles with a size of 0.2–7.2 µm are classified as pro-inflammatory.[5, 6] After phagocytosis by macrophages, increased expression of tumour necrosis factor-, interleukin-1, interleukin-6 and prostaglandin E2 was demonstrated, which in turn stimulates the differentiation of osteoclast precursors into mature osteoclasts.[7] Increased osteoclast activity due to small-volume particle contaminants would particularly explain clinically significant bone loss of individual implants in the early stages of healing or the early occurrence of peri-implantitis. The discussion about the clinical consequences of filmlike and particulate contamination is as old as implantology itself. Already more than 30 years ago, when looking at non-osseointegrated implants, that is, implants encapsulated in connective tissue, Donath, Büsing et al. found conspicuous foreign body giant cells in the surrounding area of foreign material deposits and suspected that impurities of the implant material could be a main cause.[8, 9]

Summary

Even though some suppliers of ceramic implants promote zirconium dioxide as the better implant material, there is just as much light and shadow regarding implants of this material as there is with implants made of titanium or titanium alloys. The mere fact that zirconium dioxide implants are white and are usually sintered at high temperatures should not obscure the fact that the sensitive surface can also become contaminated in subsequent processes. Contaminations of implant surfaces can technically be avoided over the entirety of the highly complex processing and packaging process. This is proven by the good results of many titanium and ceramic implants included in the same study. Whether we as practitioners should accept avoidable contamination of sterile-packaged implants is another question. Patients today are no longer unsuspecting supplicants, but informed and educated purchasers of medical services. In times when patients inform themselves in great detail about the advantages and disadvantages of vector- or mRNA-based vaccines before a vaccination and can even name the respective manufacturers, we as dentists would be well advised to have convincing answers to questions about the quality of those implant systems that we use in our practices and clinics on a daily basis. More information and study results can be found on the project's website: www.cleanimplant.org

Literature

about the author

Dr Dirk U. Duddeck studied biology and dentistry and specialised in oral implantology. He is a guest researcher at Charité—Universitätsmedizin Berlin and founder and head of the non-profit organisation CleanImplant Foundation, both in Berlin in Germany.

contact

Dr Dirk U. Duddeck
Head of the CleanImplant Foundation
Berlin, Germany
+49 30 200030190
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Restoring the function and aesthetics of central incisors

Literature

Dr Philippe Jourdan, France

A 62-year-old male patient was referred to the practice of the author after failed endodontic treatment of teeth #11 and 21, which had made the tooth roots mobile (Figs. 1 & 2). The patient had attended the practice several times in the past to have the central incisor crowns refitted, since they had kept falling off. Owing to the hopeless prognosis of the existing restorations, treatment options for restoring tooth #11 and 21 were discussed with the patient, who decided on extraction and replacement of these teeth with two dental implants. Radiographs were taken to confirm that the patient had sufficient quantity and quality of bone to support implant placement. Two 15.5 × 4.0 mm Z1-infinity implants with a zirconia collar height of 1.5 mm (TBR Dental) were planned for. The only indication for which the author uses the longest implants available, as was done in this case, is in post-extractive situations, because, in order to obtain sufficient primary stability, the implant needs to go beyond the apex of the extracted tooth.

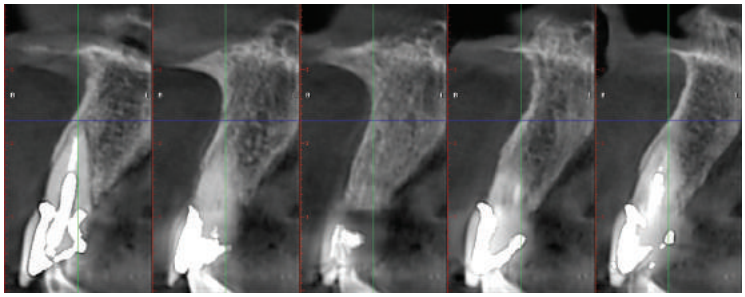

Fig. 1: CBCT scan of endodontic failure of teeth #11 and 21.

Implant placement

Surgery began with using the piezo-surgical unit to atraumatically extract the roots of the central incisors (Fig. 3). The sockets were cleaned manually and an Er:YAG laser was used to remove the periodontal ligaments. The implant sites were prepared by creating osteotomies in each socket, the implant sites parallel to each other and positioned palatally (Fig. 4). The implants were placed into the sockets at 15 rpm (Figs. 5 & 6). Using a contra-angle handpiece makes this process much quicker and easier than carrying it out manually. Impression copings designed for taking closed-tray impressions were fitted once the implants had been placed (Fig. 7). Acrylic was applied around the impression copings and the excess material was removed distal to the lateral incisors. The acrylic was then used to take a closed-tray impression, which was treated by the dental technicians at the integrated dental laboratory at the author's practice. This impression taking technique is easier, faster and more accurate than other methods and one that the author often uses in cases where there are multiple implants and joined crowns.

Thereafter, healing abutments of 5 mm in height were fitted temporarily to maintain the soft tissue while the provisional restorations were produced by the laboratory. At the same time, a grafting material called sticky bone (Fig. 8) was placed in order to regenerate the bone in this area. An allograft (Bone Bank Allografts) was mixed with a liquid platelet-rich fibrin (PRF) to create the high-viscosity sticky bone grafting material.[1, 2] A biopsy punch was then used on an PRF membrane to create two holes that were

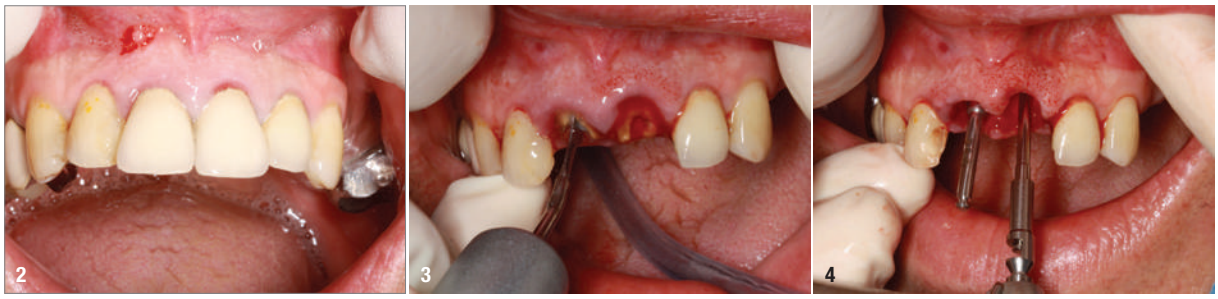

Fig. 2: Central incisors before implant surgery. **Fig. 3:** Preparation and extraction of central incisors. **Fig. 4:** Osteotomy preparation for implant placement.

slightly smaller in diameter than the healing abutments. This PRF membrane was used to hold the grafting material in place before the surgical site was sutured together using monofilament sutures (Figs. 9 & 10). The laboratory designed a unique abutment system that enabled a cement-retained crown to be fitted effectively. The dental technicians put acrylic composite around the abutment to create a transgingival barrier designed to prevent any cement from going under the soft tissue when the abutment was fitted. The specially designed abutment was placed and the provisional restoration (Fig. 11) fitted using cement (Figs. 12 & 13). The surgical site was sprayed with a combination of air and water to remove any excess and prevent cement infiltration under the gingiva. The patient was provided with appropriate postoperative care instructions to aid healing.

Implant restoration

After seven months of healing, the patient came back to the practice to have the definitive restoration placed. Figure 14 demonstrates that there was perfect healing with no signs of inflammation and an excellent emergence profile. The provisional crowns and abutments were removed to reveal pink and healthy soft tissue around the zirconia collars of the implants (Fig. 15). A radiograph also demonstrated that there was healthy bone around the implants. The definitive crowns were fabricated from a zirconia framework with an outer layer of feldspathic ceramic. The cervical part of the crown was polished rather than glazed, as this increases gingival cell adhesion and proliferation, creating an antibacterial shield for the crestal bone and the gingiva.[3] The crowns were then finished with pigment and glaze (Fig. 16) before the abutment was refitted and the definitive restorations cemented into place (Fig. 17). The patient was very happy with the outcome.

Result

The implant was reviewed three months after the definitive crowns had been fitted. The papilla had been effectively maintained and a creeping attachment of the gingiva had started to develop (Fig. 18). Having placed Z1 implants for almost 15 years, the author had every confidence that the papilla would eventually close the diastema between tooth #11 and tooth #21. The patient reported that he loved the final result. His aim was to eventually have tooth #25 replaced with an implant, but this would require a sinus lift, as there was inadequate bone to support implant placement in this area.

Discussion

Cement-retained crowns were chosen over screw-retained ones in this case, as these solutions are much easier to fit, particularly with the Z1 implant. There can be angulation issues with screw-retained restorations, as these would need to be placed more to the buccal side of the bone, meaning access to the implant could be more challenging and the overall aesthetic could be compromised. In cases of immediately loaded implants—at the stage when the soft tissue is still healing—the concern with cement-retained restorations is that excess cement can cause peri-implantitis and subsequent failure of both a bone-level and a tissue-level implant.[4, 5] Once the soft tissue has healed, excess cement remains a poten-

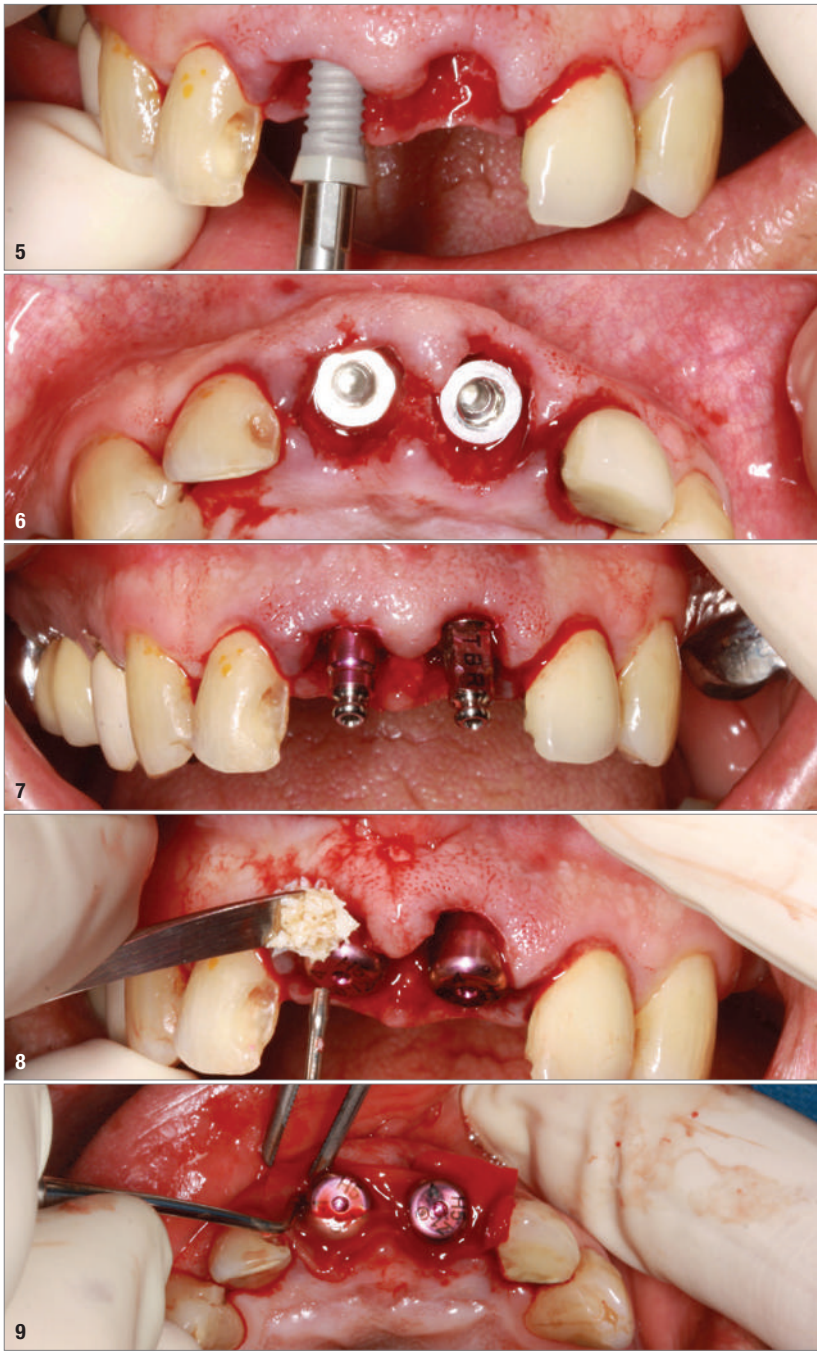

Fig. 5: Placement of implants. **Fig. 6:** Implants placed in positions #11 and 21. **Fig. 7:** Impression copings fitted. **Fig. 8:** Application of sticky bone. **Fig. 9:** Application of PRF membrane.

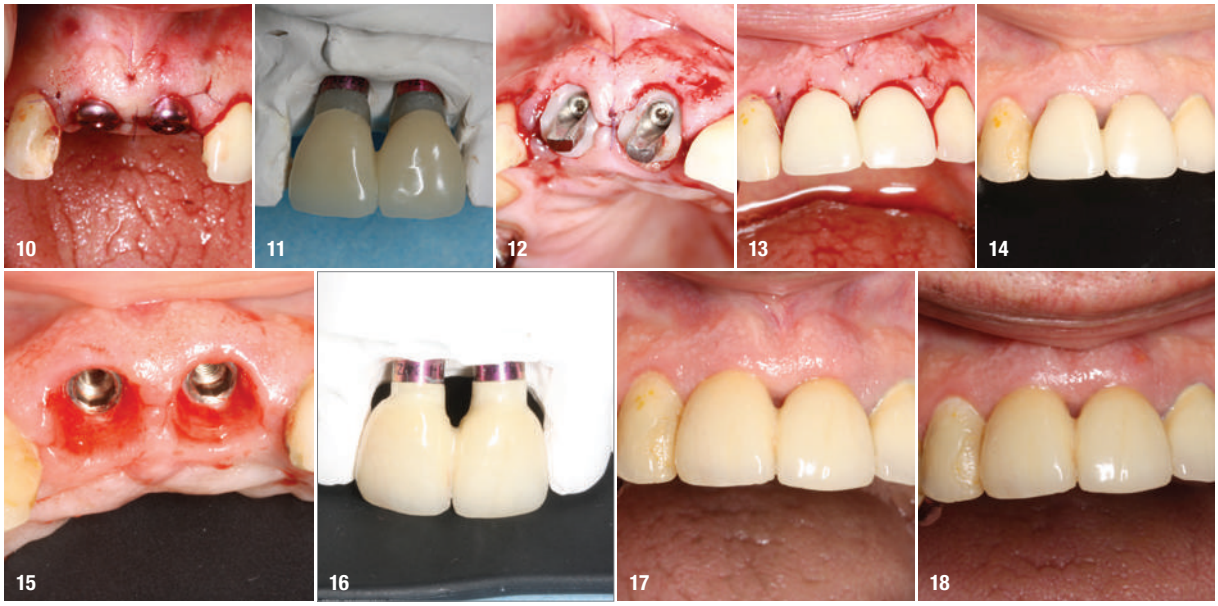

Fig. 10: Surgical site sutured together. **Fig. 11:** Provisional crowns. **Fig. 12:** Abutments fitted two hours post-op. **Fig. 13:** Provisional crowns fitted using cement. **Fig. 14:** Provisional crowns after seven months of healing. **Fig. 15:** Soft-tissue healing after removal of provisional crowns. **Fig. 16:** Definitive crowns on cast. **Fig. 17:** Definitive crowns fitted. **Fig. 18:** The result three months after placement of the definitive crowns.

tial threat to the success of bone-level implants, but not necessarily to tissue-level implants, especially if the implant is a Z1. In this regard, the soft tissue attaches itself to its zirconia collar, creating a natural barrier between the implant and the soft tissue and thereby reducing the risk of infection. If it had been available at the time, a Z1 implant with a 2.5 mm zirconia collar height would have been used in this case, replacing the transgingival barrier that the dental technicians had created with the acrylic composite around the titanium abutments. This would have created greater surface adhesion between the zirconia collar and the soft tissue, ensuring that the implant was even more impervious to bacterial infiltration at the crestal bone level.

A tissue-level implant should be the most commonly used type of dental implant as opposed to a bone-level system, which makes no biological sense to use. So long as a tissue-level implant is placed, restored and maintained properly, the risk of complications is minimised. The numerous other benefits of the implant used were apparent throughout this case. As it is a tissue-level system with a transgingival portion made of zirconia, exceptional aesthetics can be achieved with this implant that are superior to that achieved by bone-level implants, as well as other tissue-level implants that are fully titanium. Some degree of recession is inevitable with implant treatment, but the titanium components of conventional bone-level and tissue-level implants are more likely to become visible through the gingiva, thus compromising the overall visual result. To combat this issue, the zirconia collar of the implant encourages fibroblast cells to adhere and proliferate, creating an effective soft-tissue seal around the collar.[6] As such, even if there is a minimal degree of recession, the result of treatment with this particular implant is always highly aesthetic: the collar mimics the function and appearance of a natural tooth. Furthermore, this implant offers time-saving advantages. For instance, it promotes regeneration of the soft and hard tissue simultaneously for accelerated healing. This implant is also placed in one surgical step, which saves both the patient and the clinician an additional appointment. This is not necessarily the case with bone-level implants, as the surgical site has to be accessed after the implant has been placed, resulting in longer treatment times. This is why the Z1 is the preferred option for the author in most of his implant cases.

about the author

Dr Philippe Jourdan is a dentist from France who specialises in oral surgery. Between 1983 and 1988, he completed several postgraduate training programmes in both Toulouse and Marseilles in France. Since 1986, he has led a private practice in Balma in France.

contact

Dr Philippe Jourdan
Balma Dentaire
Balma, France
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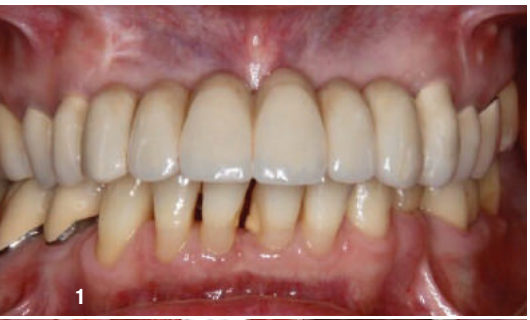
Implant surgery according to the All-In-One concept

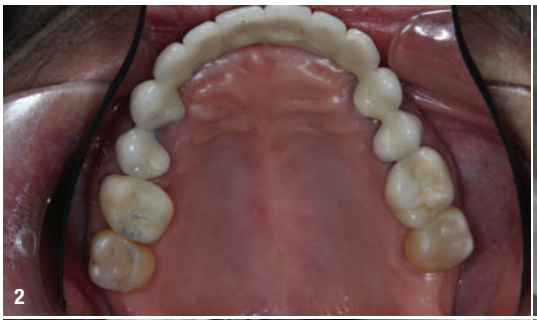
Dr Corbin Popp, USA; Dr Rebekka Hueber & Dr Karl Ulrich Volz, Switzerland

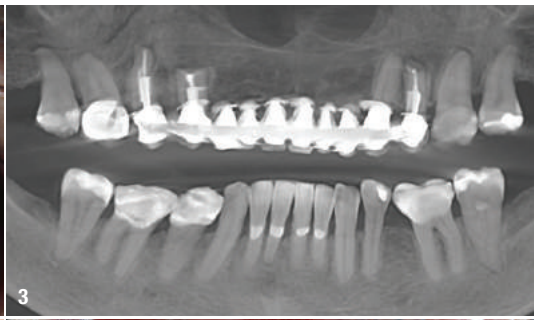
The 72-year-old female patient presented on referral for a comprehensive biological approach to restore her failing prosthetic dental work composed of porcelain-fused-to-metal crowns and bridges (Fig. 1). Her motivations were to maintain overall health and to have lasting dental work with biocompatible materials. She had a history of trauma, multiple missing teeth, multiple root canal therapies, a history of recurrent decay and periodontal disease. Her occlusion appeared to have a mandible-to-cranial base discrepancy with significant first touch and slide coupled with multiple posterior interferences. She reported previous migraine and clenching at times. The long spanning PFM bridge from #14–24 was class 1 mobile. Additional PFM crowns were at #16, 17, 25, 26, 36, 44, 46. In addition, she had multiple failing root canal treated teeth #15, 14, 25 and questionable prognosis for #24 with periodontal bone loss. She had slight mobile lower incisors with moderate recession and subsequent black triangles were apparent with moderate crowding. Aesthetically, the patient was unhappy with the shape of her current teeth. After complete examination, she expressed interest in a comprehensive programme to restore her bite using non-metal materials. Immediate implantation with ceramic implants (SDS Swiss Dental Solutions) according to the All-In-One concept (SWISS BIOHEALTH) and long-term fixed temporaries were discussed. She was referred to the Swiss Biohealth Clinic for surgical planning, once she had completed the pre-surgical site work of the first author, who removed metal PFM restorations and mercury fillings, and placed composite core build-ups with Luxatemp provisional crowns (Fig. 2).

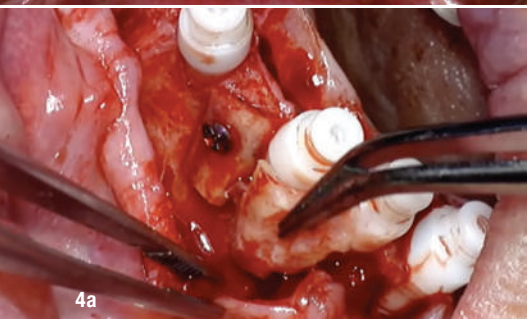
Preoperative measures

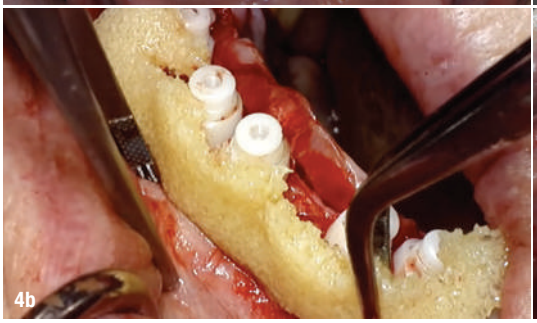
The initial examination at the Swiss Biohealth Clinic revealed that teeth #5, 6, 12 and 13 were not worth preserving due to horizontal and vertical bone loss in the maxillary anterior region. The CBCT scan revealed ischemic osteonecrosis in the sense of FDOJ (fatty-degenerative osteonecrotic jawbone; Fig. 3). A vital part of the SWISS











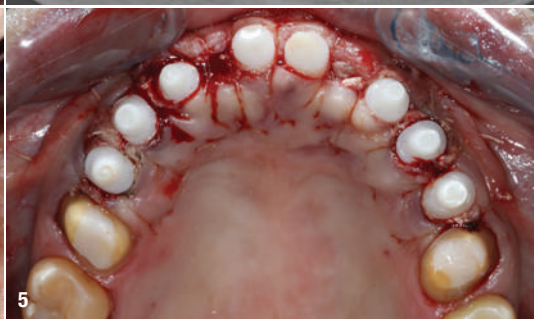


Fig. 1: Initial clinical situation. **Fig. 2:** Situation after metal removal and composite core build-ups. **Fig. 3:** Panoramic radiograph pre-op. **Figs. 4a & b:** Intraoperative situation of the upper front, augmentation with autologous bone chips and osteosynthesis screws **(a)**, insertion of sticky bone on the buccal plate of the upper front **(b)**. **Fig. 5:** Post-op view of the upper jaw.

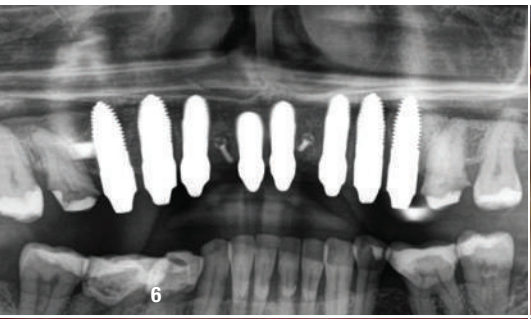
BIOHEALTH CONCEPT is to strengthen the immune system of patients to achieve optimal bone healing: four weeks before surgery, patients begin to supplement a mixture that contains every micronutrient necessary for an optimal support of the body's own regenerative mechanisms and which has a pre-biotic effect. The mixture is taken for another four weeks after surgery. In this way, the vitamin D3 value is raised to 70 ng/ml, which allows optimum bone growth. One day before surgery, the patient received an infusion of vitamin C, vitamin B12, sodium bicarbonate, magnesium sulphate, procaine and Ringer's solution. Surgery was performed the next day according the All-In-One concept. During the entire treatment, the patient received a BTPII infusion containing vitamin C, procaine, magnesium sulphate, sodium carbonate and vitamin B12. At the end of treatment, the vitamin C infusion is replaced with a pain-relieving infusion. It is crucial not to impair the body's immune system and its healing mechanisms by activating the sympathetic nervous system.

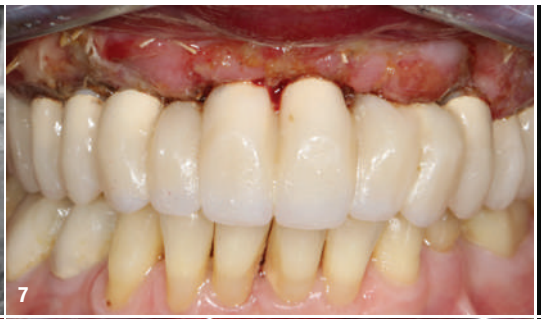
Surgical intervention

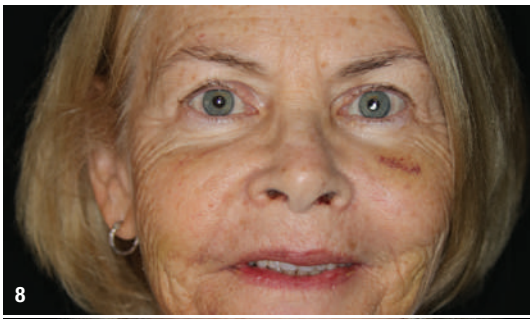
In all four wisdom tooth regions, the ischemic and degenerative bone was removed by means of piezo-surgery, and autologous bone chips were collected (Fig. 4a). In regions #38 and 48, bone windows were lifted for subsequent bone augmentation in the maxillary anterior region. The areas were treated with Ozone DTA and closed after the insertion of PRF (platelet-rich fibrin) matrices. Teeth #5, 6, 12 and 13 were extracted under local anaesthesia, aiming to save as much bone as possible. The inflamed tissue was carefully removed. It is crucial to thoroughly clean and disinfect the extraction socket, as ceramic implants will only osseointegrate in healthy bone. For additional cleaning, the Ozone DTA 60 was used at level 6.

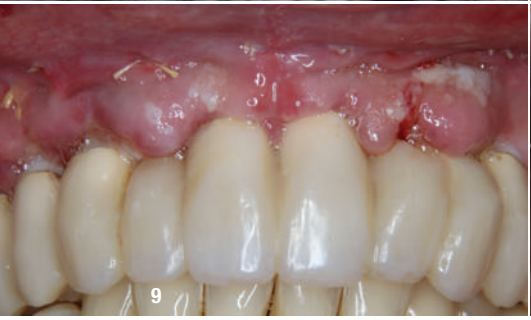
Implant placement and bone grafting

It is important to choose a drilling protocol that respects the biology of the bone. The drills used for creating the osteotomies are made of ATZ ceramic. By combining different protocols for different bone classes and appropriately adapted form drills, the implants gain excellent primary stability. In the region of the compacta, the blood flow was preserved by oversized drilling. In this way, no compression is put on the bone. Ceramic implants were placed in regions #4, 5, 6, 8, 9, 11, 12 and 13. Due to the pronounced resorption in regions #6–11, a solid sticky bone was created using allogenic augmentation material and the Low-Speed Centrifugation Concept according to Prof. Shahram Ghanaati. The augmentation material was sprinkled with injectable PRF, and was additionally activated with the exudate from the pressed PRF matrices of A-PRF tubes. Autologous bone collected during surgery was added and fixed with two osteosynthesis screws (USTOMED) in regions #7 and 10 on the buccal site. The region was then covered with sticky bone and PRF matrices (Fig. 4b). The mucoperiosteal flap, which had previously been opened by a marginal incision, was closed with deep apical mattress sutures and papillary sutures (Figs. 5 & 6). The implants were immediately restored with long-term provisionals (Luxatemp, Durelon; Fig. 7). During the following week, the patient experi-









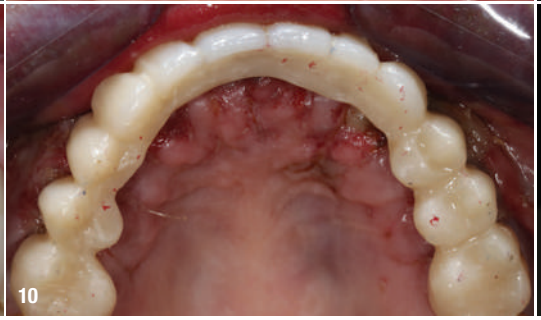


Fig. 6: Post-op panoramic radiograph. **Fig. 7:** Intra-oral situation after placement of all temporaries. **Fig. 8:** Patient twelve days after surgery. **Fig. 9:** Intra-oral situation twelve days after surgery. **Fig. 10:** Upper jaw twelve days after surgery. **Fig. 11:** Patient four weeks after surgery.

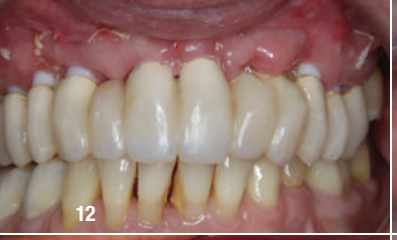
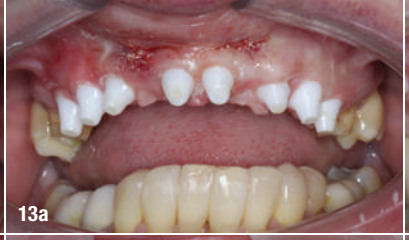
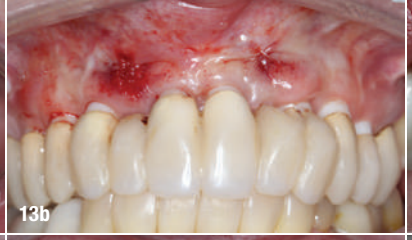
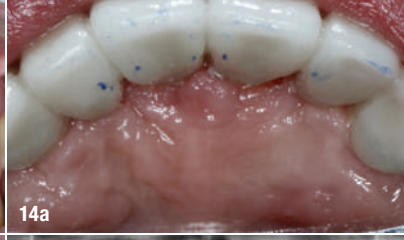
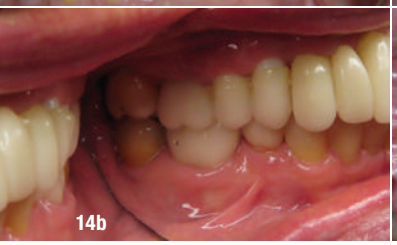
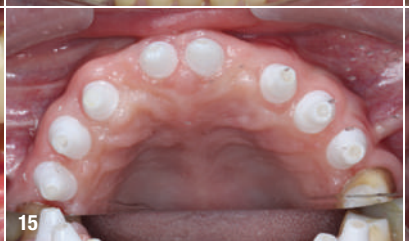
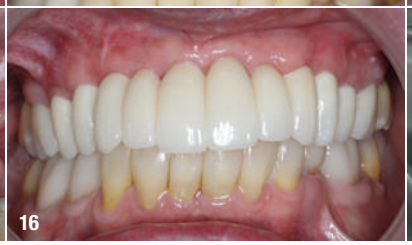
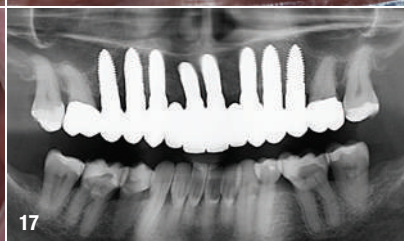









Fig. 12: Intra-oral situation four weeks after surgery. **Figs. 13a & b:** Situation at three months post-op: perfect healing of the implants **(a)**, new PMMA temporaries **(b)**. **Figs. 14a & b:** Balanced occlusion following OBI occlusal design. **Fig. 15:** Intra-oral situation after osseointegration of all implants. **Fig. 16:** Frontal view of the final restoration. **Fig. 17:** Panoramic radiograph after final prosthetic treatment.

enced no swelling on the surgical site and an instant relief of most of her symptoms. After a few days, she was able to return home to the US.

Postoperative care

Twelve days postoperative, the patient reported no pain. She was taking 400 mg ibuprofen every eight hours. Despite a slight recession in the upper palatal area and mild swelling, the tissue was healing well without redness or drainage (Figs. 8–10). Near the surgical sites, procaine without epinephrine, vitamin B12, Traumeel, and Lymphomyosot (Schwabe Austria) were infiltrated, followed by 11 gamma ozone injections. At the one-month follow-up, she returned for the removal of the remaining sutures (Figs. 11 & 12). The Foundation for Bioesthetic Dentistry (OBI) method was discussed to achieve the most stable condyle position and to simulate an increase in the vertical dimension of occlusion to expand the restorative rebuilding options. At the three-month follow-up, Alginate impressions (Dentsply Sirona) were taken to fabricate a maxillary orthotic (Fig. 13a). Multiple adjustment visits to balance the orthotic followed. The patient had significant improvement with her migraine headaches over three months time. Challenges included hyper-eruption of the lower anteriors, mobile lower teeth with black triangles and recession, in addition to lingual positioned lower canines. The lower anteriors were restored with resin (Flow A1, GC Universal) using a modified Bioclear Method. The titanium fixation screws were removed and new upper PMMA splinted partials were delivered in three sections (#15–14, 13–23, 24–25). The upper implant abutment was prepared with a red stripe diamond football bur (Brassler). Due to aesthetic concerns of the patient, the PMMA crowns were relined and recemented with a darker temp CEM (Telio A3; Fig. 13b). The lower permanent crowns (Activa) were bonded and refined to a balanced occlusion (Fig. 14). The upper arch was completed removing the provisional in sections from anterior to posterior. An anterior jig was fabricated to preserve the bite in a tripod fashion. The upper implant abutments were finalised using red strip diamond burs with chamfer margin at or slightly below the gingiva. Additional crowns were delivered on the remaining natural teeth #16, 26. According to a Perio M testing, all implants appeared well integrated and were ready for loading (Fig. 15). The permanent prosthesis was delivered with Ketac CEM (3M ESPE; Figs. 16 & 17). A final protective maxillary orthotic was fabricated for long-term protection and potential clenching.

Conclusion

This case is a good example of how failing dentistry and potential inflammatory sites are removed, zirconia implants are immediately placed according to the SWISS BIOHEALTH CONCEPT, and long-standing partial edentulism is rehabilitated utilising multiple sets of interim prostheses. This is a viable treatment option for patients with partial or complete edentulism who are looking for a biocompatible non-metal solution.



Dr Corbin Popp
Author details

Dr Rebekka Hueber
Author details

Dr Karl Ulrich Volz
Author details

contact

Dr Corbin Popp
BioDentist™
Denver, CO, USA
+1 303 3339000
drpopp@biodentist.com

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Creating natural emergence profiles in the aesthetic zone

Literature

Dr Paul S. Petrungaro, USA

Tooth replacement with dental implants is considered the standard of care for replacing the natural tooth system in the contemporary practice of dentistry. Their success rates have been well documented in the dental literature over the last half century. Advances in surgical and prosthetic techniques have allowed for more conservative surgical approaches to pave the way to achieve more predictable wound healing and less soft tissue changes: critical issues in the aesthetic zone. Metal-free implant designs are proving to be an additional component to achieving natural soft-tissue emergence profiles and eliminate the potential for soft-tissue complications that titanium implants and abutments present, especially in compromised soft-tissue volume and thickness. The following article will demonstrate the immediate restoration procedure in the aesthetic zone with multiple implant placement and provisionalisation utilising one-piece metal-free implants. The use of dental implants for tooth replacement procedures has become commonplace in the treatment planning process for dentists and dental specialists.[1, 2] During the last twenty years, variations in the conventional, multistep process of implant reconstruction have begun to demonstrate the benefits of immediate restoration, especially in the aesthetic zone.[3–8] These benefits include minimally invasive protocols, shortened treatment times, preservation of soft-tissue contours and emergence profiles, and delivery of a stable, aesthetic, provisional restorations (instead of a removable temporary) that can begin the process of tissue sculpting and forming the final emergence profile.[9–11] Ensuring the appropriate volume and quality of the peri-implant soft tissues, especially in the aesthetic zone, is paramount not only for the peri-implant environment and long-term maintenance of bone levels but also for long-term aesthetic results that can be achieved.[8–11] The incorporation of metal-free dental implant designs into, not only the holistic dental practice, but also for routine daily use in the contemporary general and specialty practice has increased over the last several years.[12–16] The benefits of zirconia dental implants, which include a high level of biocompatibility, reductions in the formation of biofilm and its resultant decrease in bacterial plaque accumulation, heightened level of fracture toughness, and the reduction in bone loss levels long-term in the implant bone crest, and soft tissue attachment areas, are a distinct alternative to titanium for an implantable implant material.[17–21] Conventional titanium two-piece implant designs have been extensively studied over the last 25 years in regard to the connection between the implant/abutment complex, and the micro-gap issue that exists and can be an introductory point for bacterial invasion into the peri-implant environment, becoming an initiation point for crestal bone loss and peri-mucositis and peri-implantitis formation.[22–28] One-piece titanium implant designs theoretically reduced the micro-gap issue, but design limitations can increase aesthetic complications and accelerate peri-implant and bone and soft-tissue loss. Two-piece zirconia implant designs reduce the micro-gap issue as a result of the decrease in biofilm formation and the reduction in soft-tissue inflammation, an important pre-curser to peri-mucositis and peri-implantitis.[29] One-piece zirconia implant designs offer additional benefits in that elimination of the micro-gap space between the zirconia implant and abutment being non-existent and reduction of biofilm formation virtually eliminated. In various zirconia implant

Fig. 1: Pre-treatment patient smile.

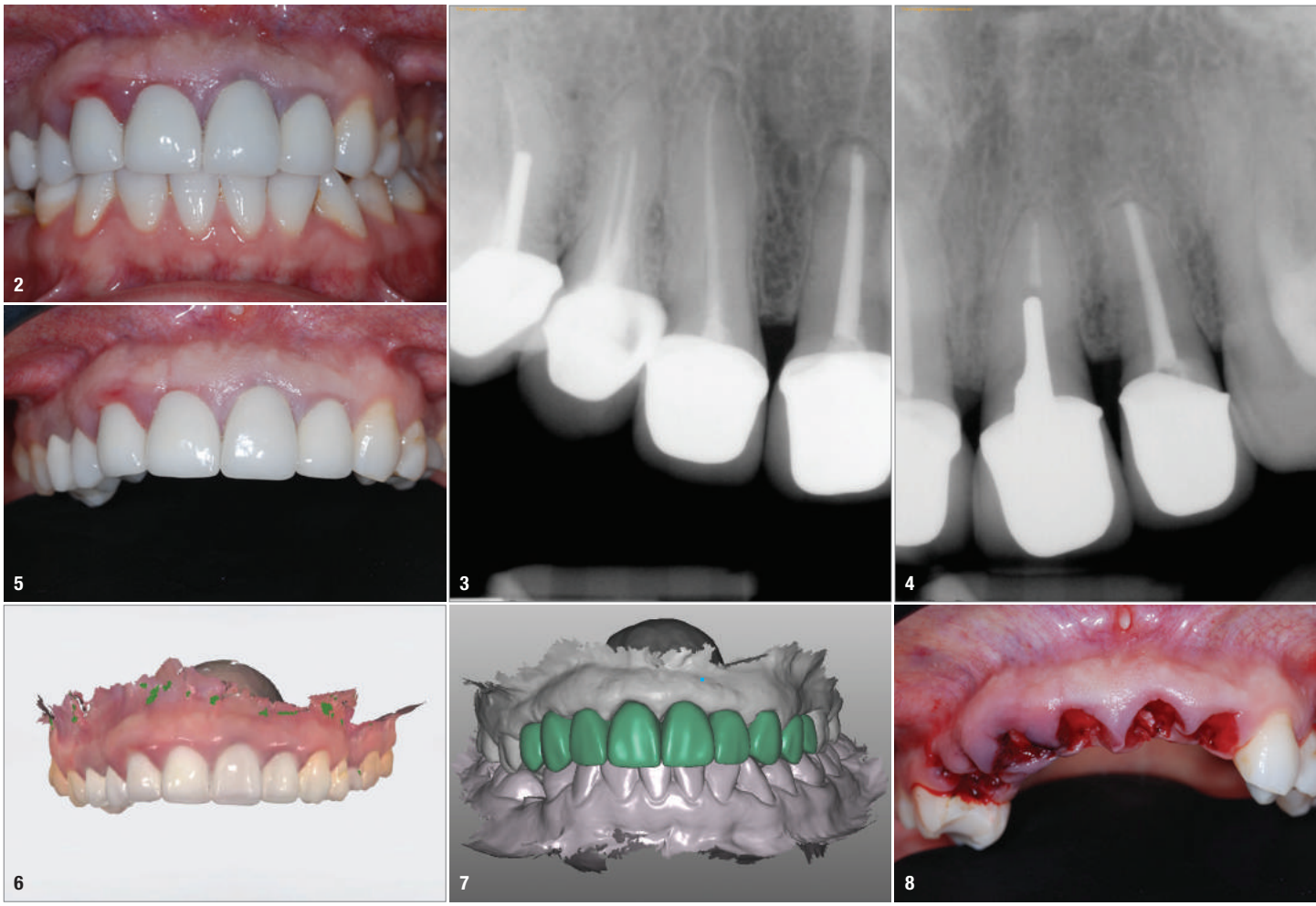

Fig. 2: Pre-treatment clinical retracted view. **Fig. 3:** Pre-treatment digital periapical view, maxillary right. **Fig. 4:** Pre-treatment digital periapical view, maxillary left. **Fig. 5:** Pre-treatment view, maxillary anterior. **Fig. 6:** Pre-treatment 3D scan of the existing maxillary anterior. **Fig. 7:** Pre-treatment 3D digital plan for aesthetic enhancement of the maxillary anterior. **Fig. 8:** Atraumatic tooth removal maxillary anterior, facial view.

one-piece designs, the ability to not only prepare the abutment portion of the implant, but also the collar and/or implant portion of the zirconia fixture allow for superior characteristics for an implant to replace the natural tooth system.[30–33] The following case report will demonstrate the use of one-piece zirconia implants to replace the natural tooth system in multiple sites in the aesthetic zone.

Case report

A forty-one-year-old non-smoking female presented for treatment of gingival erythema, missing teeth, failing root canals and wanting aesthetic enhancement of the maxillary anterior aesthetic zone (Figs. 1 & 2). The patient also complained of a dull ache in the maxillary anterior, and an overall feeling of malaise. Figures 3 and 4 show the pre-operative digital periapical views. Multiple root canal treated teeth were present with restorations invading the biologic width environment in the areas of the maxillary right second premolar to the maxillary left lateral incisor. Additionally, the maxillary left second premolar required replacement. Figure 5 demonstrates ill-fitting and misproportioned full coverage metal-based restorations with multiple biologic width impingements. After consultation with the patient, review of medical and dental histories, and an aesthetic interview with the patient, the treatment plan consisted of the removal of all maxillary teeth with root canals and poor fitting metal base restorations, and the placement of one-piece zirconia implants in the areas of maxillary right first premolar to maxillary left central incisor, veneers at the maxillary left canine and first premolar and two-piece zirconia implants at the maxillary second premolars. Following a digital workflow, pre-operative 3D scanning of the maxillary arch was accomplished (Fig. 6) and sent to an aesthetic laboratory technician to design the ideal 3D plan to address the aesthetic concerns of the patient (Fig. 7). This 3D plan becomes the digital blueprint to design the aesthetic provisionals and serve as a precursor to the final aesthetic planned restorations. After administration of pre-operative antibiotics, an appropriate local anaesthetic in the maxillary arch was given, and the teeth slated for extraction were re-

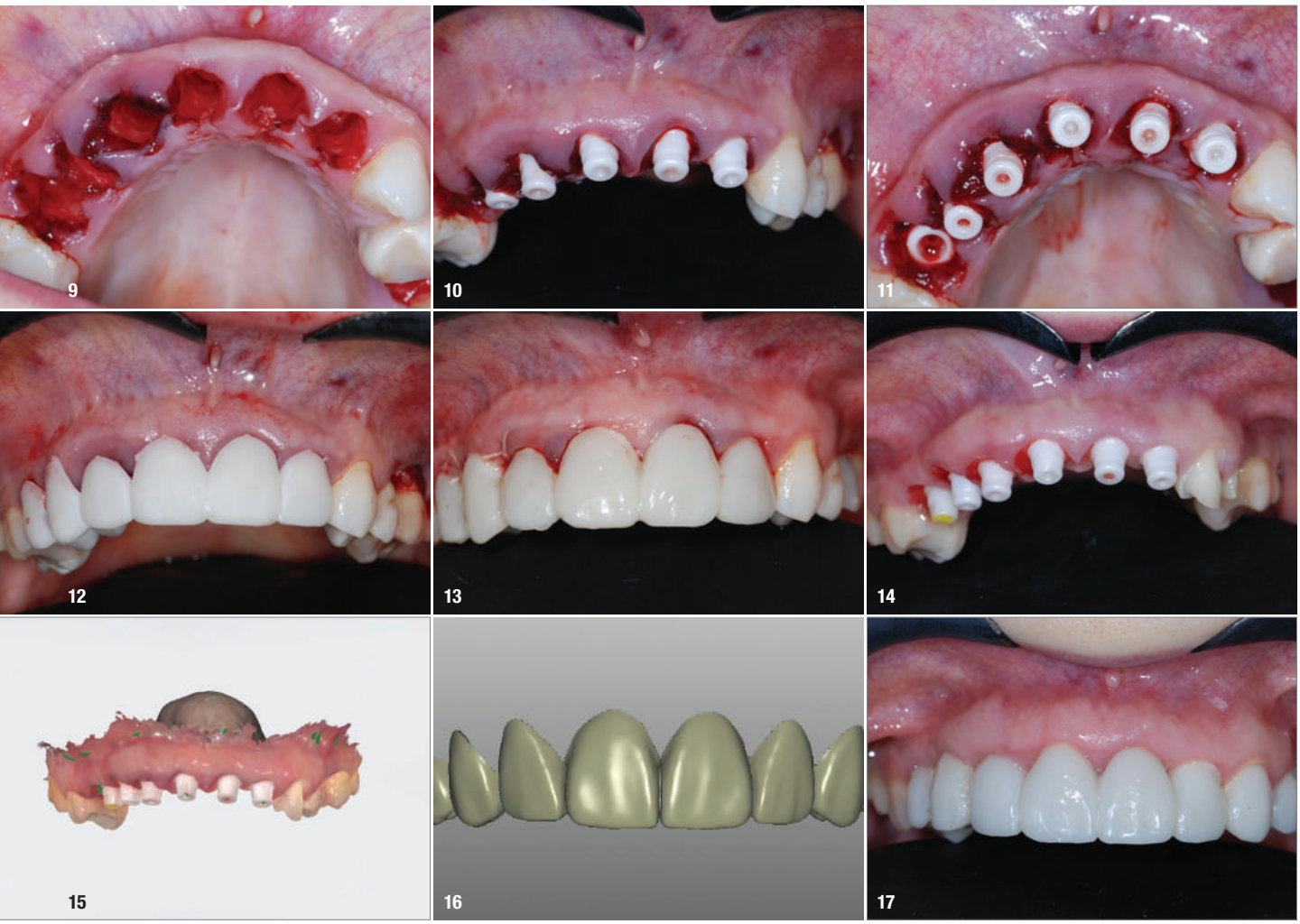

Fig. 9: Atraumatic tooth removal maxillary anterior, occlusal view. **Fig. 10:** Minimally invasive implant placement, SDS one-piece tapered implants, facial view. **Fig. 11:** Minimally invasive implant placement, SDS one-piece tapered implants, occlusal view. **Fig. 12:** 3D printed provisional shell to be retrofitted to abutment portion of one-piece SDS implants. **Fig. 13:** Immediate postoperative clinical view, maxillary anterior. **Fig. 14:** Two-month postoperative clinical view with provisional restoration removed. **Fig. 15:** 3D scanning of corrected abutment and tissue contours to create secondary provisional restoration. **Fig. 16:** Digital design of corrected contours to additionally sculpt and create natural soft-tissue contours in the interdental and facial emergence profiles of the implant sites. **Fig. 17:** Clinical appearance 10 days post-seating secondary aesthetic provisional restoration.

moved by an atraumatic tooth removal process, preserving the gingival soft tissue emergence profiles (Figs. 8 & 9). Please note the tissue hyperplasia and inflammation in the maxillary right area. Care is taken to not disrupt the natural tissue emergence profiles, facial gingival margin and remaining alveolar contours to perform a minimally invasive implant placement and bone regeneration procedure. Following site preparation, the extraction sites were replaced with one-piece implants (SDS Swiss Dental Solutions) and two-piece implants (SDS Swiss Dental Solutions) in the second premolar sites (Figs. 10 & 11). All implants achieved an initial torque measurement of 50 Ncm.

Following minimally invasive implant placement, autologous platelet-rich fibrin, prepared from a blood draw pre-surgically, was used to rehydrate a fully resorbable ceramic graft material (Osseolive, curasan) and the A-PRF/Osseolive complex placed peri-implant in the void between the implant surface and the residual buccal plate gap space remaining post-extraction and implant placement. Digital scanning post-insertion of the implants and communication with the original 3D smile design allows for printing off of the provisional shell (Fig. 12). The provisional shell is then retrofitted, and margins verified. Cementation of the provisional is then completed with ETC temporary cement dual cure (Parkell). Excess cement is removed, and bite evaluation/adjustment completed. The immediate postoperative clinical view can be seen in Figure 13. Two months post-implant placement the patient was appointed for 3D scanning and secondary provisional fabrication. Figure 14 demonstrates the clinical appearance of the zirconia implants and resultant soft tissue contours obtained from the initial im-

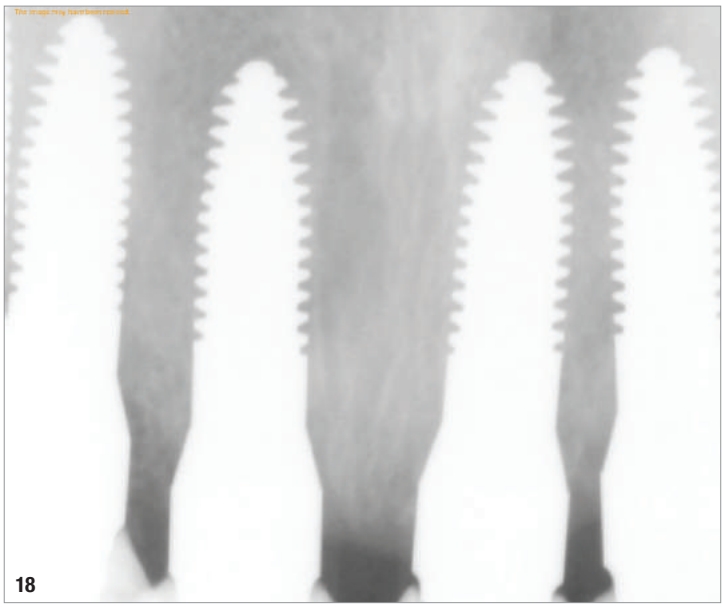
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Fig. 18: Three-month post-implant placement digital periapical radiograph, maxillary anterior. **Fig. 19:** Patient aesthetic tissue contours obtained, final provisional restorations before final all-ceramic aesthetic restorations are fabricated.

mediate restoration procedure. Figure 15 shows the 3D scanning view which is then blended with the initial smile design (Fig. 16) and the new provisional, with updated contours to ensure natural emergence profiles, papillary contours and interproximal tissues is printed, and seated again with provisional cement. Figure 17 shows the aesthetic provisional with final soft tissue profiles 10 days post-secondary provisional seating. Please note the aesthetic soft tissue contours created and maintained to support natural aesthetics in the final restorations. Figure 18 shows the 3-month post-insertion digital periapical radiograph and Figure 19 is the facial view of the final provisional restorations prior to initiation of the final all-ceramic restorations.

Conclusion

Tooth replacement in the aesthetic zone has become a highly predictable procedure utilising immediate restoration protocols that have been well documented in the dental literature over the last 15 years. Minimally invasive protocols to preserve natural soft tissue contours present after tooth removal have been shown to cause less soft-tissue complications in the final restoration, especially in the aesthetic zone. Incorporating one-piece zirconia implants into the immediate restoration protocol offers additional benefits over titanium as a dental implant option; improved soft tissue response, virtually non-existent biofilm formation, micro-gap elimination between the implant/abutment complex and heightened aesthetics are normally achieved in the final all ceramic restorations. Additionally, with one-piece zirconia implant designs, especially with a zirconia composition that allows the clinician to prepare the abutment, collar and base aspect of the implant itself, and additional level of flexibility is present in the instance that additional preparation is necessary for the correction of compromised bone and soft-tissue contours, or to correct angulation issues present due to malpositioning of the implant complex. As the success rates of zirconia implants continue to be positive in the dental literature, their position as a common option for tooth replacement will continue to rise and gain popularity in the dental implant field.

about the author

Chicago-based **Dr Paul S. Petrungaro** is an expert in oral Implantology, the treatment of failed implants and zygomatic implants. He graduated from Loyola University Dental School in 1986. He is a fellow of the International and American College of Dentists, and a Diplomat of the International Congress of Oral Implantologists. Dr Petrungaro has been in private practice of Periodontics and Implantology since 1988.

contact

Dr Paul S. Petrungaro
DDS, MS, FICD, FACD, DICOI
Start Smiling Dental Implant Centers
Chicago, IL, USA
+1 847 3866351
info@startsmilingchicago.com

Author details

Multiple restoration with two-piece zirconia implants

Dr Gernot Obermair, Italy

Literature

In the early days of implant dentistry there was a strong focus on osseointegration to make sure that the implants stayed in the bone for a long time. In recent years, the focus has shifted to soft-tissue integration and different prosthetic components to realise long-term aesthetic results with healthy gingiva and stable tissue levels. However, the increased complexity of the solutions and the phenomenon of peri-implantitis has created a lot of challenges for current systems, jeopardising their long-term success. The implant system inserted in following clinical case (Patent™ Dental Implant System, Zircon Medical) has a patented surface and is significantly rougher than other systems. Also, it's integrated abutment eliminates a micro-gap and the high-tech glass fibre post offers effective retention and load distribution for the superstructure. In addition, the implant system's success is backed by clinical long-term follow-up.[1] Studies indicate that the survival rates of ceramic implants are on par with titanium implants, and that stable marginal bone levels as well as soft-tissue integration are superior to titanium implants.[2, 3] These properties lead to complete biointegration of the implant system.

Initial situation

A 59-year-old male patient with partial edentulism asked for dental implants. Teeth had been extracted more than one year prior to implant placement due to periodontitis. Implants were planned in regions 15, 24, 25, 26 and 36. Bone quality was D3 in region 24–26 and D2/D3 in region 15 and 36. The implant selection is presented in Table 1.

Pretreatment

Teeth were extracted and socket preservations with PRGF (plasma rich in-growth factors) were carried out. No further bone augmentation procedures were performed. Gentle periodontal treatment was performed successfully on the remaining teeth. A titanium stimulation test was done, which revealed significant inflammatory values with regard to titanium particles. As a result, a metal-free solution (Patent™, Zircon Medical) was selected for the patient. A treatment plan was then developed and surgical guides were fabricated to allow precise flapless surgery.

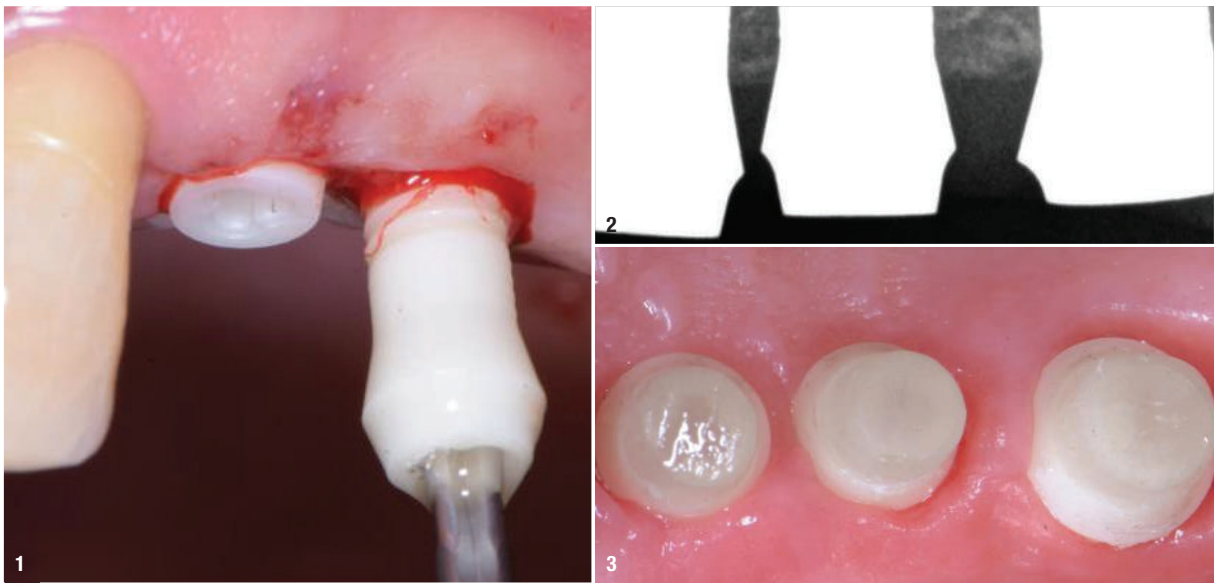


Fig. 1: Implant insertion. The Patent™ implant has a hydrophilic surface. **Fig. 2:** Control radiograph at the time of surgery. **Fig. 3:** Glass fibre posts cemented and prepared after a healing period of three months. Note the healthy soft tissues.

Position	Implant diameter (mm)	Prosthetic platform diameter (mm)	Implant length (mm)
4	4.1	5.2	11
24	4.1	5.2	13
25	4.1	5.2	13
26	4.5	6.2	9
36	4.5	6.2	13

Table 1: Implant sizes for the different positions.

Surgical procedure

With the help of surgical guides, flapless surgery could be performed. First, osteotomies were prepared, in which the implants were then inserted without complications. Insertion torques were between 22 and 35 Ncm. The surface of the implant shows high hydrophilicity (Fig. 1). It is crucial to place the implant in the right vertical position in relation to the soft tissue (equigingival) to facilitate the prosthetic procedure. A control radiograph was taken at the time of surgery (Fig. 2).

Prosthetic reconstruction

After a healing period of three months, the prosthetic work commenced. The glass fibre posts were cemented and prepared in the same way that conventional crown and bridge preparations are (Fig. 3). A conventional impression was taken and sent to the dental laboratory, which prepared the models in the same way they would for any conventional crown and bridge works (Fig. 4). No impression posts or replicas are needed. All restorations were made of zirconia and the occlusal table was made of acrylic. The flexibility of the acrylic allows for a more favourable stress absorption of the masticatory forces (Fig. 5). Instead of three individual crowns, a bridge on three implants in region 24–26 was fabricated to distribute the occlusal loads more evenly. The antagonist to the implant in position 26 is an implant as well. Since the implant in position 26 was only 9 mm in length and 4.5 mm in diameter, it was decided to realise a bridge restoration in order to distribute the load over the three implants (Figs. 6–9). A control radiograph was taken after the final cementation (Fig. 10). The single-tooth implant in position 15 can

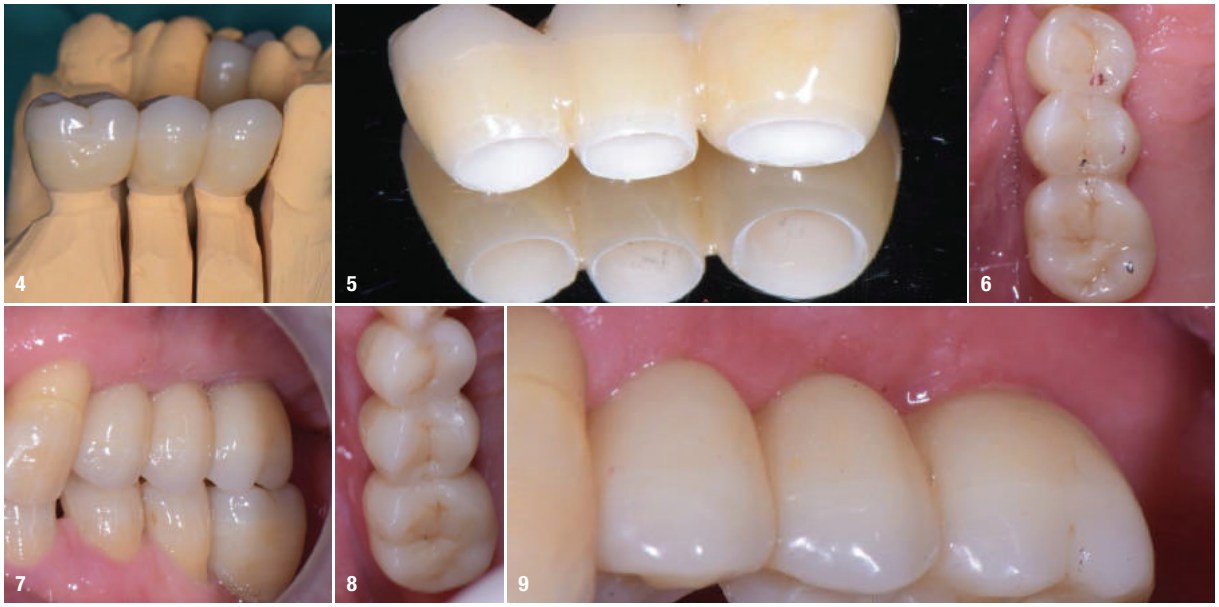
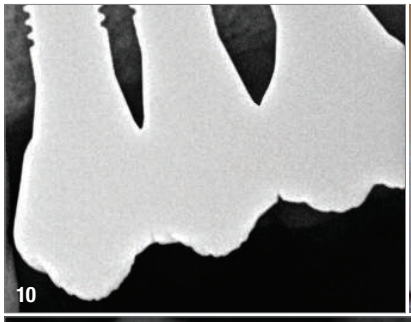
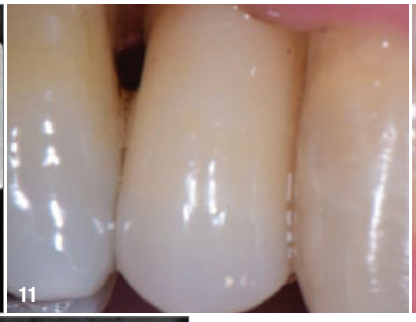
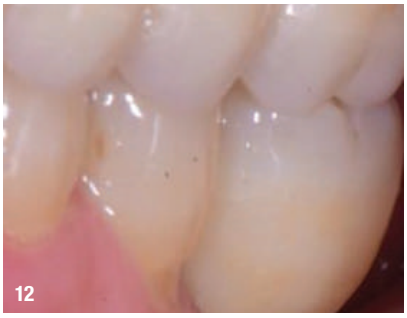
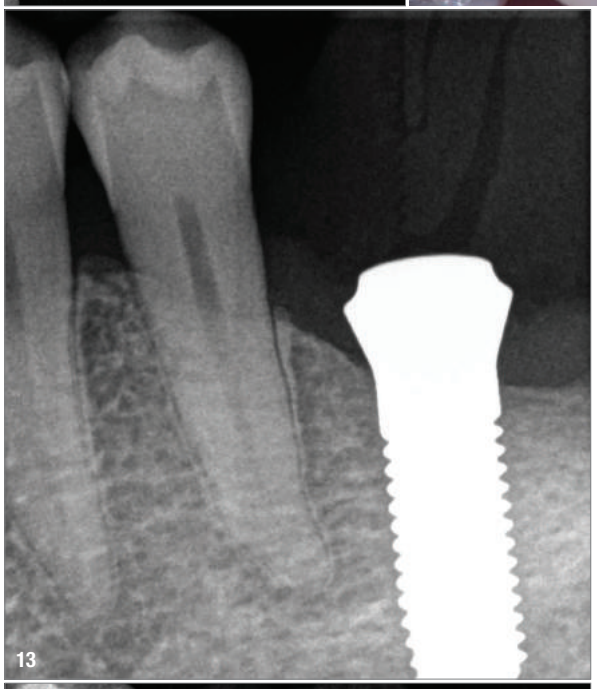


Fig. 4: The laboratory works with a plaster model for crowns and bridges. No impression posts or replicas are needed. **Fig. 5:** The restoration is made from zirconia with the occlusal table made in acrylic to absorb the masticatory loads in a favourable way. **Fig. 6:** Occlusion is checked. **Fig. 7:** Vestibular view. **Fig. 8:** Occlusal view. **Fig. 9:** Final result at the time of delivery.









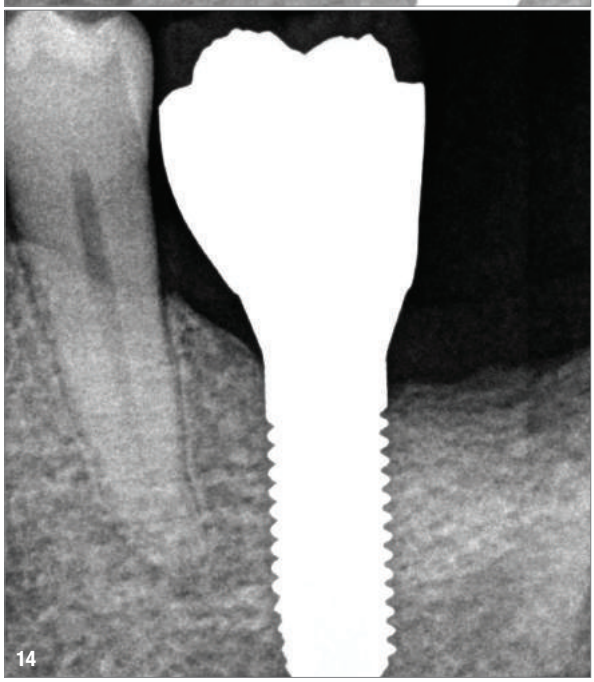


Fig. 10: Control radiograph after prosthetic delivery. Note the stable marginal bone levels. **Fig. 11:** Single-tooth implant in position 15. **Fig. 12:** Single-tooth implant in position 36. **Figs. 13&14:** Control radiograph at the time of implant placement and at the time of prosthetic delivery. Very stable marginal bone levels.

be seen in Figure 11. In region 36, another single-tooth implant was placed (Fig. 12). The implant was slightly exposed after insertion. However, the soft tissue is expected to grow to some extent over time. The control radiographs show very stable marginal bone levels (Figs. 13 & 14).

Conclusion

The implant system used in the here described case offers a high degree of prosthetic flexibility in combination with the glass fibre post. Single units or bridge constructions can be realised in a very efficient way using conventional dentistry techniques. Thanks to the roughness of the implant surface, complete biointegration of the machined transmucosal part with the surrounding bone can be achieved. In combination with the microgap-less design, very stable tissue levels are achieved (Figs. 3, 10, 13 & 14). The implant system has shown survival rates that are on par with titanium, as well as a favourable soft-tissue interaction.

about the author

Dr Gernot Obermair is an Italy-based dentist who specialises in ceramic implantology and three-dimensional guided surgery. He currently runs the private practice Happy Implant – Dental Implant Center in Bozen in Italy. In addition, he is a member of the International Society of Metal Free Implantology (ISMI).

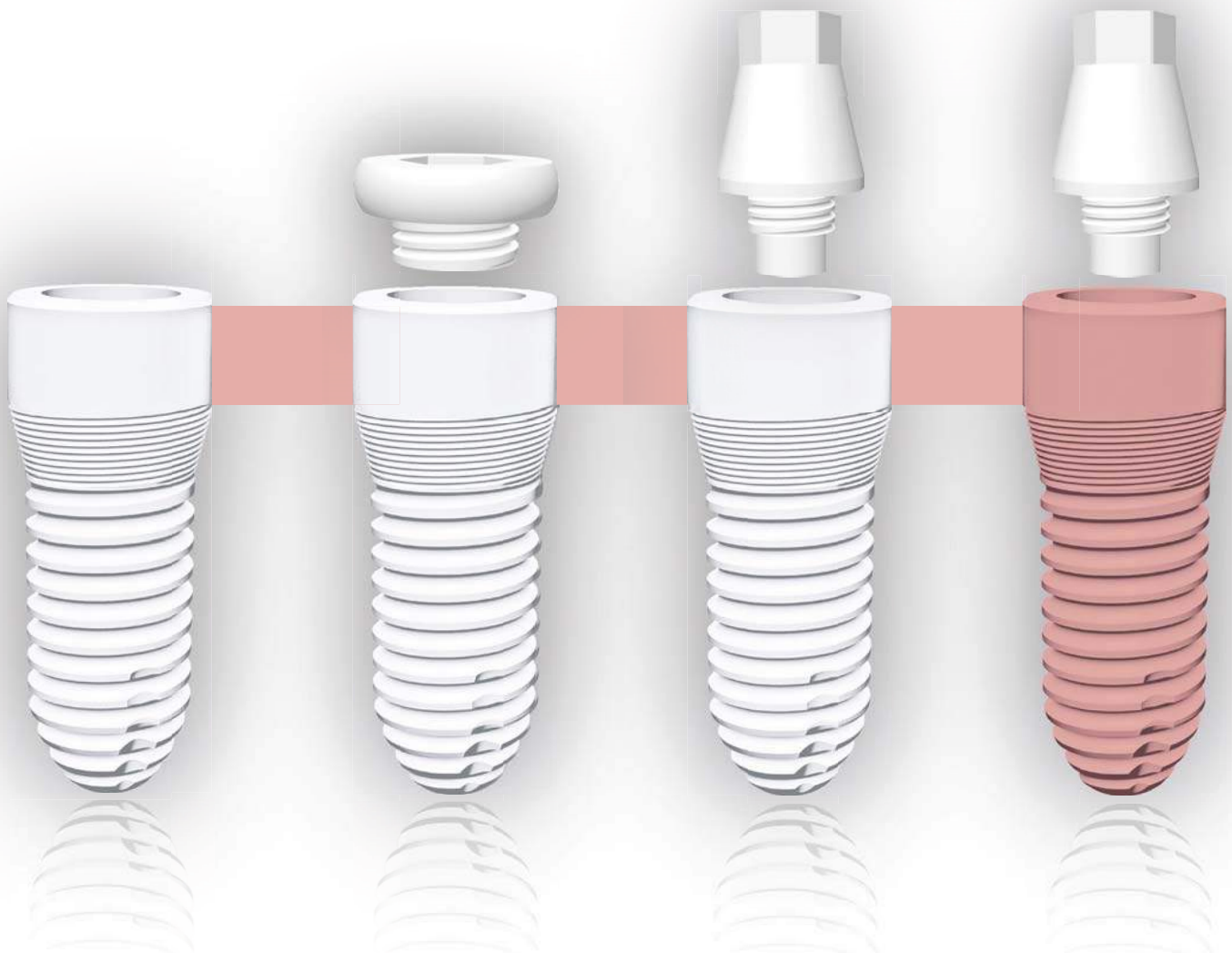
contact

Dr Gernot Obermair
Happy Implant – Dental Implant Center
Bozen, Italy
+39 0471 300082
gernot@happy-implant.com
www.happy-implant.com

Author details

AWI

Albus WITAR Implants



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Replacement of two incisors with zirconia implants

Prof. Curd Bollen & Dr Ilian Dargel, UK & Netherlands

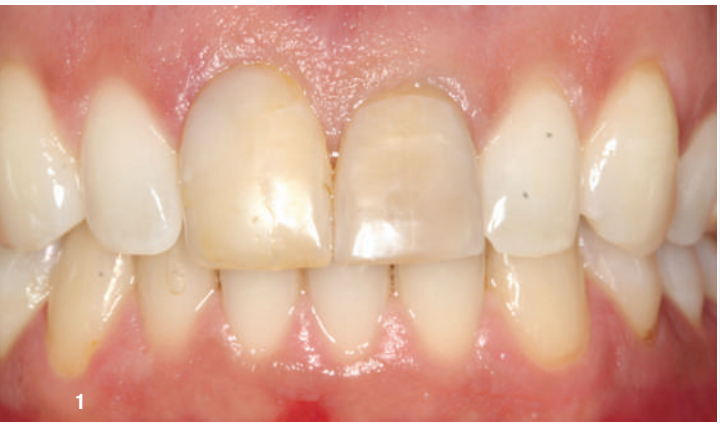
Literature

Modern implant dentistry is a continuously changing discipline in which high-tech approaches are involved to optimise the treatment results. An increasing number of cases are performed with guided surgery systems or even with navigated implant placement.[1, 2] The complete digital workflow, including cone beam computed tomography (CBCT) scans, intra-oral scans and prosthetic 3D printing, is nowadays gaining in importance.[3] Moreover, we are seeing changing trends in the applied implant materials. For more than 60 years, titanium was the primary implant material used. Recently, a shift towards biological approaches can be seen in society overall: green energy supply, clothes recycling and biological food products. As a significant consequence, the use of more biocompatible, metal-free and non-toxic materials in oral rehabilitation is booming. Therefore, zirconia (a very biocompatible material) is playing an important role in implant dentistry, not only as the actual preferred crown material but also as the material of choice for fabricating "healthy" dental implants.[4]

Several reasons can be highlighted for this paradigm change in implant material: firstly, zirconia is a white material, offering better aesthetic results than greyish titanium, especially in patients with a thin biotype; secondly, zirconia is extremely biocompatible, showing perfect soft-tissue adaptation and limited plaque retention;[5] thirdly, zirconia is metal-free; fourthly, the material is very strong (in many respects even stronger than titanium); fifthly, it has not been associated with peri-implantitis (yet); and lastly, zirconia is a really bio-inert material with no (tribo-)corrosion. Types VI and V of commercial pure titanium, on the contrary, show high levels of tribo-corrosion, which could explain the growing increase of titanium allergy and which could also be related to the growing incidence of peri-implant infections.[6] These important aspects are the main reasons why zirconia could be the future of implant dentistry.[7] The case presented in this article is a clear example of the optimal application of ceramic dental implants in an aesthetic prosthetic anterior rehabilitation. It involved the replacement of two infected teeth with two two-piece zirconia implants.

Initial situation

This 37-year-old female patient presented to our clinic at the end of 2016. Her ASA score was I and she claimed to have never smoked. Her alcohol consumption was moderate. In 2013, this patient was involved in a minor car accident, causing damage to her maxillary anterior teeth. In particular, teeth #11 and 21 sustained significant trauma. An endodontic treatment was only performed on tooth #21 at that time. On tooth #11, no endodontic treatment was indicated by her former dentist. This tooth showed severe untreated root caries in combination with an inadequate distal composite filling on our initial radiograph. Both central incisors had buccal composite restorations (Fig. 1). On both apices, cystic inflammation was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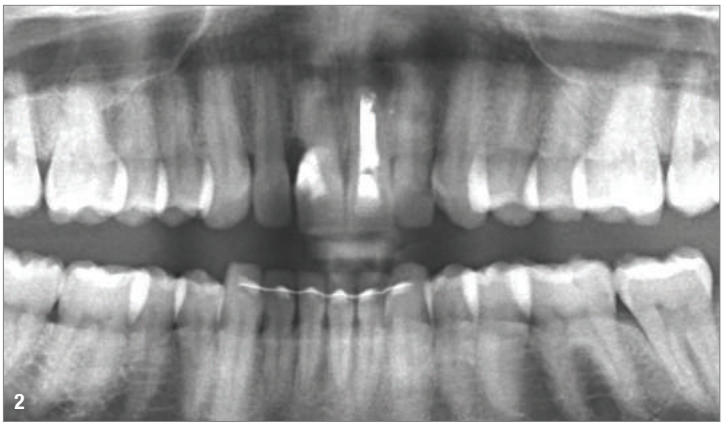
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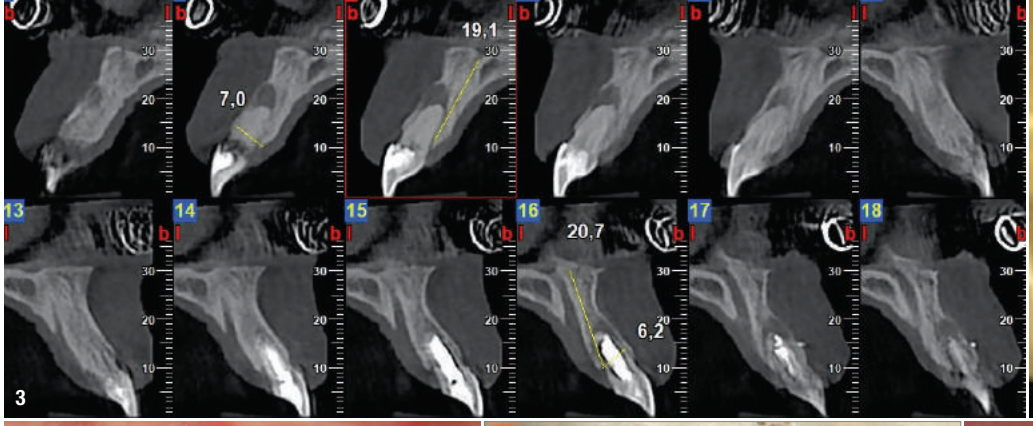
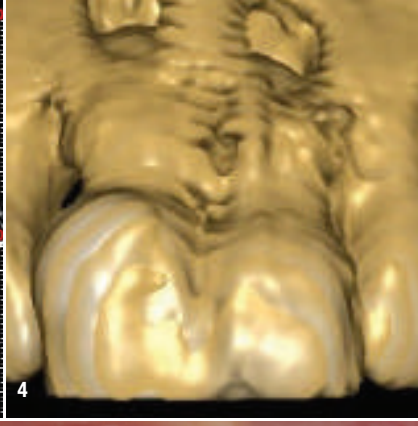
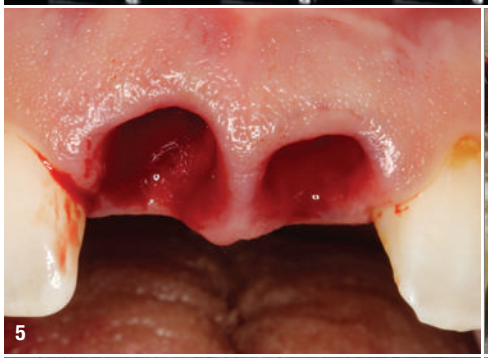
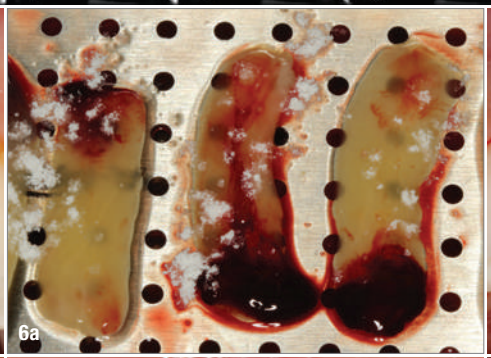
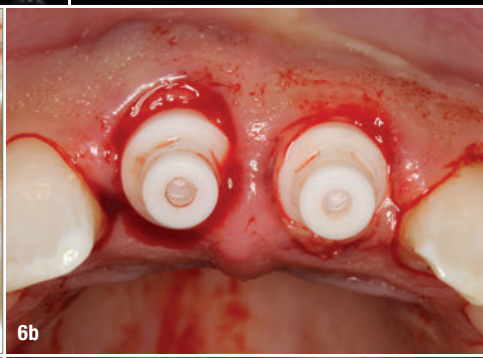
Fig. 1: General intra-oral situation at baseline in 2016. **Fig. 2:** The panoramic radiograph.

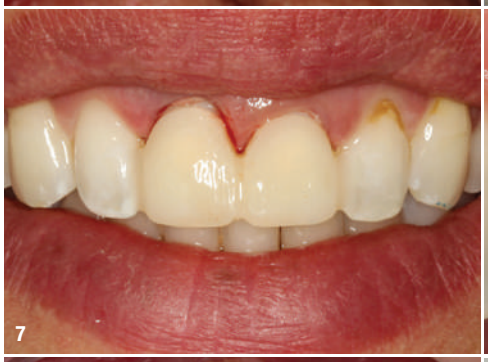


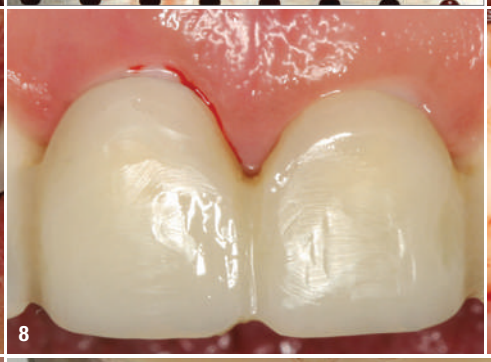


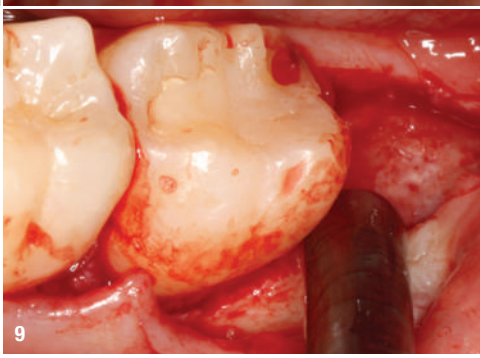


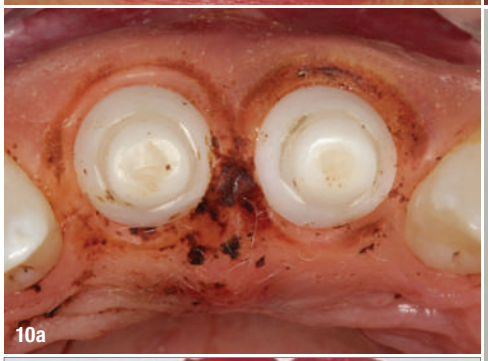


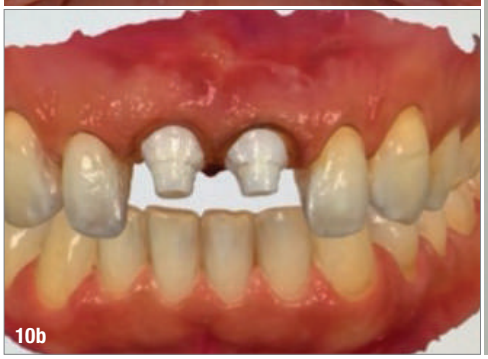


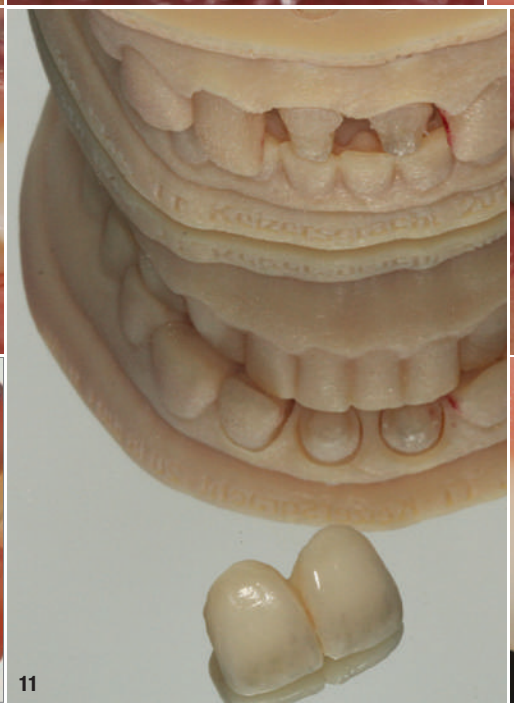


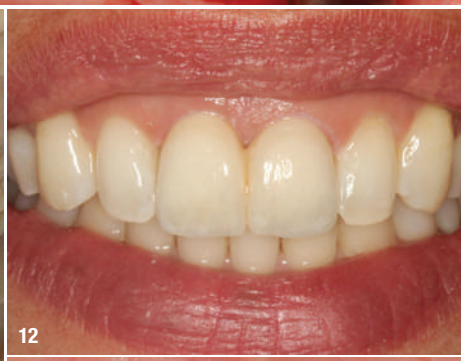












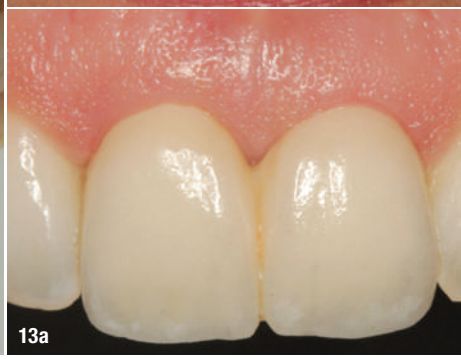
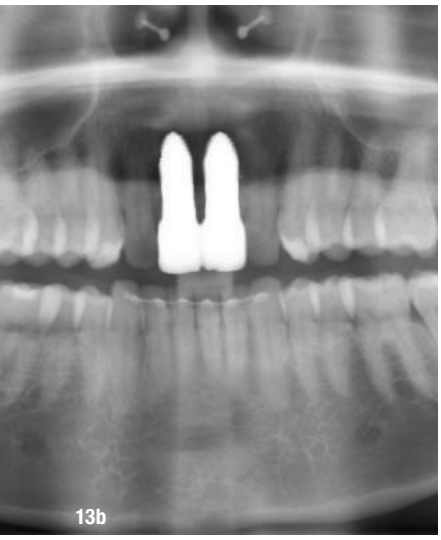


Fig. 3: The CBCT evaluation of teeth #11 and 21 at the end of 2016. **Fig. 4:** Presence of fenestrations at both teeth; dehiscences are absent. **Fig. 5:** Immediately after the extraction of teeth #11 and 21 and the removal of periapical cysts. **Fig. 6a:** The prepared A-PRF membranes. **Fig. 6b:** The two immediately placed ceramic implants wrapped in the A-PRF membranes. **Fig. 7:** Direct provisional restorations *in situ* (note the asymmetrical gingival level of the crown margins). **Fig. 8:** Soft-tissue situation two weeks after the small tunnel graft with connective tissue at tooth #11. **Fig. 9:** The neuralgia-inducing cavitational osteonecrosis was opened, and a connective tissue graft from the distal tuberosity of tooth #37 was simultaneously harvested. The osteonecrosis was completely cleared, and the cavity was filled with an A-PRF plug. **Fig. 10a:** Prepared abutments and laser-corrected gingiva before intra-oral scanning (occlusal view). **Fig. 10b:** Intra-oral scanned situation. **Fig. 11:** The 3D model and two ceramic crowns. **Fig. 12:** Definitive cemented crowns *in situ*. **Fig. 13a:** Clinical situation six months later.



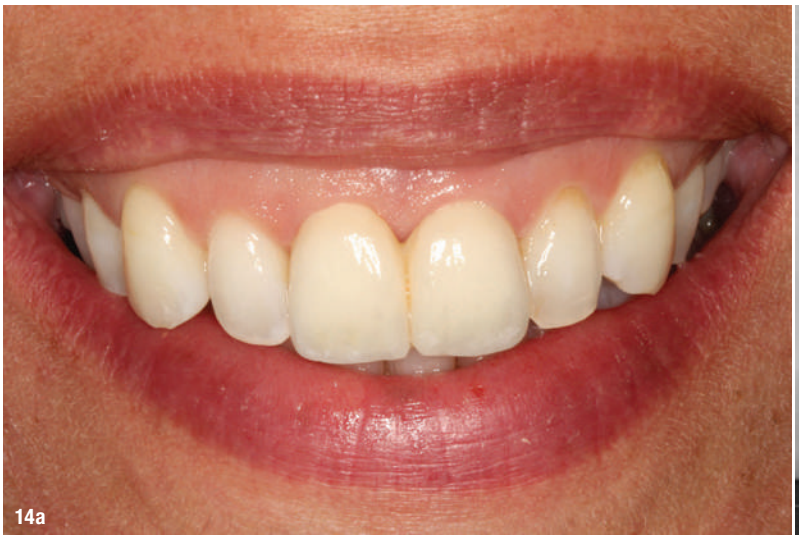


Fig. 13b: Panoramic radiograph after six months. **Fig. 14a:** Clinical situation two years after initial surgery. **Fig. 14b:** Periapical radiograph after two years.

detectable (Fig. 2). The patient complained of diffuse pain at the apical area of tooth #11 especially. Slight mobility of teeth #11 and 21 was detected. An additional CBCT scan was taken in order to evaluate the endodontic treatment of tooth #21 and the apical situation of tooth #11 (Fig. 3). The radiographic situation clearly revealed that both teeth were unsalvageable and had to be removed at the earliest. The buccal bone plate of both teeth showed two clear fenestrations, but no dehiscences (Fig. 4). It was therefore decided that immediate implantation, after extraction, was a proper indication for this case.

Implant placement

Two weeks later, the patient was scheduled for surgery under local anaesthesia. Both teeth were carefully and atraumatically extracted without raising a flap. Tooth #11 showed a root fracture (Fig. 5). Both cysts were meticulously removed, and the alveoli were extensively disinfected with ozone therapy. Both fenestrations were clearly detectable. Before the surgery, five tubes of venous blood were collected through venepuncture of the right median cubital vein. The blood tubes were used to prepare concentrated growth factors (A-PRF technique according to Choukroun[8]). All the tubes were used to prepare concentrated growth factor-rich membranes. Before application, all the membranes were impregnated with metronidazole powder (40 mg/ml). After strictly following the drilling protocol of the implant system (SDS Swiss Dental Solutions), an A-PRF membrane was plugged into the apical part of the prepared osteotomy to fill up the fenestration. Afterwards, the two selected implants (SDS1.1–4.6, 4.6 × 14.0 mm) were wrapped in the other previously prepared A-PRF membranes and were placed following the SDS protocol (Figs. 6a & b). High initial stability was obtained for both implants.

No sutures were placed. Local injections with dexamethasone (4 mg/ml) were performed to reduce postoperative swelling. No antibiotics were administered, neither preoperatively nor postoperatively. The patient was asked to rinse twice per day with chlorhexidine (2 mg/ml) for a duration of 60 seconds for ten days. As for an analgesic, ibuprofen (600 mg, a maximum of four times per day) was prescribed. The patient was also instructed to take supporting vitamins D3 and K2 (15 µg and 75 µg, respectively, per day), starting one month before surgery until two months after surgery, to optimise bone quality. Immediately after implant insertion, two provisional acrylic crowns were prepared and placed with temporary cement. Both crowns were placed out of the occlusal plane, avoiding early loading of the freshly placed implants (Fig. 7).

Further surgical interventions

Owing to the apical disbalance in the soft-tissue level at both crowns, a small grafting procedure was performed two months after the implant insertion. A connective tissue graft was harvested from the tuberosity area in the third quadrant and placed with a tunnel procedure. After the graft had healed completely two weeks later, an improved aesthetic result was obtained (Fig. 8). This surgery was combined with the procedure to remove the neuralgia-inducing cavitational osteonecrosis at positions #28 and 38, according to the theory and procedures of Dr Johann Lechner.[10] The cavities were afterwards filled with A-PRF plugs (Fig. 9). After an osseointegration period of four months, the final prosthetic procedure was performed. First, the two abutments were intra-orally prepared with a diamond bur at high speed and with extensive cooling. The gingival margin was then adapted with a laser (Epic Pro, BIOLASE). Finally, a digital impression with an intra-oral scanner (3Shape) was taken (Figs. 10a & b).[11]

Definitive prosthetic restoration and recalls

Two CAD/CAM crowns were fabricated in the dental laboratory. Both crowns were prepared from zirconia and

covered with an IPS e.max layer (Ivoclar Vivadent). For stability reasons, it was decided to fuse both crowns centrally (Fig. 11). The definitive crowns were cemented with a glass ionomer cement (Ketac Cem, 3M ESPE). The radiograph showed an excellent fit at the crown–implant connection (Fig. 12). After six months, the patient was invited to a recall. The soft tissue was extremely healthy, and there was complete papillary regrowth between tooth #12 and tooth #11, tooth #11 and tooth #21, and tooth #21 and tooth #22 (Fig. 13a). The radiograph showed no signs of inflammation or marginal bone loss (Fig. 13b). Two years postoperatively, the patient was seen at another recall. The soft tissue was still very healthy. The radiograph taken at this appointment again showed no signs of inflammation or bone loss (Figs. 14a & b).

Summary

Two-piece ceramic implants are a reliable option for replacing maxillary anterior teeth. Direct placement after extraction in an infected area is possible if strict cleaning and thorough disinfection are performed. A provisional crown can be used to pre-shape soft tissue and help in the reconstruction of papillae. The final clinical outcome can be very satisfying, functionally and aesthetically. Long-term follow-ups are necessary to check the stability of the restorations.

about the author

Prof. Curd Bollen obtained his DDS in 1992 from KU Leuven in Belgium. In 1996, he received his PhD and, in 1997, his MSc in periodontics and implantology. In 2016, he completed the MClinDent programme at University of the Pacific in the US. As for his active clinical work, Prof. Bollen specialises in periodontics, implantology and halitosis. He recently joined the College of Medicine and Dentistry in Birmingham in the UK as an associate clinical professor.

contact

Prof. Curd M. L. Bollen
College of Medicine and Dentistry
Birmingham, UK
+44 121 3459847
c.bollen@comd.org.uk

Author details

Treating stable periodontitis patients with two-piece implants

Drs Alaa Khutaba, Daniel Rotenberg & Hadar Zigdon-Giladi, Israel

In patients who suffer from periodontitis, the treatment with dental implants can pose unique challenges for clinicians. In most cases, periodontal therapy needs to be carried out first, before implants can be installed successfully. In the following, two clinical cases are described in which tooth replacement with dental implants was carried out once the patients had successfully completed preceding periodontal therapy.

Case 1

Initial situation

A 26-year-old female patient visited the Department of Periodontology at Rambam Health Care Campus. She was complaining about "advanced gum disease" and she expressed the fear of losing her teeth. She was healthy and a non-smoker. Periodontal examination revealed severe attachment loss in all quadrants, mobility of teeth, poor oral hygiene and insufficient restorations. Plaque and gingival indices were above 70%.

The patient was diagnosed with generalised periodontitis, stage IV, grade C, according to the 2017 workshop on the Classification of Periodontal and Peri-implant Diseases and Conditions (Fig. 1a).

Pre-surgical treatment

The first phase of periodontal therapy (cause-related therapy) involved a motivational interview as well as an explanation about the cause and progression of her periodontal disease. Thereafter, sub- and supragingival debridement was performed in all quadrants under local anaesthesia and systemic antibiotics were prescribed. The hopeless teeth #11, 12, 21 and 22 were extracted and the extraction sockets were filled with an alloplastic material (bi-phasic calcium sulphate). A provisional bridge was installed in the maxilla on #15 and 25. At the re-evaluation appointment six months after the first phase of therapy, the self-oral hygiene of the patient had improved with plaque and gingival indices below 15% (Fig. 1b). However, deep periodontal pockets up to 10 mm remained especially in the posterior segments of the dentition.

To further threat the periodontal disease, a second phase of therapy was planned, which involved the extraction of teeth #16, 26 and 28 owing to grade 3 furcation, and regenerative periodontal surgery (Fig. 1c). Repeated root surface debridement was performed for the single-rooted teeth with residual pockets of 5 mm. Six months after the periodontal surgeries, the case was re-evaluated. Intra-oral radiographs and a periodontal chart confirmed

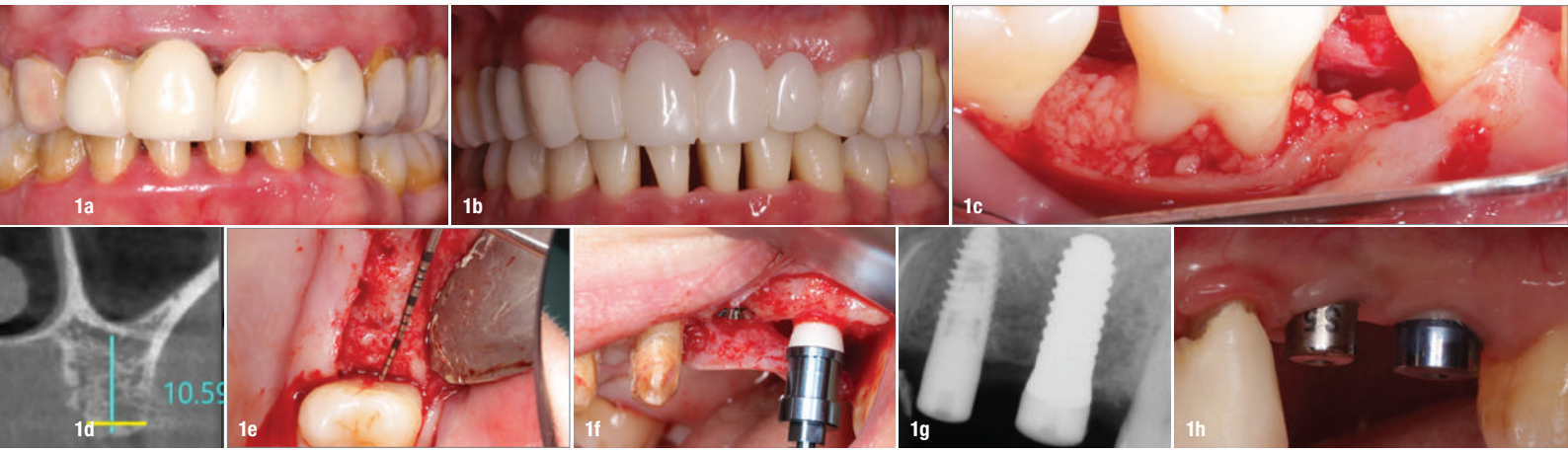


Fig. 1: Periodontal and prosthetic treatment of a patient with stabilised periodontitis, stage IV, grade C: baseline clinical findings **(a)**, clinical situation six months after phase one periodontal therapy **(b)**, periodontal regeneration of intra-bony defect **(c)**, CBCT of the edentulous area **(d)**, interdental space allowing placement of two implants **(e)**, installation of bone-level titanium implant in the mesial position and two-piece zirconia tissue-level implant in the distal aspect **(f)**, intra-oral radiographs immediately after implant placement **(g)**, uneventful healing of the peri-implant soft tissue **(h)**.

the elimination of deep pockets and the stability of the periodontal disease. At that point, after prosthetic consultation, it was decided to restore the missing teeth #16 and 26 with dental implants and to realise a cross arch, tooth-supported, fixed partial denture between tooth #15 and 25.

Implant surgery

The partially edentulous ridge at positions #16 and 26 was evaluated by means of CBCT (Fig. 1d). The interdental space was 15 mm, which allowed the insertion of two dental implants in each side. On each side of the maxilla in position of the missing teeth #16 and 26, two implants were inserted: a standard titanium-based implant on the mesial side and a two-piece zirconia tissue-level implant on the distal side (4.1 mm in diameter and 10 mm in length; TAV Dental; Figs. 1e–g). In both sites healing was uneventful (Fig. 1h). The final restoration of the implants was planned to be carried out four months after insertion.

Case 2

Initial situation

A 57-year-old female patient with a medical history of osteopenia, and who had undergone six years of Zoledronic acid treatment, presented at the Department of Periodontology at Rambam Health Care Campus. There, she was diagnosed with localised periodontitis, stage II, grade B (Figs. 2a–c).

Pre-surgical treatment

The first phase of periodontal therapy included sub- and supragingival debridement, and the extraction of tooth #14, which was diagnosed with vertical root fracture. The periodontal pockets of teeth #11 and 21, which had been successfully treated with a Slow-Release device (PerioChips, Dexcel Pharma), had depths of 6–7 mm. Treatment outcomes were re-evaluated four months after the first phase of periodontal therapy had ended, revealing the elimination of deep pockets (Fig. 2d).

Implant surgery

Before dental implant placement, the patient paused her Zoledronic acid treatment for three months. After the evaluation of the partially edentulous ridge by means of CBCT (Fig. 2e), a two-piece zirconia implant, 4.1 mm in diameter and 11.5 mm in length (TAV Dental), was installed (Figs. 2f–h). Subsequent healing was uneventful. Six months after insertion, the implant was rehabilitated with a crown (Figs. 2i & j).

about the author

Dr Hadar Zigdon-Giladi is a periodontal surgeon and researcher in the field of bone regeneration. She is the Deputy Director of the Department of Periodontology at Rambam Health Care Campus. In addition, she is a clinical instructor at the Department of Periodontology, Head of the Laboratory for Bone Repair in the School of Graduate Dentistry at Rambam, and a member of the Clinical Research Institute at Rambam (CRIR).

contact

Dr Hadar Zigdon-Giladi
Department of Periodontology
Rambam Health Care Campus
Haifa, Israel
h_zigdon@rambam.health.gov.il

Author details

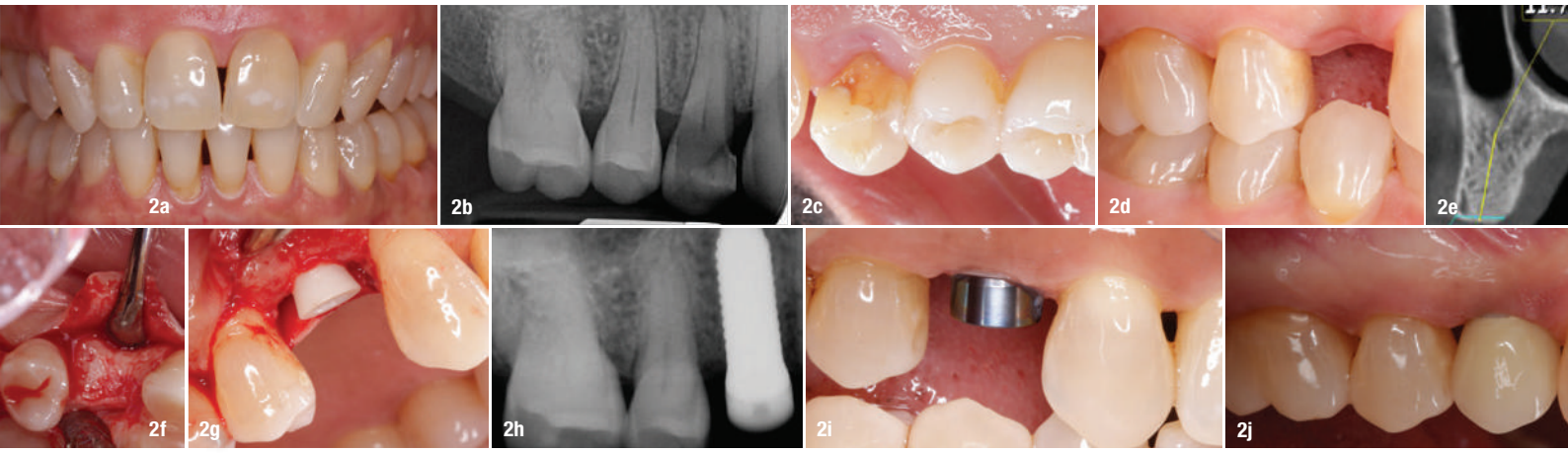
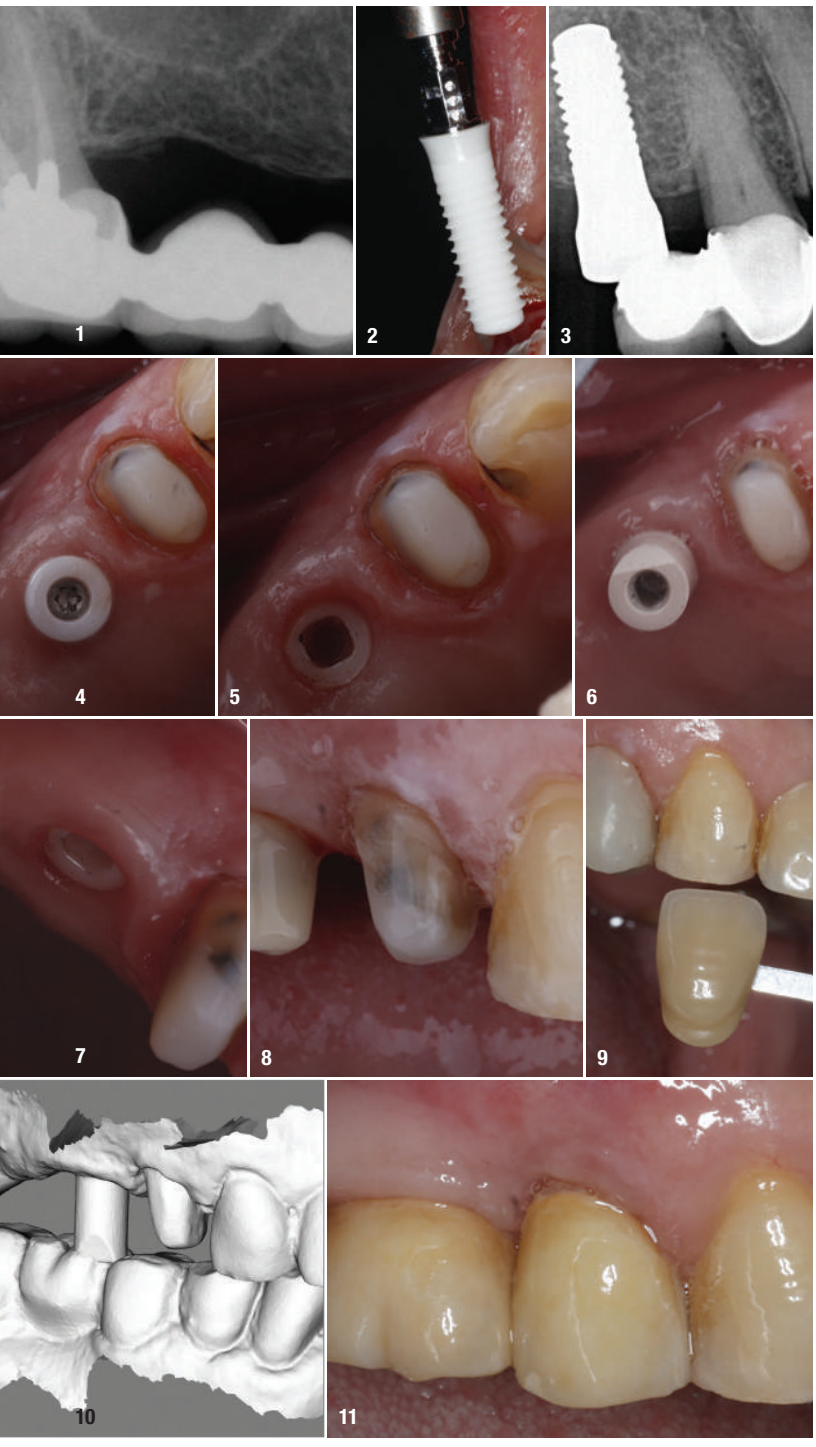


Fig. 2: Periodontal and prosthetic treatment of a patient with stabilised periodontitis, stage II, grade B: baseline clinical and radiographic findings **(a–c)**, clinical assessment of edentulous area at missing tooth #14 **(d)**, CBCT analysis of the edentulous area **(e)**, edentulous ridge after flap elevation **(f)**, installation of two-piece zirconia tissue-level implant **(g)**, intra-oral radiographs immediately after implant insertion **(h)**, rehabilitation of the implant with a crown **(i & j)**.

Posterior single-tooth replacement using a two-piece tissue-level implant

Dr Dan Hagi, Canada



Diagnosis

The patient, a 72-year-old male with well controlled hypertension, arthritis and an otherwise unremarkable medical history, presented with decay under the distal abutment of a long standing 4-unit fixed partial denture replacing teeth #15 and #16 (Fig. 1). Radiographic and clinical exams revealed an endodontically compromised #17, that was suspected to be vertically fractured. Also, tooth #18 was periodontally involved and unrestorable. The right maxillary sinus was pneumatised and the patient did not wish to have any sinus augmentation. The abutment tooth #14 exhibited coronal leakage and fractured porcelain, but was vital.

Treatment plan

As the patient wanted a fixed restoration, the only option was an implant-supported restoration. He desired to be completely metal-free as teeth were replaced on the contralateral side with one-piece ceramic implants four years prior. A decision was made to place an implant at tooth #15 and make it a molar size, thus avoiding sinus involvement and giving the patient a first molar occlusion. The possibility of the use of a zirconia two-piece dental implant (PURE, Institut Straumann) was discussed and the alternative titanium implant option was also reviewed. The replacement of the restoration on tooth #14 was also planned. Temporisation initially was to be with a cantilevered restoration from the sectioned bridge. After healing, a fixed provisional was to be made on the implant. The final treatment would involve the sectioning of the fixed bridge, extraction of tooth #17 and placement of the two-piece ceramic implant and healing abutment. After a period of three months and the rigid fixation of the

Fig. 1: Preoperative radiograph. **Fig. 2:** Insertion of the two-piece implant. **Fig. 3:** Postoperative radiograph: implant is in final position. No violation of the maxillary sinus and placement of the implant at the correct vertical position. **Fig. 4:** Healed implant with healing abutment. **Fig. 5:** Soft tissue immediately surrounding the implant. **Fig. 6:** Scanbody in place. **Fig. 7:** Soft-tissue health after three months of healing. **Fig. 8:** Preparation of temporary abutment. **Fig. 9:** Provisional restoration. **Fig. 10:** Intra-oral scan STL files, lateral view. **Fig. 11:** Final restoration day of insertion.

implant, full contour milled Prettau crowns would be used as final restoration.

Surgical treatment

The patient was pre-medicated with an antibiotic (Amoxicillin 500 mg). Infiltration with 4% Articaine 1:200,000 epinephrine (Septocaine, Septodont Inc.) was performed to anaesthetise the operative area. The prosthesis was sectioned and removed, and tooth #17 atraumatically removed. A full-thickness flap was raised to expose the underlying bone. The osteotomy was preformed utilising drills at a maximum speed of 350 rpm. The slow drilling helps to maintain the vitality of the bone. No irrigation was used during the drilling and bone debris was collected from the drills. The implant was threaded into position (Fig. 2) and achieved excellent stability at 30 Ncm, threads in bone and the mucosal portion terminating 0.5 mm below the expected tissue level. The facial portion was grafted with the autogenous bone chips mixed with allograft (Oragraft, LifeNet), which was done to thicken up the crestal bone profile. The fixed partial denture that was removed and sectioned was cleaned and cemented with a resin cement to act as a one tooth cantilevered provisional. The post-surgical intra-oral radiograph shows the final position of the implant (Fig. 3).

Prosthetic treatment

After twelve weeks, the soft tissue had healed and the implant had integrated. At that point, the implant was ready for final restoration (Figs. 4 & 5). The provisional was cut off and tooth #14 prepared for full coverage restoration. A scanbody was secured on the implant and both arches were scanned with an intra-oral scanner (CS3700, Carestream) before tissue retraction with retraction paste (3M Retraction Paste, 3M ESPE) on tooth #14 was performed (Fig. 6). After the scanning was completed, a PEEK abutment was secured on the implant and prepped to accommodate a new provisional (Fig. 8). An immediate provisional (VISCO III Auto-cure, anaxdent) was made with a direct method from a digital wax-up that was prepared previous to surgery and transferred intra-orally via matrix (Fig. 9). The STL files from the scan were transferred to the laboratory (Fig. 10). Utilising the digital files, the Prettau crowns were designed and milled. The screw-retained implant crown was inserted with 25 Ncm torque on the abutment screw. The access was sealed with a layer of PTFE tape and flowable composite. The crown on the tooth was inserted with a glass ionomer cement (GC FujiCEM 2, GC America). Excess cement was carefully cleaned. Occlusion was adjusted again as to avoid any prematurities (Fig. 11).

Discussion

Two-piece ceramic implants are entering the marketplace. The key advantage over the one-piece option is the ability to accommodate angulation as well as to simplify the healing period by minimising the surface area exposed to the oral cavity and thus reducing the occurrence of premature loading of the implant abutment. Proper angulation is achievable with the one-piece implant but needs to be managed by meticulous surgical planning and execution. If the angulation or spacing of implants is not correct, the outcome is very difficult to manage as we do not have a myriad of prosthetic options that can ameliorate poor placement. One-piece ceramic implants are a double-edged sword. If placed correctly, the soft-tissue profile and tissue health is remarkable, but if placed incorrectly, there are very few options to fix problems. The availability of two-piece ceramic implants certainly expands the application of the metal-free approach. As with the one-piece implants, soft-tissue health seems to be enhanced and thus so are aesthetic outcomes. The absence of a micro gap at bone level assures better bone preservation and thus better soft-tissue outcomes (Fig. 7).

Conclusion

This case presented an example of where old concepts can be used with new cutting edge materials and a tooth can be replaced in an efficient, aesthetic and predictable manner. As with any aspect of this emerging field, we need more evidence and more work to validate the application of these techniques in the long term.

about the author

Dr Dan Hagi received his dental training at the University of Toronto and now maintains a multidisciplinary implant and rehabilitative practice in Thornhill, Ontario. He is an associate Fellow of the American Academy of Implant Dentistry (AAID), a Fellow of the International Congress of Oral Implantology (ICOI), the Academy of General Dentistry (AGD), the Academy for Dental Facial Esthetics (ADFE) and the Misch International Implant Institute (MIII). His private practice focuses on metal-free, minimally invasive implant rehabilitation and aesthetic smile design. He is a lecturer and mentor at the Dental Implantology Center of Excellence (DICE), as well as a consultant on emerging metal-free materials and techniques.

contact

Dr Dan Hagi
DDS, FAGD, FICOI, (A)FAAID
DH Smile Center Dentistry
Thornhill, ON, Canada
+1 905 7093177
www.drdanhagi.com

Author details

Straumann

Natural ceramic—proven quality

PURE ceramic implants have an ivory colour that resembles natural tooth roots. This gives the most natural look even in thin gingiva biotypes. ZLA, the surface of the PURE ceramic implant, is characterised by macro- and micro-roughness which is similar to the original Straumann SLA surface. In several studies, the ZLA surface has also demonstrated similar healing patterns, healing times and osseointegration qualities with regards to peri-implant bone density and bone-to-implant contact (BIC). In addition, the zirconia-based ZLA surface of PURE implants shows a favourable formation of the epithelial attachment, as well as significant lower bacterial accumulation compared to titanium-based SLA surfaces.

Compared to titanium implants, a higher degree of soft-tissue integration around the PURE ceramic implant was observed in scientific studies. By placing the Straumann PURE ceramic implant system, excellent aesthetic outcomes with favourable soft-tissue attachment and papilla formation around the implant can be achieved.

Institut Straumann AG
Switzerland
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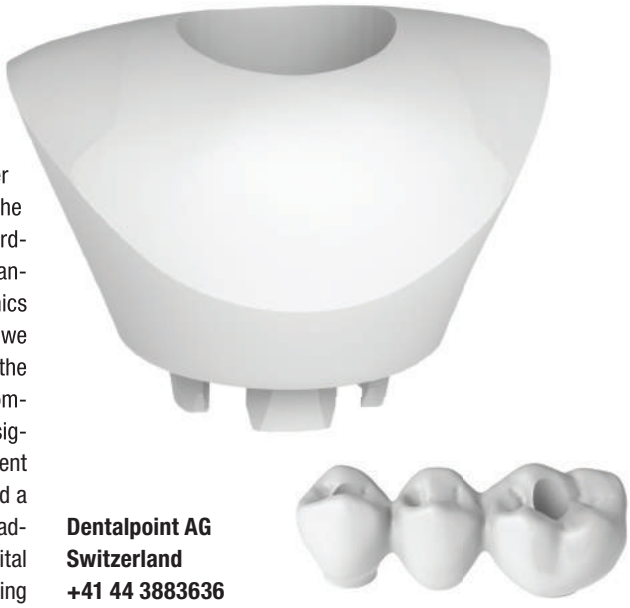
Dentalpoint

Zeramex Digital Solutions expanded

Zeramex is pleased to introduce another ground-breaking innovation to implant dentists: new custom gingiva formers made of zirconium oxide as well as three-unit monolithic bridges are now available and can be ordered via Zeramex Digital Solutions. These brand new metal-free products offer new levels of customisation and flexibility when it comes to the prosthetic treatment options of Zeramex XT implants. According to Dentalpoint CEO Adrian Hunn, Zeramex has achieved another milestone with this. “Digitalisation and the use of ceramics are currently the key trends in implantology. With Zeramex, we aim to play a leading role in both trends and our expansion of the Zeramex Digital Solutions product portfolio with ceramic customised gingiva formers and monolithic bridges has brought us a significant step closer to this goal.” Along with the R&D department at Zeramex, collaboration with external laboratories has played a central role in the development of Zeramex Digital Solutions. In addition to the production of custom restoration options, the digital workflow from Zeramex offers clinicians a service for processing digital data or for finishing restorations.



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Switzerland
+41 44 3883636
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CAMLOG

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The demand for highly aesthetic, natural-looking restorations is continually increasing. This trend favours ceramic implant solutions with high levels of biocompatibility, particularly zirconia, known for its excellent soft-tissue compatibility. The CERALOG® Implant System is established and has been in clinical use for more than seven years. It offers a high level of predictability and provides aesthetically pleasing results. The two-piece design of the system that allows for screw-retained prosthetics offers great benefits. CERALOG® is easy to use, owing to the simplified prostheses, lean instrumentation, and clearly structured surgical procedure. Options for the treatment workflow include flexible trans- or submucosal healing of the two-piece CERALOG® Hexalobe implant and transmucosal healing of the CERALOG® Monobloc implant. The implants are made of yttria-stabilised tetragonal zirconia, which is a ceramic widely used in the dental industry and other highly demanding medical fields. The ivory colour of the material, which is very close to that of a natural tooth, and the properties of zirconia lead to natural-looking results. Zirconia is chemically inert, making it especially suitable as an implant material. Due to its manufacturing process called ceramic injection molding (including sintering and hot isostatic pressing), it offers an outstanding combination of excellent mechanical properties and high strength.

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The ivory colour, which is close to the natural tooth colour and the properties of zirconia supports high aesthetic results.

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Amann Girrbach has expanded the portfolio of Zolid Gen-X zirconias, thus further reducing the complexity of material selection. The highly translucent zirconia with a natural colour gradient is now available in all heights and shades commonly in use on the market. From now on the blanks are available in 12, 14, 16, 18, 20, 22 or 25 mm heights, eliminating all height limitations. The latter is particularly suitable for large-span, implant-supported restorations with a gingival section. The blanks now also cover the complete range of shades. They are available in 16 A–D VITA shades and two bleach shades. With its integrated colour and translucency gradient, Zolid Gen-X zirconia is the material of choice for virtually all common zirconia indications. The flowing colour and translucency gradient is a perfect imitation of nature. With this all-rounder, laboratories can significantly reduce their inventory and save time-consuming selection processes based on the indication and positioning of the respective restoration. At the same time, users can rely on the advantages of the Zolid HT+ material, which has been proven since 2017 and which forms the basis for Zolid Gen-X. With a flexural strength of 1,000 MPa, it meets almost every requirement for the stability of the restoration.

Amann Girrbach AG
Austria
+43 5523 623332381
www.amanngirrbach.com

TAV Dental

Innovation for a healthier world

TAV Dental is focused on developing and manufacturing zirconia dental products using the advanced ceramic injection technology with a vision to redefine the quality of zirconia dental products and its performances and to make these premium implants common worldwide. We offer a variety of solutions in the field of dental implants under one roof. The passion behind developing zirconia products for dental implantology is to provide patients with products that are much healthier for their bodies along with the advantage of uncompromising aesthetic results. The white colour of zirconia ceramic implants, its biocompatibility and low affinity of plaque, along with its high mechanical properties and osseointegration, make it a material of choice. TAV Dental offers the one-piece zirconia implant with integrated abutment and the two-piece configuration with slot connection geometry, which optimises the force transfer applied on the implant connection during insertion and, as a result, simplifies implant placement.

TAV Dental
Israel
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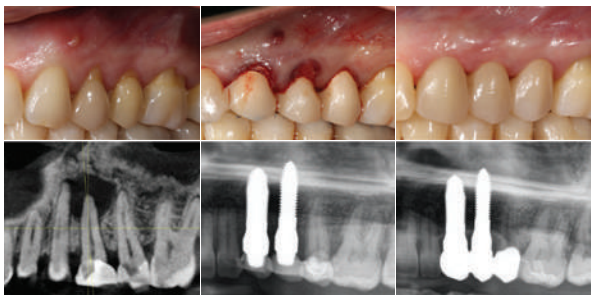
SDS Swiss Dental Solutions

The “healthy implant”: A supportive therapy concept

Ceramic implants of the worldwide market leader SDS Swiss Dental Solutions are made of high-purity zirconium dioxide without the addition of metal oxides or other factors that would influence its colour. This material is therefore considered immunologically neutral. Prof. Hendrik Terheyden describes zirconia ceramics as a completely inert, sufficiently reacted material. No immune reactions are to be expected with zirconia, since the material does not lead to the deposition of corrosion products. Furthermore, the crucial role of bone metabolism is widely underestimated: without sufficient supplementation of micronutrients such as vitamins D3, K2 (Subtype MK-7), C as well as magnesium citrate, the storage of calcium in the bone will not succeed sufficiently. Without these nutrients, the osteoblasts will not synthesise osteocalcin. SDS Swiss Dental Solutions is the only ceramic implant manufacturer that, in combination with SWISS BIOHEALTH, offers a supportive therapy concept as well as a comprehensive offering of high-quality micronutrients.

SDS Swiss Dental Solutions
Switzerland
+41 71 5563670
info@swissdentalsolutions.com



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ISMI e.V. Office Leipzig
Holbeinstraße 29 | 04229 Leipzig | Germany
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Z-SYSTEMS

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Ceramic implants have been at the cutting-edge of dental implant technology for over a decade, and are becoming increasingly popular with patients and practitioners worldwide. As a market leader, Z-SYSTEMS has taken another leap forward with its innovative Z5-BL (Bone Level) and soon-to-be-released Z5-TL (Tissue Level): the world's first two-part, screw-retained implants made entirely of ceramic. For the first time, completely submerged healing is now also possible with ceramic implants. The Z5-BL's advantages are evident in its beautiful bone level design and a unique variety of abutments. A high-precision, extremely stable conical connection between the abutment and the implant makes it possible to use this material even for the occlusal screw. Many practitioners also like to work with tissue level implants—especially in biological dentistry. In recognising these clinical demands, Z-SYSTEMS is rapidly following the release of the Z5-BL with an equally-revolutionary Z5-TL. These latest releases build on the proven platform of Z-SYSTEMS heritage line: the Z5m, Z5m(t) and Z5c. Each Z-SYSTEMS product features the technology's unique, patented laser surface for outstanding osseointegration. The company's proprietary manufacturing process has produced a top-quality implant family renowned for its great durability. In addition to fixed restorations, removable locator-like abutments are also possible on all two-piece Z-SYSTEMS implants. Available lengths are 8, 10 and 12 mm and diameters are 3.6, 4.0 and 5.0 mm.

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A wide range of zirconia products

Based on more than 30 years of experience, COHO has been producing orthopaedic and dental implants, and surgical instruments made from zirconia for many years. In collaboration with renowned experts and research units from National Taiwan University, a wide variety of ZiBone zirconia products have been launched in the past, including implant drills, pilot drills, tissue punch devices, tissue trimmers, scalpels, or elevators. COHO is always looking to advance research on surface treatment to reduce metal-related health risks for patients and to facilitate safety and convenience during surgery. COHO is currently working towards the market entry of Zircasso, IZI and a tissue-level implant system. In addition, COHO offers the new Deguide Kit, a set of accurate tools designed and developed by Dr Noran Debasso, which provides patients with a simple way to clean their implants and achieve good oral hygiene. Based on a novel, encompassing technique from Dr Noran Debasso, the Deguide Kit is a solution that does not require CBCT and that fits every type of dental implants. To find out more, go to www.zibone.com.

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Taiwan
+886 3 3112203
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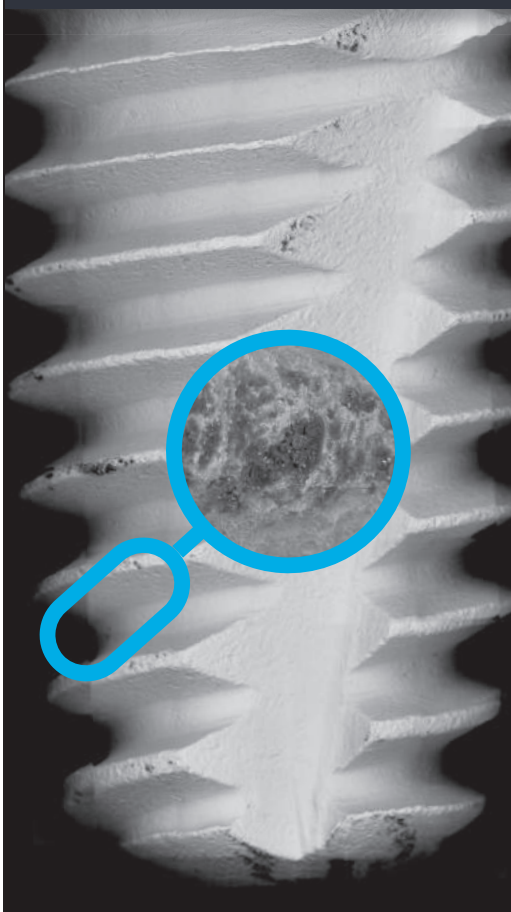
EXPECTATIONS

VS.

REALITY



WITAR

Ideal solution for all indications

AWI ceramic implants from WITAR offer superior aesthetics, stability, accuracy and healthy osseointegration. A sophisticated design combined with modern materials make for an ideal solution for all bone classes and indications. Made of zirconium dioxide, AWI dental implants are metal-free and thus fully biocompatible. The cemented zirconia abutment allows an individual design. The transgingival shoulder has an ideal surface for interacting with soft tissue for any type of indication. The conical micro-thread allows great primary stability and axial loading. Studies have shown that the thread roughness of 1,7 µm leads to optimal osseointegration. Also, the surface is coated with a bioactive BIOVERIT I nano-coating. This surface-thread combination enables superior osseointegration for all bone classes. The self-tapping implant tip provides space for bone chips and low-compression insertion. AWI ceramic implants are now available in gingiva colour too, which leads to even better aesthetics and optimised risk areas.

WITAR Consulting GmbH
Germany
www.witar.de

A revolution in dental implantology

With INPERIO, the Spain-based manufacturing company Nanoker Research is entering the ceramic implant market with the goal of revolutionising dental implantology. In order to achieve this, the company utilises two specific materials: a bioceramic composite on the one hand and a specific bacteriostatic bioglass coating on the other. In this interview with *ceramic implants*, Lidia M. Goyos Ball, medical devices division manager at Nanoker, talks about the advantages of the company's novel system.

First of all, what type of implant is INPERIO?
INPERIO is an all-ceramic monobloc dental implant made of our outstanding bioceramic composite. Only the inner screws (prosthetic or accessory screws), which do not come into direct contact with the body or bodily fluids during their expected use, are metallic (Ti-6Al-4V ELI, Grade 23).

For INPERIO, you utilise bioceramic composite and a bacteriostatic bioglass coating. What is so special about these materials?
Titanium implants made from Ti-6Al-4V currently make up 86.2% of all implants. Although mechanically reliable, they present various drawbacks, such as poor aesthetics, allergies, peri-implantitis and the release of complex metal alloy particles. Our bioceramic composite combines ceria-stabilised zirconia and alumina (Ce-TZP/Al) and is aesthetic by nature. This material's fracture toughness is superior to that of other ceramic materials owing to its intrinsic reinforcement mechanism, associated with its phase transformation, called transformation toughening or stress-induced martensitic transformation. Also, this ceramic does not suffer from hydrothermal phase transformation or ageing, which affects conventional yttria-stabilised zirconia (3Y-TZP). Moreover, Ce-TZP/Al exhibits some plastic deformation (ceramic ductility), a key feature in modern implant design. Beyond the well-proven preventive adhesion properties of our composite, which leads to enhanced soft-tissue attachment, our INPERIO system will incorporate a glassy coating on the transgingival abutment in the near future, once the regulatory certification process of our bacteriostatic bioglass is complete. This material acts as a biological seal, prevents the accumulation of bacterial plaque and guarantees preservation of bone, which is the main cause of long-term failure of conventional implants. It has been proved to prevent bacterial dysbiosis in the peri-implant sulcus in comparison with both titanium and 3Y-TZP.

What are INPERIO's properties regarding loading and biocompatibility?
INPERIO is the first ceramic solution that mechanically qualifies for implant insertion torque values up to 50 Ncm and screw-retained prosthetic solutions based on a ceramic multi-unit abutment termination, whereas other ceramic systems recommend not exceeding 35 Ncm, which does not allow immediate loading. Clinically speaking, INPERIO is suitable for immediate loading protocols and direct screwing to the implant with primary stability, even in extremely compromised cases. In terms of biocompatibility, INPERIO has similar success rates to titanium implants (>95%). Owing to its optimum surface roughness (Sa = 1.4 µm), there is no need to perform additional aggressive surface treatments to favour osseointegration. In fact, histological studies show that the degree of osseointegration in terms of bone–implant contact is similar to that of titanium implants. In addition, INPERIO's bioceramic composite (being a ceramic material) resists corrosion and wear and has high chemical stability. Its biocompatibility and enhanced soft-tissue attachment (anatomical emergence profile) are

outstanding. Moreover, we have demonstrated, in *in vivo* tests in dogs, that the accumulation of plaque and the dysbiosis in the peri-implant sulcus are much lower in the case of INPERIO implants when compared with commercially available titanium or zirconia implants—and especially in the case of preventive bioglass-coated INPERIO implants.

What kind of connection do you utilise?

Being a monobloc ceramic implant, INPERIO allows clinicians to follow the recommended one abutment–one time protocol that is applied in the aesthetic zone to prevent soft-tissue damage owing to repetitive abutment insertion. Furthermore, its design avoids micro-movements and bacterial microfiltration in the implant–abutment gap. INPERIO presents a platform switching arrangement and a concave emergence to jointly support and give space to the soft tissue. It also has a multi-unit connection, which allows the correction of disparallelisms of up to 25° between implants, using straight or dynamic screws and rotatory or anti-rotational systems for multiple and single restorations, respectively. We bring together a real screw-retained connection for single and multiple prosthetic restorations and ceramic biological advantages for the aesthetic zone, which cover even the most challenging cases. Our connection also means that the prosthetic workflow is exactly the same as with titanium implants: the one abutment–one time procedure, immediate provisionalisation on our multi-unit termination and immediate loading are possible. Protocols that have proved to be clinically successful do not need to be changed, but may be improved by using the most biologically friendly implant materials.

Why should clinicians offer their patients INPERIO?

Owing to its composition, design and optimised processing conditions, INPERIO has significant advantages over most solutions currently available. Its unique mechanical properties allow, for the first time in ceramic implantology, the use of the same workflow as that for titanium implants in terms of both surgical procedure and multiple prosthetic restorations. Moreover, INPERIO is available in different diameters (3.30, 3.75 and 4.20 mm) to respect the patient's bone and provide an anatomical emergence profile for the prosthetic restoration. Our narrow-diameter implants (3.3 mm) are ideal for compromised aesthetic restorations. INPERIO shows extraordinary bone and gingival biocompatibility and outstanding mechanical properties, and it presents superior ageing properties to biomedical-grade 3Y-TZP. Its bending moment (250 Ncm in the worst case) and fatigue limit (125 Ncm, in the worst case) values prove it reliable to survive oral cavity forces in the long term. Also, its tri-edge, self-tapping, compressive, bone-level/tissue-level and domed apical design improves implant–bone interactions and stability. In a nutshell, the INPERIO system combines the biological advantages of ceramics with the most outstanding clinical protocols for the aesthetic zone and tissue preservation while also effectively improving peri-implantitis prevention. It is a ceramic implant with the advantages of titanium solutions.

When and where will it be available for clinicians?

We predict that it will be available during the second half of 2022. Also, the next steps towards market entry include covering all the necessary regulatory validations towards CE mark approval according to the new EU Medical Device Regulation (EU MDR 2017/745). In addition, we are already working on our next product, a two-piece all-ceramic implant with the versatility of the most advanced two-piece titanium implants, and we are performing the necessary certification actions to get our bioglass coating to market as soon as possible, with the intention of including it on our proprietary products and on those of any interested third parties so that society as a whole can benefit from it.

contact

Nanoker Research
Oviedo, Spain
+34 984 836852
l.goyos@nanoker.com
info@nanoker.com
www.nanoker.com

A new concept in ceramic implantology

The team behind Polish ceramic implant system OriCera is convinced that a new era in dental implantology will be dominated by metal-free products and that its implant will soon become the most advanced ceramic implant in the world and will contribute to improving the health and quality of life of patients worldwide. In this interview with *ceramic implants*, Chief Science Officer at OriCera Dr Jarosław Pospiech explains the rationale behind this ambitious view.

What's the back story of OriCera?
Several years ago, I met two engineers—Adam Zdybel, a specialist in nanomaterials, and Przemysław Grycza, a specialist in materials processing—with the requisite knowledge and production facilities who were both enthusiastic about the production and marketing of modern dental implants. OriCera initially had a different name and was intended to create a state-of-the-art titanium implant with a reduced osseointegration period. However, Adam introduced us to the current knowledge on ceramic materials and showed us scientific reports by authors like Curd Bollen, Johann Lechner and Sammy Noumbissi, and we unanimously concluded that ceramics are the future of dental implantology. The clinical and biological reasons for this are obvious. Zirconia ceramics especially have excellent biological and physical properties, such as resilience to bending and abrasion. It is an interesting but also a demanding material for the production of implants. The existing ceramic implant systems try to copy titanium solutions, which we believe is not the best approach.

Where do you see the biggest problems with ceramic implants?
I believe the biggest problem is the insecure connection between the prosthetic component and the implant. In two-piece ceramic implants, many manufacturers use screw connections between the implant and abutment which are usually made of metals or composites. From a technical stance, mechanical connections of elements of different physical parameters, such as hardness, are debatable owing to differing abrasion of the materials over time. There is currently not enough clinical data to conclude that these solutions are really safe. Recently, ceramic screws have been used for connection. However, we also do not have long-term data to prove the effectiveness of this approach. Research has exposed the structure's greatest weakness: the connection between screw, abutment and implant. The accumulation of stress in these places leads to microcracks and, ultimately, implant fracture. In mechanics, screws are usually used for connecting materials with similar strength parameters and with a certain degree of plasticity, like metals or plastics. Ceramics are by nature hard structures with negligible plasticity. After an in-depth market analysis, we decided to develop a screwless, detachable connection without the use of glue or cement. This allows for the removal, placement and eventual replacement of the prosthetic work at any time. The process of removing the crown does not subject the implant to damage by exposure and the formation of areas that initiate rupture. The dentist won't need to invest in expensive equipment, as placing and removing the crown is rather simple. Digital techniques will allow the production of a strength-optimised, stable prosthetic work. Also, in most clinical situations the use of an abutment won't be necessary. In addition, our connection is aesthetically improved.

Apart from the screwless connection that works without the use of glue or cement, are there any other improvements introduced by OriCera?
Our goal is also to reduce osseointegration time. Quick prosthetic restoration is important for patients when planning therapy. Based on my long-term clinical observations on the osseointegration of titanium implants, I am convinced that this is possible with ceramic implants too. The surface of the implant body is obviously very important. In this regard, we have achieved a certain gold standard applied successfully in various implant systems. A micro-rough surface design helps to achieve quicker and more successful osseointegration. I believe that we still do not utilise bone to its full regenerative potential. I would also argue that the surgical technique and to some extent the macro-design of the implant, which we have improved in our project, are decisive in this context. When talking about surface porosity, we also have to talk about peri-implantitis. Research indicates that there is much less inflammation around ceramic implants than around titanium systems. Preliminary clinical reports of spontaneous bone regeneration after cleaning and decontamination procedures around ceramic implants are also interesting. With this in mind, OriCera offers a novel modification of the implant's cervical part that increases its effectiveness and simplifies the treatment of the complications mentioned earlier.

It sounds like your system has great market potential. What stage is the currently project at, and when can we expect it to be marketed?
Our team is made up of carefully selected members, who are highly committed to our project. We have the necessary tools as well as scientific and research contacts to design and process ceramics. The digital models of the implants we have created have undergone a very thorough numerical analysis. They have been optimised in terms of strength and mass production capabilities. We are on the eve of producing prototypes and mechanical testing to ISO standards. We still have a lot of work ahead. In the near future, we will have to make a decision regarding subsequent stages of the project. We are thinking about starting our own production, though we are not excluding an alliance with a big implant company. The latter option would certainly accelerate the commercialisation of the project and market debut.

How did you personally find your way into implantology?
Besides medicine, I have always been interested in micromechanics because of my father, an engineer, who sparked my interest in this field. To be honest, even the most advanced state-of-the-art smartwatch will always lose my interest in favour of a mechanical one. When working at the Poznan University of Medical Sciences in the early 1990s, I joined forces with a colleague for the development of the titanium implant system Osteoplant, which was one of the leading implants in Poland until recently. While making implants and using various brands, I had the opportunity to fuse medical and technical knowledge and draw conclusions as to how technical aspects influence clinical effects, for example the speed of osseointegration. In implantology, I have always tried to combine biological knowledge, surgical art and technology. My expertise has been recognised by several companies in the medical industry, and this has led to the development of infini-Ti sinus grafting kit, a tool for sinus augmentation, and Coreflon PTFE surgical sutures. As for the OriCera system, every idea in it is original, supported by clinical observations and the technical knowledge of a doctor with the ambitions of an engineer. I see OriCera as the essence of 30 years of my work at the interface of medicine and technology, which is why I'd like to develop it to the most thoroughly perfected ceramic implant system on the market. Together with my great team members, Adam and Przemysław, as well as our research partners, I hope to succeed.

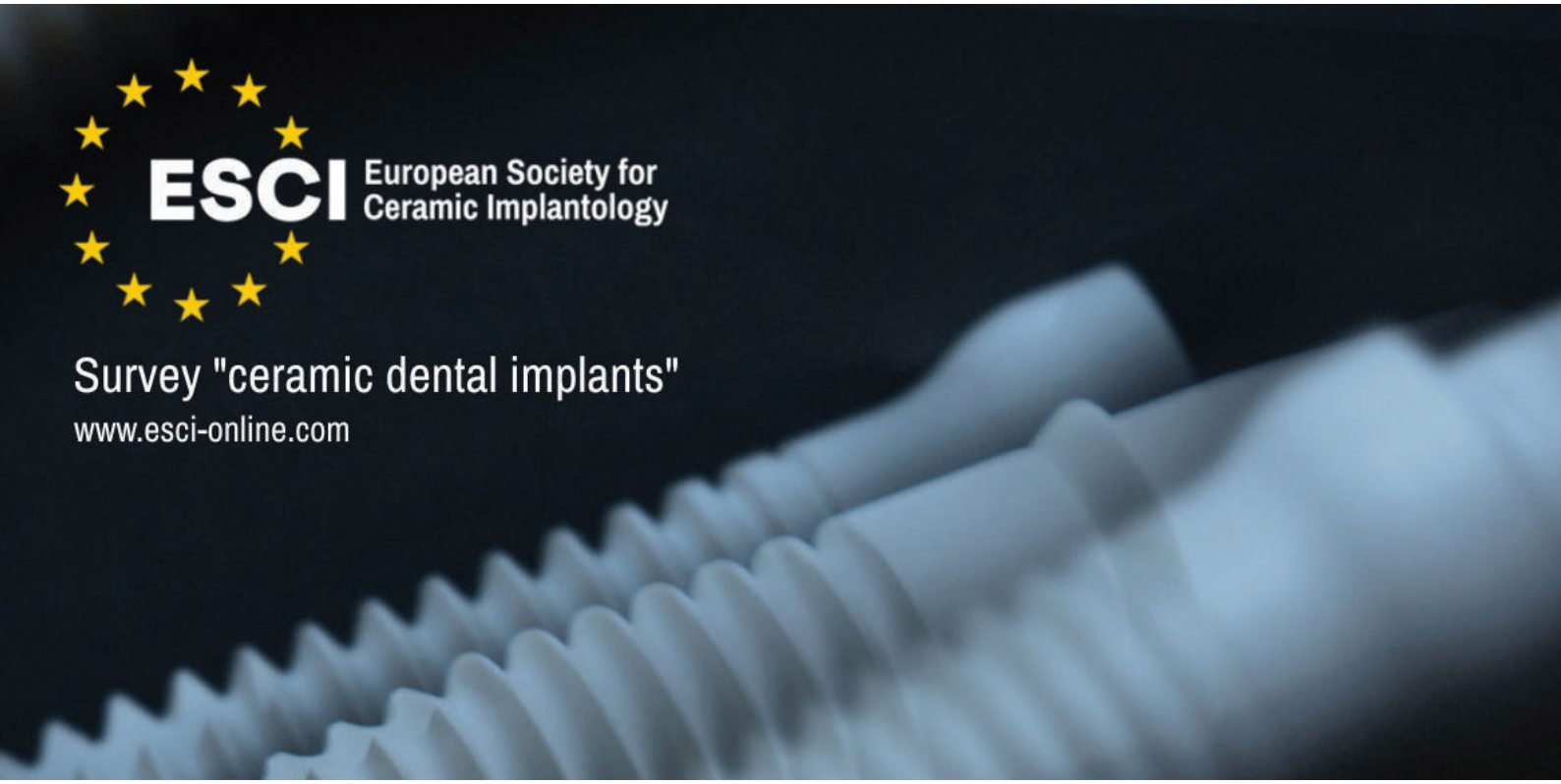
OriCera® high-end ceramics implants

about the author

Dr Jarosław Pospiech is a Poland-based oral surgeon who has been actively involved in implantology and bone regeneration techniques since 1991. He has helmed various inventions; for example, he is the co-inventor of the first Polish implant system, Osteoplant. He is active as a clinical researcher on bone grafting procedures and biologically driven fixture design. He currently runs a private dental practice called ImplantPoint with a focus on implantology.

contact

Dr Jarosław Pospiech
ImplantPoint
Poznań, Poland
biuro@implantpoint.com



ESCI survey on

Ceramic dental implants

Ceramic implants are establishing themselves in modern implant dentistry as a viable treatment alternative to titanium implants. Owing to their biological advantages, there is an increasing interest in this material both from practitioners and health-conscious patients. Promising short- and medium-term data on the successful use of ceramic implants is already available. However, the topic is still controversially discussed, in part because long-term data is still lacking. Above all, there is a lack of comprehensive knowledge about the use of ceramic implants in the daily clinical practice.

With a Europe-wide survey, the European Society for Ceramic Implantology (ESCI) aims to provide answers to relevant questions regarding the handling of ceramic implants in the daily clinical practice and to push forward developments toward a safer and more reliable use of ceramic implants in patients worldwide. The ESCI further aims to provide an understanding of market developments, assess the readiness for use of ceramic implants, identify and address possible resentments towards ceramic implants, evaluate future prospects with regards to distribution, and analyse existing problems in terms of the integration of ceramic implants into practice workflows. The questionnaire was designed by the ESCI Scientific Advisory Board in cooperation with a number of renowned partners including Deutsche Gesellschaft für Orale Implantologie (DGOI), Österreichische Gesellschaft für Implantologie (ÖGI), Institut Straumann AG, CAMLOG Biotechnologies AG, Nobel Biocare AG, Dentalpoint AG, Z-Systems AG, COHO Biomedical Technology and Dental Campus Association. The survey results will be scientifically evaluated by the ESCI and published in appropriate journals. The ESCI does not pursue commercial goals with this survey and it guarantees to evaluate the results independently and neutrally. No personal data will be collected and the answers will be processed in an anonymous fashion. The survey is targeted at dentists, oral and maxillofacial surgeons with and without experience in ceramic implantology, as well as dental technicians.

Participate now!

Participate in the survey today via **www.esci-online.com** and contribute to a better understanding of ceramic implants. The survey will only take 5–10 minutes to complete. Alternatively, you can scan the QR code for instant access from mobile devices. Please note that you can switch between English and German. For further information, contact info@esci-online.com. The ESCI is looking forward to your participation!

Source: ESCI

Your professional society for ceramic implantology

ESCI European Society for Ceramic Implantology

learn more and visit
www.esci-online.com

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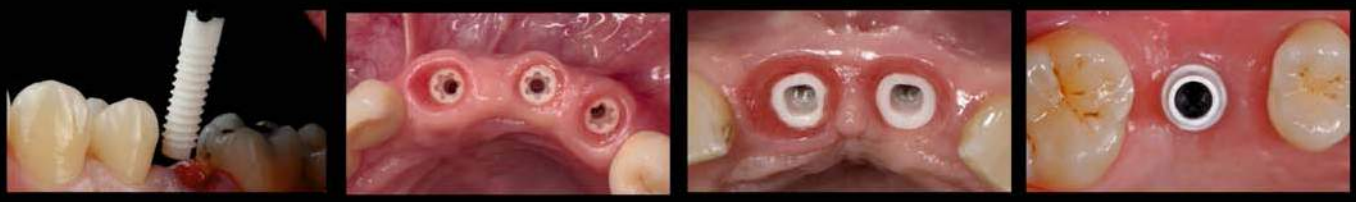


As Member of the ESCI ... get free access to the ESCI Partner Dental Campus
In order to provide our members with a scientifically sound background knowledge also on general implantology topics,
the ESCI has entered into a cooperation and partnership with Dental Campus Association.
Each member of the ESCI includes free access to all content on the implantological learning platform Dental Campus!
For ESCI members this is not only a gain in knowledge, but also a significant cost advantage: 0 EUR instead of 348 EUR/year.

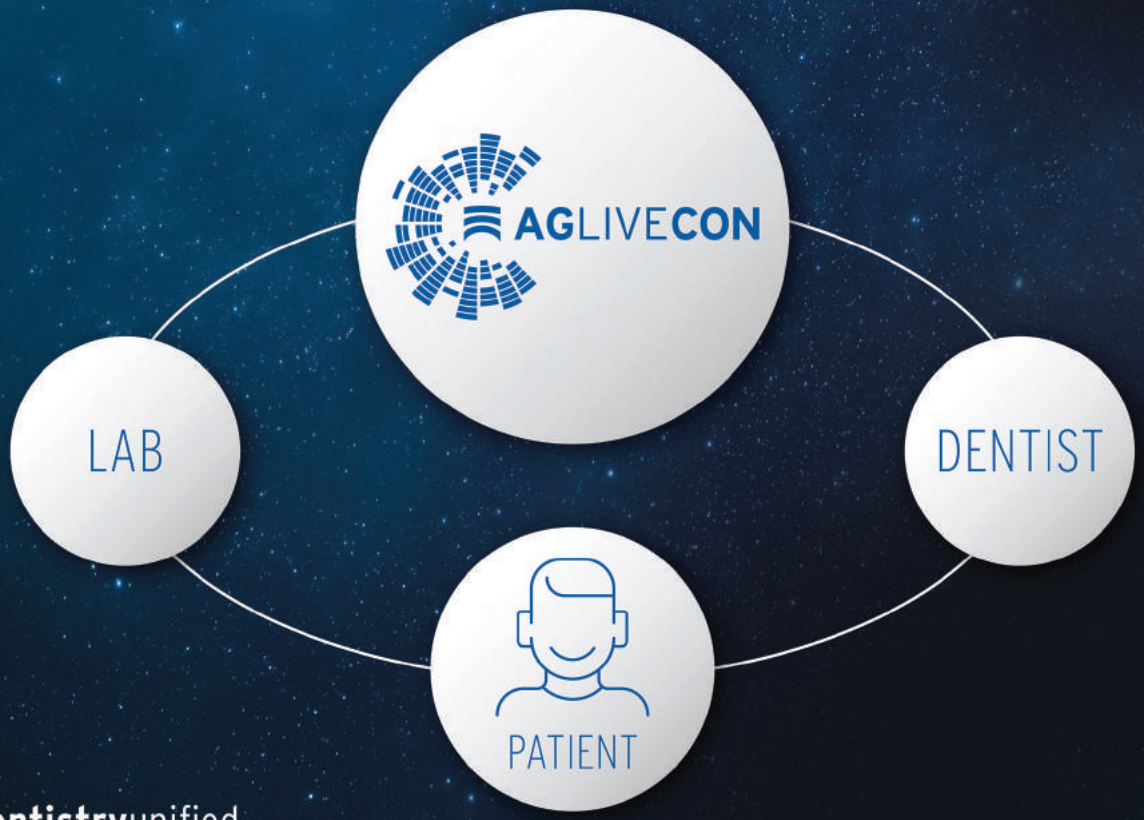
DC Dental Campus

ESCI European Society for Ceramic Implantology

European Society for Ceramic Implantology - ESCI

Kreuzstrasse 2
CH 8802 Kilchberg
Switzerland

+41 (0)44 715 48 77
info@esci-online
www.esci-online.com



Capitalising on digitisation with the right strategy

Digitisation can bring dental technicians and dentists closer together. How best to exploit these new opportunities in an interdisciplinary team is the topic of Amann Girrbach's AG.Live CON virtual congress, which will be held from 20 to 24 April. The event will kick off with a top-class panel discussion in which independent experts such as Prof. Daniel Edelhoff, Prof. Florian Beuer and Prof. Andreas Moritz discuss the issues governing current patient care: What is the significance of digitisation for dentistry? Is it possible to sustainably narrow the communication gap between dentists and dental technicians and unite both parties in a common, efficient treatment approach? Will all dentists in future be required to offer direct restorations? The individual problems and approaches to solutions will be dealt with in greater depth covering a wide-ranging programme of specialist presentations from internal and external experts. But theory is only part of the equation. As part of the event, Amann Girrbach will present numerous new product developments during a virtual expo, including the AG.Live platform, which networks dentists and dental laboratories and thus enables effortless interdisciplinary teamwork. This networking also supports cooperation in direct restoration, which is increasingly being demanded by patients for uncomplicated restorations. Using AG.Live, the dentist can always consult the dental technician, as his/her expertise remains indispensable for high-quality restorations. With the new intra-oral scanner and the AG.Live platform, Amann Girrbach offers dentists an easy introduction to direct restorations and enables same-day dentistry in laboratory quality. Dental technicians and dentists can register free of charge for the digital congress at **show.aglivecon.digital**. In addition, the site provides further information on the congress programme with its numerous presentations. The virtual expo offers the opportunity of making direct contact with Amann Girrbach's specialists.

Source: Amann Girrbach

A new award for high

Production standard of ceramic implants

In January this year, the CeramTec Group, a world innovation leader for advanced ceramics, was awarded the "Certified Production Quality" seal by the CleanImplant Foundation in Berlin. "Although the approval of medical devices is largely regulated in every country, large studies still find numerous dental implants with significant particulate contamination from the production process," said Dr Dirk Duddeck, CEO of the CleanImplant Foundation. "There are too few controls on dental implants. Users need more safety and better, reliable guidance to avoid putting patients at unnecessary risk." Based on the globally established CleanImplant consensus guideline on the cleanliness of dental implants, the independent non-profit organisation is also awarding a certification to contract manufacturers, producing implants for various trade brands. The certificate not only confirms high production quality. At least twice a year, the implants' purity is also monitored through unannounced inspections in accredited testing laboratories, using a scanning electron microscope before the final packaging and sterilisation process. Providers of implants produced by CeramTec do not only benefit from the new award in the context of medical device regulation. The CleanImplant Foundation also facilitates access to the coveted "Trusted Quality Mark" for sterile-packaged end products, which is awarded after the SEM analysis of five randomly selected samples of the same type and a final peer review of all results.

Dr Dirk Duddeck (left), CleanImplant Foundation, presents the certificate to Dr Hadi Saleh, CEO of the CeramTec Group. *(Photo: © CleanImplant Foundation)*

Source: CleanImplant Foundation

2021—A year of audacity

For the EACim

After an extraordinary year 2020, the ongoing health crisis, with its magnitude and suddenness, continues to make planning efforts difficult. However, as Dr Giancarlo Bianca, President of the European Academy of Ceramic Implantology (EACim) explains: "It is often in times of difficulty that we find unsuspected resources allowing us to develop the resilience necessary to prepare the future as well as possible. This is how the EACim got through this period, and how it continues its development while adapting to health hazards". After having postponed its 2020 congress, which will now be held on 25 September 2021, "the Academy has decided to develop a mixed offer made up of both face-to-face training already provided during its congresses and workshops, and a new offer of webinars/online conferences aimed at a potentially wider audience". With these words, Dr Pascal Eppe, Secretary of the EACim, unveiled their new strategy for 2021.

New distance learning offer

"Our objective is always to share our experience with ceramic implants and the idea of a distance learning offering came quite natural to us." This is why the EACim has set up a series of monthly live online webinars starting from December 2020. EACim members can access these for free via the e-learning platform. The upcoming webinars will focus on the following topics: "Review of 16 Years of Experience and Implant Practice with Ceramic Implants" (by Drs Simon Tordjman and Tolomeo Boioli, 19 May) and "Soft and hard tissue reaction to ceramic implants" (by Prof. Eric Rompen, 23 June). The first three webinars were already a huge success with over 500 attending participants hailing from 46 countries. In addition, the next congress will be held in a mixed format in that participants will be able to either attend the conference in person (which will most likely be limited due to health-related restrictions), or to participate remotely via the "Full Virtual" mode. "Full Virtual" participants will also have access to video recordings of the congress so they can re-watch individual sessions once the conference has ended. Register now via the EACim website **https://eacim-ceramic-implantology.com** or via e-mail at contact.eacim@gmail.com.

Source: EACim

Congresses, courses and symposia

6th Annual Meeting of ISMI

7 & 8 May 2021
Düsseldorf, Germany
www.ismi-meeting.com

10th IAOCI World Congress

19–21 August 2021
Las Vegas, NV, USA
www.iaoci.com/iaoci2021

2nd EACim Congress

24 & 25 September 2021
Brussels, Belgium
www.eacim-ceramic-implantology.com

30th annual scientific meeting of EAO

14–16 October 2021
Milan, Italy
www.eao.org

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Publisher
Torsten R. Oemus
oemus@oemus-media.de

CEO
Ingolf Döbbecke
doebbecke@oemus-media.de

Members of the Board
Jürgen Isbaner
isbaner@oemus-media.de

Lutz V. Hiller
hiller@oemus-media.de

Editorial Council
Dr Michael Gahlert (Germany)
Dr Sofia Karapataki (Greece)
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Editorial Manager
Georg Isbaner
g.isbaner@oemus-media.de

Editorial Office
Johannes Liebsch
j.liebsch@oemus-media.de

Executive Producer
Gernot Meyer
meyer@oemus-media.de

Product Manager
Timo Krause
t.krause@oemus-media.de

Art Director
Alexander Jahn
a.jahn@oemus-media.de

Designer
Laura Wajsprych
l.wajsprych@oemus-media.de

Customer Service
Marius Mezger
m.mezger@oemus-media.de

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04229 Leipzig, Germany
Tel.: +49 341 48474-0
Fax: +49 341 48474-290
kontakt@oemus-media.de

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34253 Lohfelden, Germany

www.oemus.com

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