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Prof. Michael Gahlert

Specialist in oral surgery and ceramic implantology

A beautiful smile—long-lasting and natural-looking

Cosmetically, a great deal can be concealed nowadays. However, what about sustainability? Have we as dental professionals not made the attempt to achieve *restitutio ad integrum* our highest goal? In oral surgery, this applies above all to the difficile rehabilitation of tooth gaps in the anterior area, which has unfavourable anatomical conditions for single-tooth restorations with dental implants.

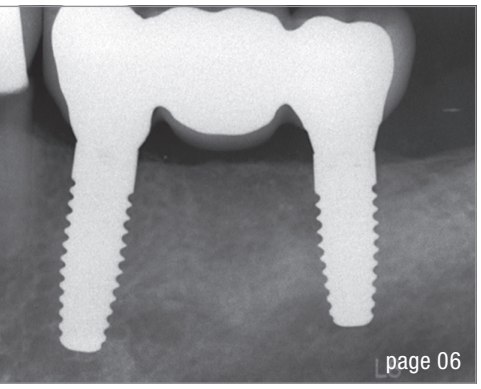
This so-called restoration of the original form and function is challenging and can only be achieved through compromise, tricks and superior clinical expertise. To this end, we use materials that today promise high biocompatibility, and it is at this very point that the wheat is separated from the chaff. What was considered highly biocompatible yesterday is already being critically examined and called into question today. Consider how often, for instance, autologous bone grafting materials are scrutinised at prestigious conferences, whereas in contrast, artificial biomaterials only backed by sparse long-term results are being marketed.

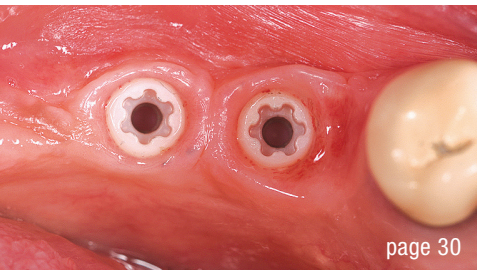
Unlike industrially produced biomaterials, there is no lobby for autologous bone grafting materials, although they have proved to be clinically reliable for decades.

In modern-day implantology, tooth-coloured ceramic implants made of zirconium dioxide—zirconia—are considered a viable alternative to established titanium implants when it comes to the replacement of teeth in the aesthetic zone. A 2018 meta-analysis by Roehling et al. concludes that these ceramic implants show a higher biocompatibility in terms of plaque affinity and soft-tissue healing and that peri-implantitis occurs significantly less around these implants, as opposed to comparable titanium implants. If we were to expand the sound evidence base with more data, we would have made a small—or perhaps even a giant—leap forwards in terms of the development of biomaterials. We would then also be one step closer to imitating nature in a sustainable manner and achieving *restitutio ad integrum*, at least in a cosmetic sense.

I therefore urge you to stay critical and judge what is new always with a view to scientific evidence. This is the only way we will be able to debunk many of the fairy tales that have established themselves within our profession. With this in mind, I wish you an exciting read with this new issue of *ceramic implants—international magazine of ceramic implant technology*.

Yours, Prof. Michael Gahlert





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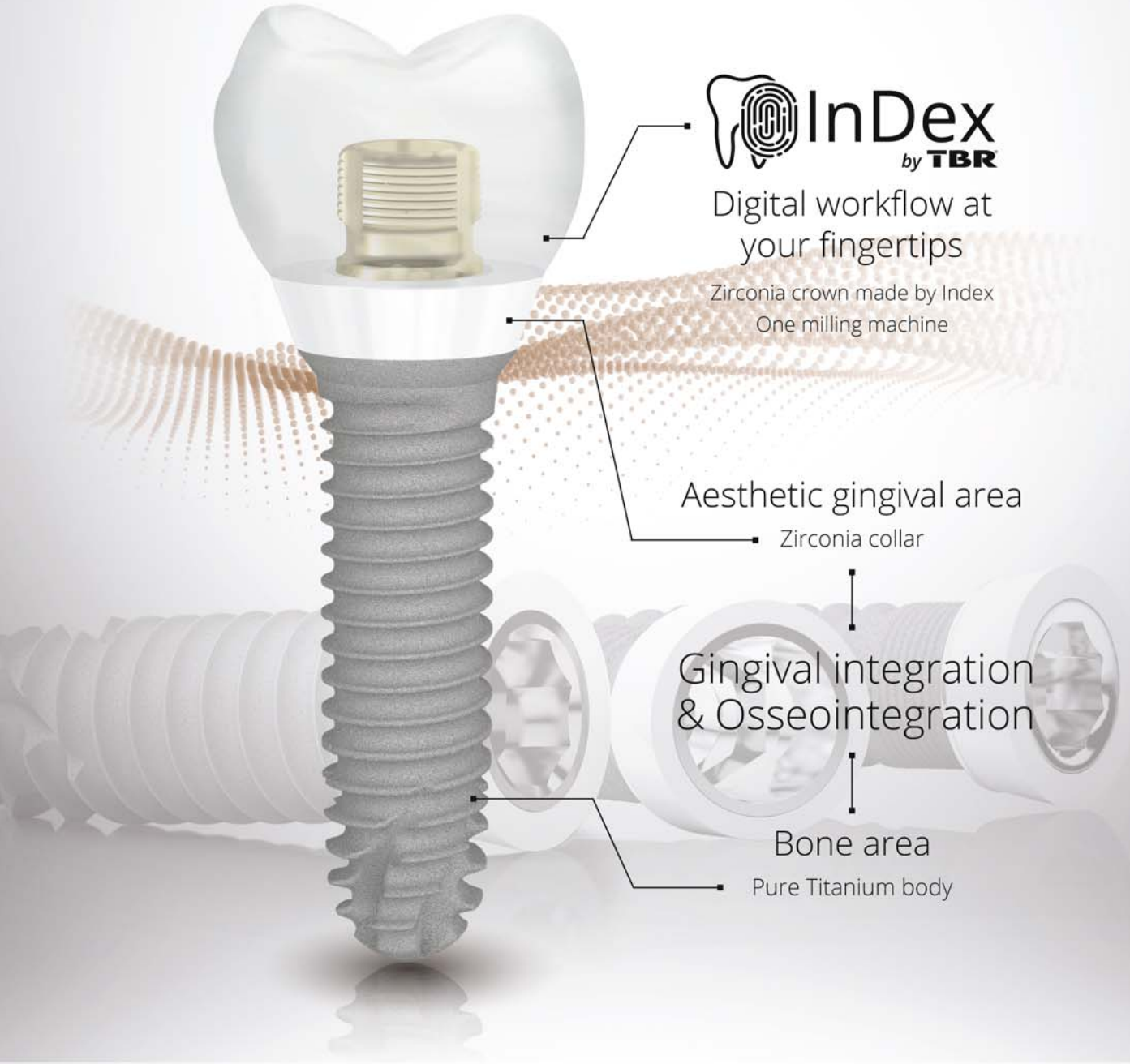

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Clinical application of zirconia implants

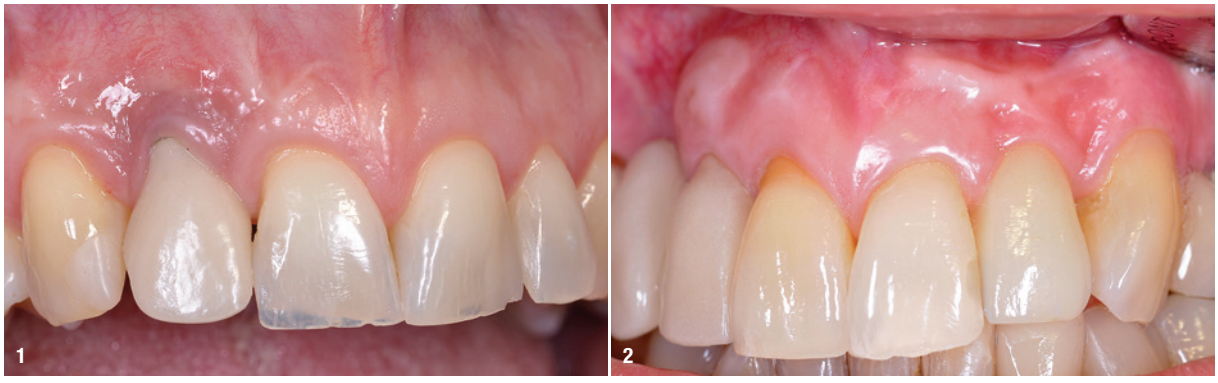
Results from comparative studies

Dr Elisabeth Jacobi-Gresser, Germany

Since the market entry at the end of the 1990s, the number of inserted zirconium oxide implants has been steadily increasing. Today, however, they constitute only an estimated three to 5 % of all inserted implants worldwide. Market analyses predict a significant rise in the coming years (Dental Implants Market Research Report 2017). This trend is due to the increasing confidence in the material zirconium oxide, the evolution from one-piece to two-piece configuration, as well as optimised abutment connections on ceramic implants.

Compared to titanium implants, one-piece zirconium oxide implants have shown equally good results in clinical studies with regard to osseointegration. In addition, they have obvious advantages in terms of soft-tissue acceptance. Titanium and zirconium both belong to the group of transition metals in the periodic table of elements. However, the physicochemical properties of these two metals and their oxides differ significantly. While titanium inside of a biological system is subject to tribocorrosion and subsequently triggers immunological reactions, the completely oxidised and sintered material zirconium dioxide is characterised by excellent corrosion resistance and therefore has a high biological compatibility.[11, 19] In a meta-analysis on titanium implants, the weighted average for the occurrence of peri-implantitis was 43 % and for mucositis it was 22 %.[9] There is a correlation between peri-implantitis and a reduced implant function time. The success rate of zirconium oxide implants of the younger generation is comparable to that of titanium implants.[2, 15, 24, 26] For one-piece implants made of alumina toughened zirconia (ATZ), the three-year success rate is 98.5 % and five-year success rate is 94.3 %. The seven-year success rate for one-piece implants made of yttria-stabilised zirconia (Y-TZP) is 88.6 %. The occurrence of fractures is generally rare, but it is observed with Y-TZP implants of the first generation owing to the use of diameter-reduced implants, aggressive surface treatment (aluminum powder blasting) during production, incorrect loading with an unfavourable implant-crown axis, occlusal overload, and bruxism.[29]

The availability of two-piece implants made of the more durable ATZ ceramics for ten years now extends the range of indications and facilitates clinical application. These factors contribute significantly to the further rise of ceramic implants and it is expected that they will be used even more strongly in the future. In addition to the advantages in the aesthetic zone owing to the white colour, the relatively low biofilm adhesion, as shown in in-vitro and in-vivo studies, and the higher corrosion resistance compared to titanium are emphasised in the literature.[1, 5, 25, 26, 19] The aesthetic advantages that the implant material zirconium oxide has over titanium, especially in the anterior aesthetic zone, are particularly evident in patients with thin gingiva of less than 2 mm (Figs. 1 & 2).[32]



Figs. 1 & 2: Aesthetic advantages of the implant material zirconium oxide (regio 22) compared with the titanium-based material.

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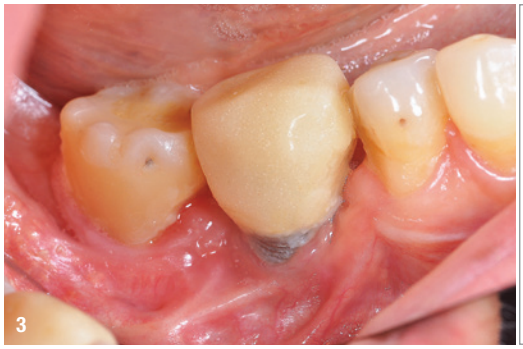

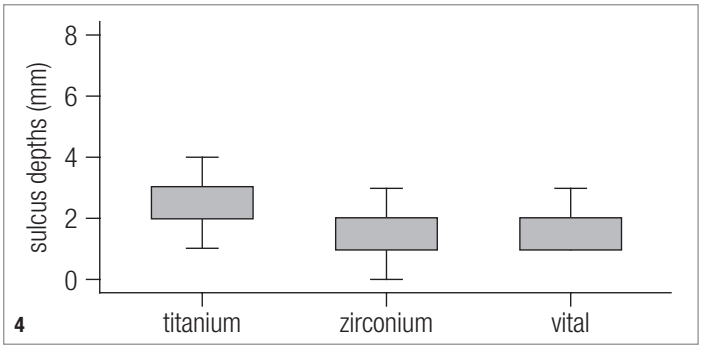

Fig. 3: Microbial load around a titanium implant in a patient with periimplantitis. **Fig. 4:** The sulcus depths of titanium implants differ in a statistically significant way from the ones of zirconium oxide implants (p = 0,03). The average value of titanium implants is 2,3 mm, whereas the average value of zirconium oxide implants is at 1,8 mm (personal and unpublished data).

Possible effects of titanium implants

Comparative studies have examined the toxicological effects of nano-/microparticle load in tissues in addition to immunological-inflammatory parameters. They found increased formation of free radicals (ROS) in titanium particles compared to zirconium oxide particles.[19] Lipopolysaccharides (LPS) in bacterial membranes of periodontal-pathogenic germs and titanium particles stimulate inflammasomes in macrophages, resulting in a release of the pro-inflammatory cytokine interleukin-1. The stimulation effect by titanium particles was enhanced in LPS-exposed (*Aa*, *Pg*, *e.coli*) macrophages. Titanium ions alone do not lead to the transcription of inflammasomes. The amount of titanium found in peri-implant tissues was enough to stimulate the release of IL-1b in vitro.[22,23] Microbial load in the oral cavity additionally promotes the corrosion tendency on titanium implant surfaces. This milieu-altering microbial influence by periodontal early colonisers is reflected in the development of mucositis and peri-implantitis. It also triggers surface corrosion on the titanium implant which, in turn, leads to an increase in metal deposits (Fig. 3).[30]

As a consequence, the microbiome shifts from the "healthy" diversified to a pathological and less diversified germ load. The correlation between the amount of titanium corrosion products in the peri-implant tissue and the presence of peri-implantitis has been proven. The amount of particles found in inflamed peri-implant tissue was eight times higher as opposed to the tissue around "healthy" implants, which had no or only a low particle load. The authors argue that these findings confirm the correlation between corrosion products and peri-implantitis and that they also confirm the role of corrosion products in modifying the peri-implant microbial structure and diversity.[7,28] An evaluation of various inflammation markers in the tissue around implant healing caps made of titanium compared with zirconium oxide revealed that there is significantly higher evidence of inflammation parameters when titanium is used in relation to all markers investigated.[8] Significantly increased systemic markers for "silent inflammatory" processes were also found in patients with grade V titanium implants (titanium alloy $TiAl_6V_4$), which had been in situ for more than ten years in combination with amalgam fillings, compared with the control group with neither implants nor fillings and also with the patient group who had amalgam fillings but no implants.[18] Histopathological examinations of rare oral soft- and hard-tissue changes associated with titanium implants show an increased particle load.[21] In the various extra- and intraosseous tissue changes (with the exception of the traumatic bone cyst and the intraosseous metastasis of a renal carcinoma) an increased titanium particle load associated with inflammatory processes was found in 52.9 % of the 68 cases. The question arises whether these titanium particles could be involved in the development of these lesions as a promoting aetiological factor.

Clinically stable peri-implant tissue conditions around zirconia

Preclinical and clinical studies on periodontological parameters around "healthy" titanium and zirconium implants have shown that there are statistically significant differences with regard to sulcus depths.[16] The values prove to be higher for titanium implants than for zirconium oxide implants both in animals as well as in humans. As experience shows, sulcus probing on zirconium implants is more difficult owing to the dense fibrous tissue structure (Fig. 4). More than ten years of clinical experience confirm the stable peri-implant soft-tissue conditions and the lower incidence of peri-implantitis, which can develop if adhesive residues remain after insertion of the abutment and crown or if titanium particles remain in the tissue after loss of a titanium implant and re-implantation of a zirconium oxide implant in the same site or in close proximity (Figs. 5–7). Comparative analyses of the structure and the purity of ceramic implant surfaces were done on various Y-TZP and ATZ implants, which showed that all systems differ in their surface morphology and

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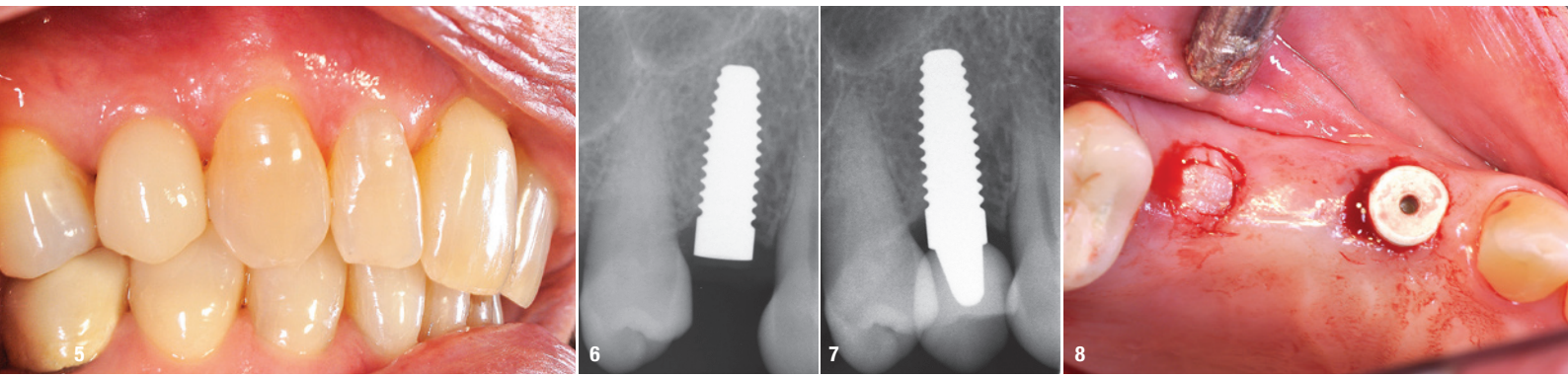
[1] Becker J, John G, Becker K, Mainusch S, Diedrichs G, Schwarz F. Clinical performance of two-piece zirconium implants in the posterior mandible and maxilla: a prospective cohort study over 2 years. Clin. Oral Impl. Res. 28, 2017, 29–35 doi: 10.1111/clr.12610



Figs. 5–7: Stabile periimplant bone situations over the course of eight years. **Fig. 8:** Tissue collection at implant uncovering.

do not show any impurities that could cause undesired adverse immunological reactions.[4] In dynamic load tests and tests on the hydrothermal aging of ATZ implants, high fracture resistance (> 1,100 N), low expansion of the monoclinic phase layer on the surface and no change in surface roughness were found.[31]

Histological and photometric tissue analyses

In a pilot study on initially 43 tissue samples around two-piece ATZ implants, analyses were carried out with regard to the particle load in the tissue and corresponding inflammatory reactions. The tissue samples were collected at the uncovering of two-piece ZrO_2 implants (Zeramex® T implants, Dentalpoint AG; alumina-toughened zirconia = ZrO_2 76 %, Al_2O_3 20 %, Y_2O_3 4 %) three to four months after the implantation. Until today, more than 200 samples have been histologically and photometrically examined in another study (Fig. 8).[14] The biopsies were fixated in 20 % formalin solution and embedded in paraffin. The evaluation of the histological preparations was done by the Department of Oral Pathology of the University of Buenos Aires (Prof. Daniel Gustavo Olmedo). In all samples a fine-particle material was detected, they showed epithelial hyperplasia and dense cell infiltrates without detectable foreign giant cells. The histological findings differ from those around titanium implants, which show a loose tissue structure, focal accumulations of titanium particles of different shape and size with macrophage and lymphocyte infiltrations, as well as a higher number of blood vessels. In addition to various metals detected in the EDS analysis, the accumulation of aluminium is considered conspicuous, which is not only ubiquitously distributed in our environment but is also present in ATZ zirconium oxide ceramics in concentrations of up to 20 %. However, small amounts of aluminium could also be detected in the tissue of healthy volunteers without ATZ implants by means of multi-element analysis (Tab. 1). The remaining metals detected are for the most part not due to the use of the implant material zirconium oxide, but are relics from earlier dental restorations (Figs. 9–11). This could be demonstrated in individual patient cases.

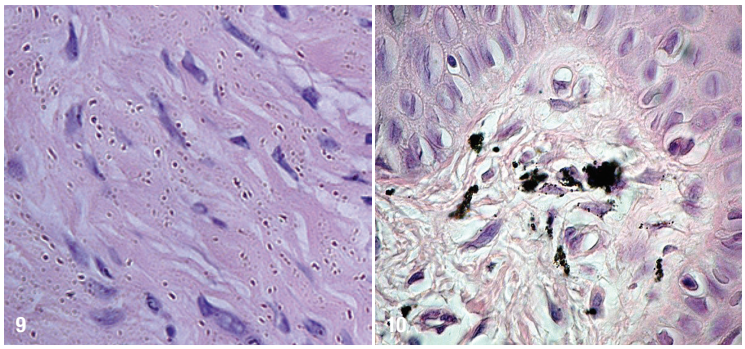


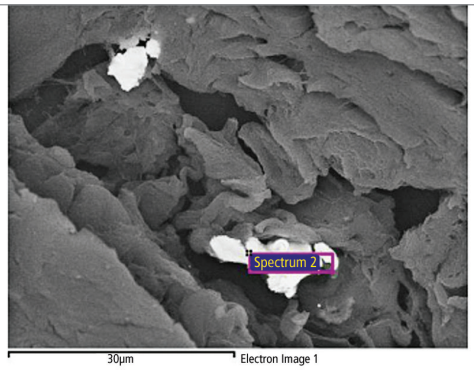
Fig. 9: Zirconium oxide particles are equally distributed inside the periimplant tissue (200 x-magnification). **Fig. 10:** Titanium oxide particles inside the tissue (200 x-magnification).

Element	Weight %	Atomic %
C	54,41	60,14
N	18,93	17,94
O	26,21	21,75
Al	0,17	0,08

Table 1: EDS analysis: control group without implants, aluminum detection in oral tissue.

Studies on the corrosion resistance of zirconium oxide

To analyse the corrosion resistance and the possible tissue load owing to particles released from the zirconium oxide implant surface, ten ATZ test implants were inserted in animals. The peri-implant tissues as well as the control tissues were examined after a period of six months. The test bodies were obtained by cutting them from the original ATZ implant bodies. Once the obtained tissue samples had been plasma cleaned, they were divided and subjected to histological examination and EDS analysis (evaluation of particles) on the one hand and to



Element	Weight %
C K	43,33
O K	6,94
Pd L	3,57
Pt M	3,50
Au M	42,66
Totals	**100,00**

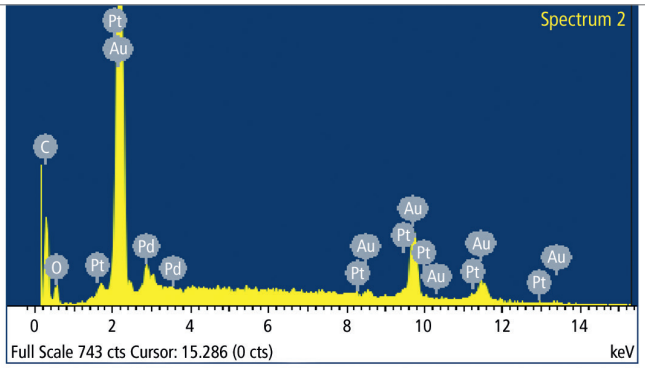
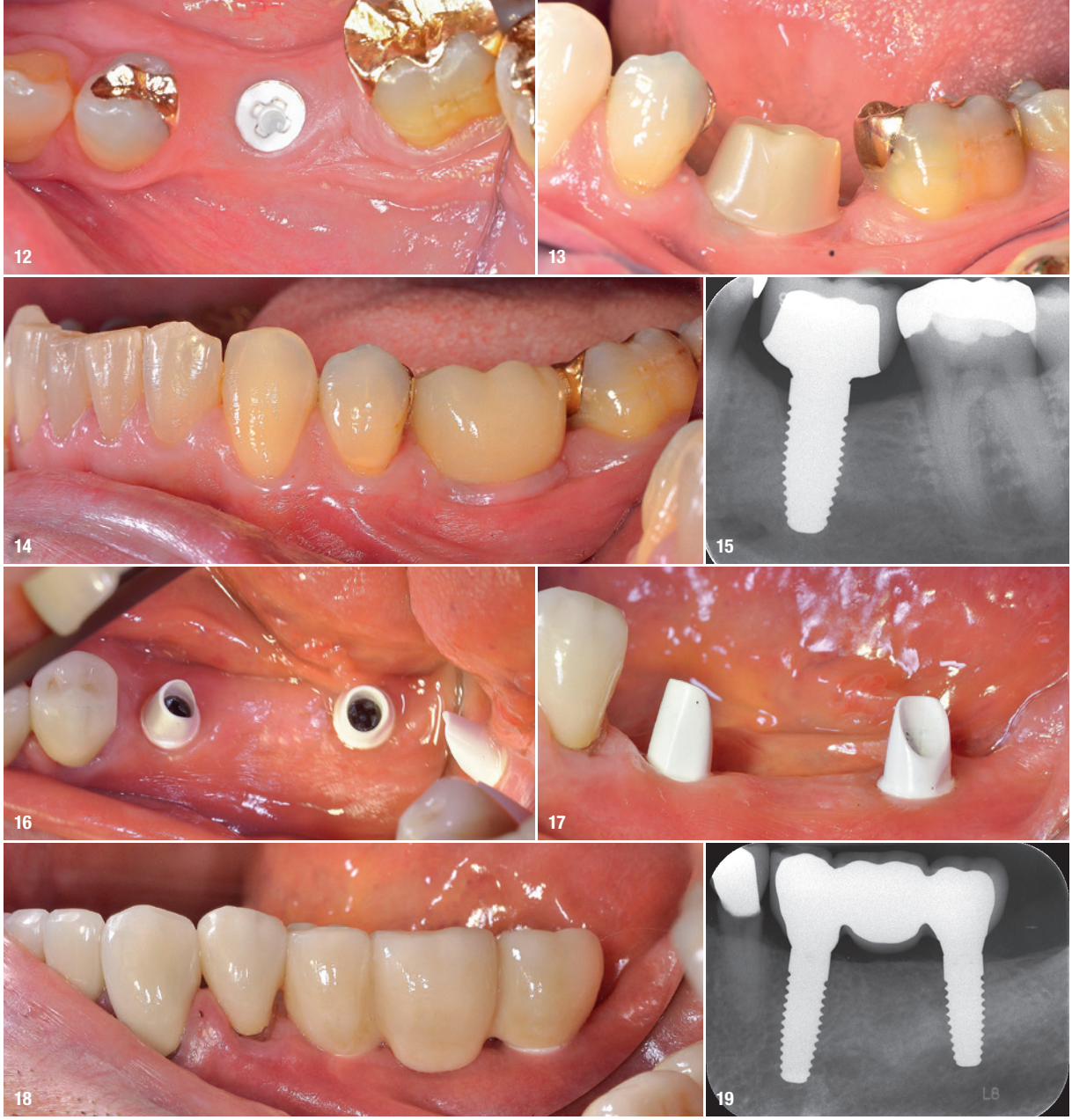


Fig. 11: SEM-EDS analysis (clinical case: evident residues of gold, platinum and palladium detected in tissue sample of patient with preceding year-long metal-ceramic bridge construction).

multi-element analysis (ICP-MS) on the other in order to assess the aluminium and zirconium concentrations. In addition to the detected aluminium and zirconium particles between cells, and also intracellularly in macrophages, a significantly higher number of mast cells could be detected compared to the control tissues.[14] Presumably, the particle dissection is due to the test implant surface not being finalised and finished in the way that commercially-available implants usually are by the manufacturers. To clarify this, a similar series of investigations was done with ATZ test implants that had the certified implant surface by the manufacturer. Further histochemical examinations (CD 34, CD 45, VEGF, CD 68) to evaluate immunological reactions as well as investigations on particle migration from peri-implant tissue around zirconium oxide implants into the body and the potential risk for organs are planned. Results of a recent study confirm the different corrosion behaviour of titanium and zirconium oxide surfaces in animals. Twelve weeks after implantation in the maxillae of mini-pigs, titanium and zirconium



Figs. 12–19: Single crown and bridge construction on reversibly screw-retained zirconium oxide implants in situ and radiographic control images after insertion of the definitive prosthetics.

deposits were detected in the peri-implant tissue. The tissue load with the corresponding implant materials was twice as high around the titanium implants than around the zirconium oxide implants. The cytotoxic effects and DNA damage caused by material nanoparticles, which were also measured, were significantly higher for titanium than for zirconium oxide.

Conclusion

In preclinical and clinical studies, zirconium oxide implants convince with good osseointegration, good material stability, good immunological/toxicological compatibility, good hard- and soft-tissue stability and first-class aesthetics (Figs. 12–19). Reversible screw-retained two-piece implant systems allow an expansion of the prosthetic indications beyond single-tooth and bridge restorations. In individual cases, hybrid prosthetic constructions with telescopes and locators as connecting elements have been realised in the past two to three years. However, there is currently still a lack of clinical evidence in this regard. As is expected, corresponding scientific studies on zirconium oxide implants to assess their long-term success and the associated biological complications beyond ten years have yet to be completed.

Literature

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Silent inflammation in the jaw and neurological dysregulation

Part one of a two-part article series

Literature

Dr Johann Lechner, Germany

Editorial note: This is the first part of a two-part article series. The second part will be published in issue 1/21 of ceramic implants and will cover further aspects of fatty degenerative osteolysis of the jawbone in relation to a clinical case that is described in the first part.

The transition from acute local inflammation after surgical removal of third molars to a chronic stage of silent inflammation could be a neglected cause of inexplicable medical symptoms. In this case report, we present an unusual case of recurrent syncope in a 19-year-old woman, whose 12-month treatment in various clinics, including a wide range of medications, did not lead to an improvement in her condition.

Background

Autonomous dysregulation with poorly defined multisystem disorders often represents a challenging clinical situation for doctors.[1,2] With no apparent cause and insufficient research on this increasingly common phenomenon, many representations of this form of idiopathic multi-morbidity are often assumed to be of psychogenic origin and pharmacological interventions in the form of psychoactive substances are common.[3,4] A case study from our clinic in Munich in Germany calls for a broader pathogenetic perspective in neurological dysregulation. Here we describe the case of recurrent syncope in an adolescent patient. In view of the unclear aetiology, we connect this case with the phenomenon of avascular and aseptic osteolysis in the jaw, which is also known collectively as "silent inflammation".

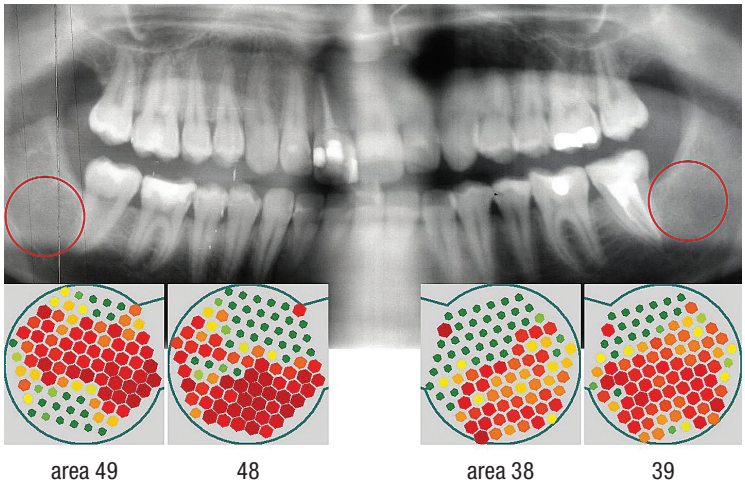


Fig. 1: Inconspicuous dental panoramic tomogram from December 2009 with no radiological abnormalities in the areas of the surgically removed teeth #18, 28, 38 and 48. The lower line shows the through-transmission alveolar ultrasonography scan; green corresponds to firm, that is, healthy jawbone; red indicates softened jawbone with inflammation potential.

The case report

The 19-year-old patient lost consciousness between two third molar extractions in October and December 2008. In the months that followed, the number of syncope incidents increased. After admission to a clinic, she was diagnosed with postural orthostatic tachycardia syndrome (POTS) and a disorder of the autonomic nervous system. Numerous drugs (for treating adrenal insufficiency, high blood pressure and paroxysmal tachycardia) brought no improvement. After further tests, the patient was discharged as a psychological case after one year. After that, it was "normal" for the patient to lose consciousness several times a day. She could no longer leave the house unattended, and the syncope resulted in daily falls.

From June 2009 to January 2010, a total of ten internal, neurological and psychiatric evaluations were carried out. The diagnosis of POTS and orthostatic hypotension was made repeatedly. In November 2009, the patient was last examined by a specialist in psychiatry and psychotherapeutic medicine, who noted "recurrent falls due to dissociation" and noted that the previous diagnosis of POTS from a clinical historical perspective and epileptic events was extremely unlikely or atypical. He recommended the rigorous discussion of the psychosomatic connections and the continuation of the accompanying psychotherapy consultations. Socio-therapeutic care was considered necessary for the 19-year-old because her mobility and safety outdoors and in traffic were severely restricted owing to her frequent syncope episodes.

Materials and methods

Diagnosis of silent inflammation in the jaw

After the hospitalisation period mentioned, the patient brought a 2D dental panoramic tomogram to our clinic to assess the possibility of chronic inflammatory processes in the tooth and jaw area. This showed no anomalies or indications of silent inflammation or osteolysis in the third molar areas (Fig. 1). In previous publications, we pointed out the insufficient diagnostic presentation of silent inflammation in the form of fatty degenerative osteolysis of the jawbone (FDOJ).[5] 2D radiographic technology alone is not suitable for a reliable diagnosis to rule out FDOJ. However, complementary through-transmission alveolar ultrasonography of bone density is suitable for diagnostic imaging of FDOJ.[6] Such ultrasonic imaging enables targeted detection and, on this basis, treatment of osteonecrotic and ischemic areas of the medullary alveolar bone.[7]

Morphology of FDOJ

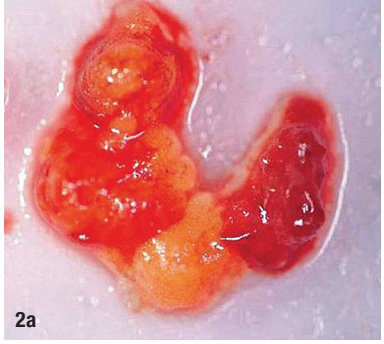
In the FDOJ areas, there is an irregular bone structure with thinned and hollowed cancellous and marrow cavities. Clinically and macroscopically, FDOJ often presents as a fatty lump. The almost complete absence of trabecular cancellous bone structure is remarkable. Figure 2 shows an intraoperative FDOJ tissue sample with predominantly fatty transformation and the extent of this FDOJ in the mandibular right retromolar area.

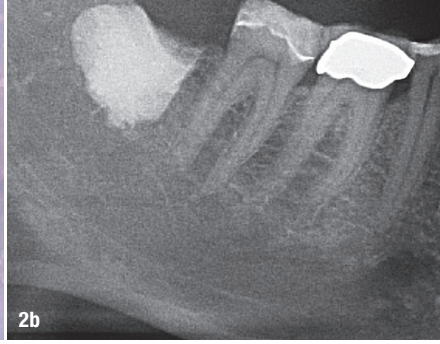
Over-activated immune mediators in the osteolytic jawbone

In previous studies, we were able to determine a 21-fold increase in RANTES/CCL5 (R/C) expression in 31 FDOJ samples compared with normal control samples (Fig. 3).[8] The pathologically altered FDOJ samples from 31 jawbones were obtained from the third molar and retromolar areas. A total of seven cytokines were measured in FDOJ tissue from the FDOJ group (n = 31). The distribution of immune mediators shows the clear prevalence of R/C. The mean value of R/C in the FDOJ samples was 3,810.90 pg/ml. These high R/C values in the FDOJ tissue were observed in all 31 samples. Figure 3 compares the medians of seven cytokines in 19 healthy bone samples (149.9 pg/ml for R/C) with those in 31 FDOJ samples. The fact that the acute cytokines tumour necrosis factor-α and interleukin-6 are almost absent in the FDOJ samples proves that FDOJ is a chronic, subliminal inflammatory process. FDOJ areas can be defined as osteolytic areas of the jaw with a non-acute but chronic inflammatory burden.

Histology of the FDOJ areas

The histological evaluation of this patient reads: "Vital, irregular cancellous bone tissue with no signs of active bone reconstruction. In the medullary spaces, there is not only internal bleeding but also moderate, chronic osteitis. No florid inflammation, no osteomyelitis. The fat cells partially show a myxoid transformation or a vacuolar degeneration of the cytoplasm, which is consistent with trophic disorders." The signs of FDOJ are present, but there is only a moderate inflammatory tendency without the clinical development of osteomyelitis. This histology with the long-term transition from an acute infectious wound to chronic inflammation is characteristic of FDOJ.[9]





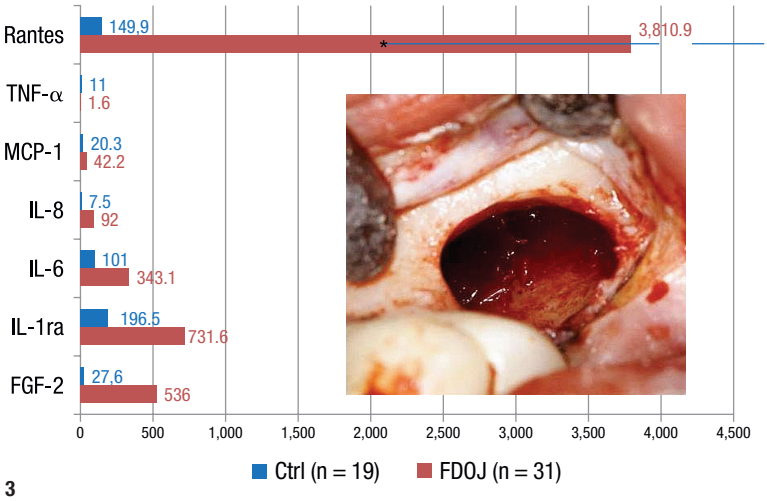


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Fig. 2: a) Typical fatty degenerative structure of FDOJ. **b)** Documentation of the extent of FDOJ in the mandibular right retromolar area with contrast medium intraoperatively, comparable to the case described here. **Fig. 3:** Comparison of the medians of seven cytokines in 31 FDOJ samples (red) and in 19 samples from healthy jawbone (blue); the inset shows the mandibular left retromolar area after the FDOJ parts had been removed from the medullary canal.

TNF-α = tumour necrosis factor-α; MCP-1 = monocyte chemoattractant protein-1; IL-8 = interleukin-8; IL-6 = interleukin-6; IL-1ra = interleukin-1 receptor antagonist; FGF-2 = fibroblast growth factor-2.

about the author

Since 1980, **Dr Johann Lechner** has been the head of a clinic for holistic dental medicine in Munich. He is a guest lecturer at Capital Technology University, USA, and Beijing University Dental Clinic, China. He holds several medical patents for holistic systemic diagnostics and ultrasonic application in the jaw area.

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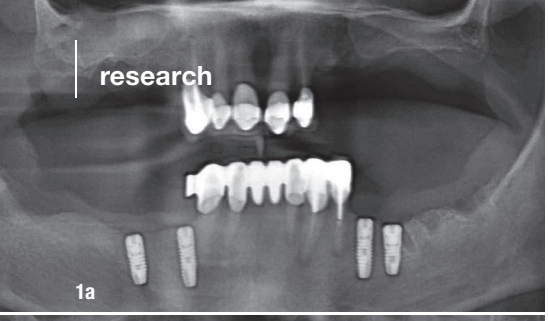
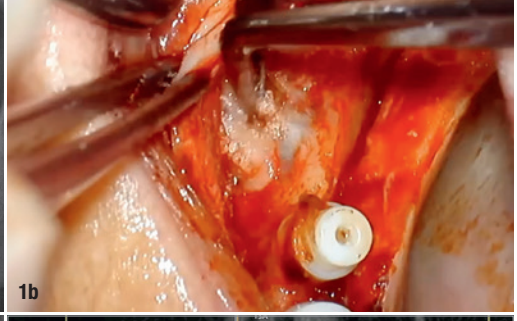
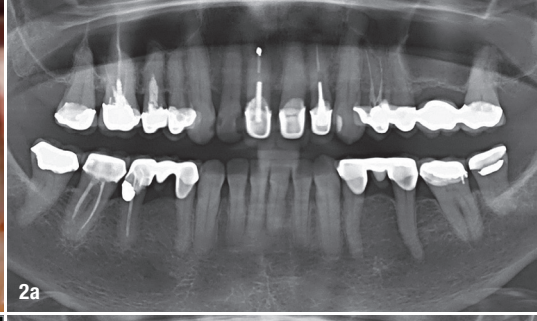
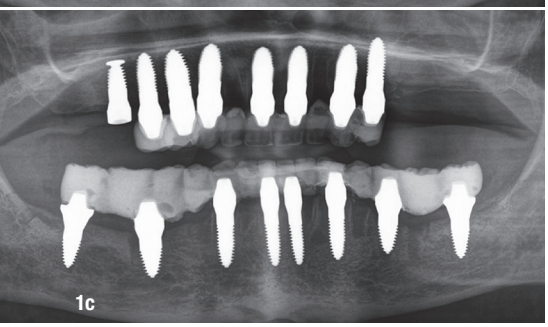
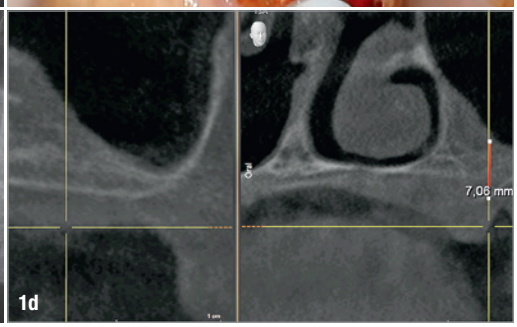










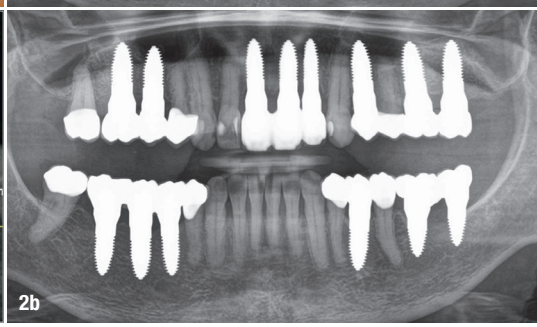


Fig. 1: Pre-op panoramic radiograph showing obvious horizontal resorption of the sinus area in the second quadrant **(a)**, intra-oral imaging of region #26 after applying the dome technique **(b)**, post-op control of the implants in the upper and lower jaws after placing fixed temporary restorations **(c)**, post-op CBCT scan of region #26 after a healing phase of six months, displaying a considerable gain of bone **(d)**. **Fig. 2:** Pre-op panoramic radiograph with distinct horizontal resorption in region #26 **(a)**, post-op control after implant placement and major external sinus floor elevation in region #26 **(b)**.

Biological guided bone regeneration and ceramic implants

The second of a two-part series

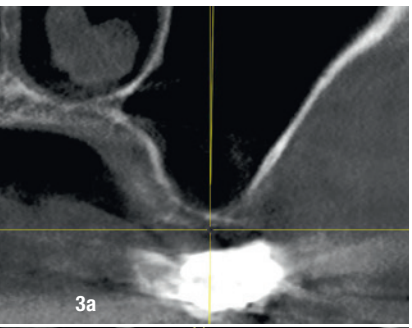
Part I

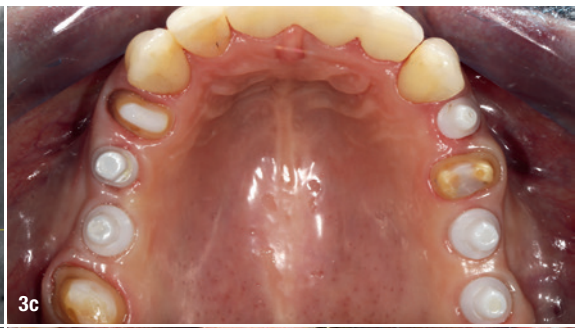
Dr Karl Ulrich Volz, Dr Stephanie Vergote, Dr Rebekka Hueber & Dr Josephine Tietje, Switzerland; Dr Tobias Wilck & Prof. Shahram Ghanaati, Germany

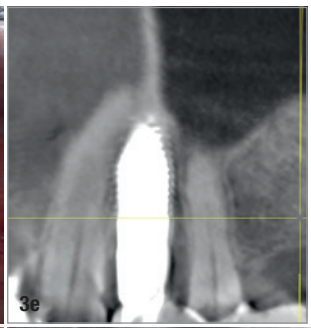
Editorial note: The first part of this series was published in issue 1/2020 of ceramic implants and can be accessed via the QR code to the left.

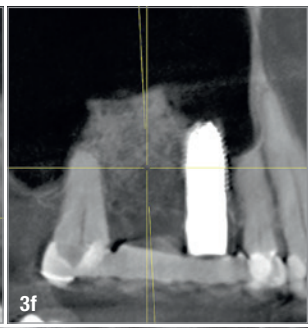
Nowadays, there are still many patients who have lost significant bone volume as a result of tooth extractions and who therefore require bone augmentation measures. In the following second part of the article series

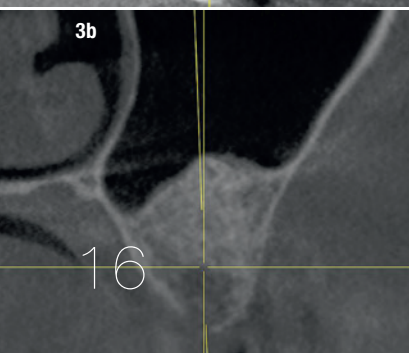
Fig. 3: Pre- and post-op CBCT scan of region #26 **(a & b)**, intra-oral images after implant placement and a healing phase of six months **(c & d)**, CBCT images of region #26 showing significant bone growth **(e & f)**, CBCT image showing pronounced bone growth in region #26 **(g)**.

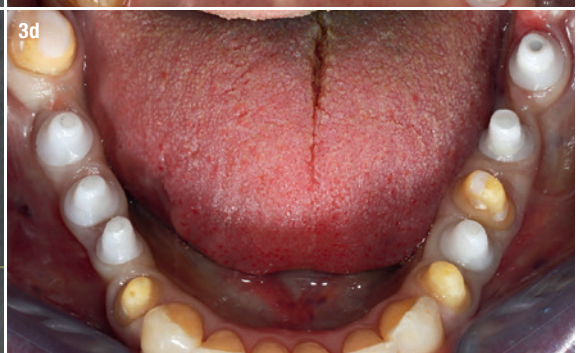


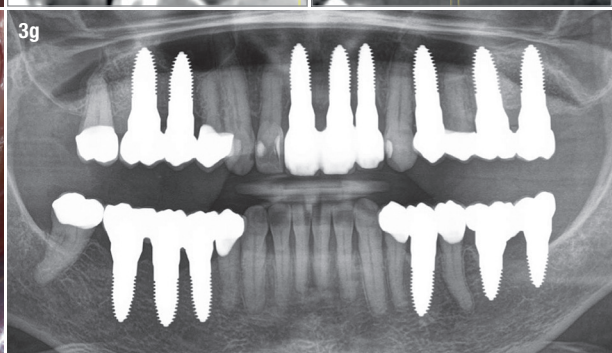












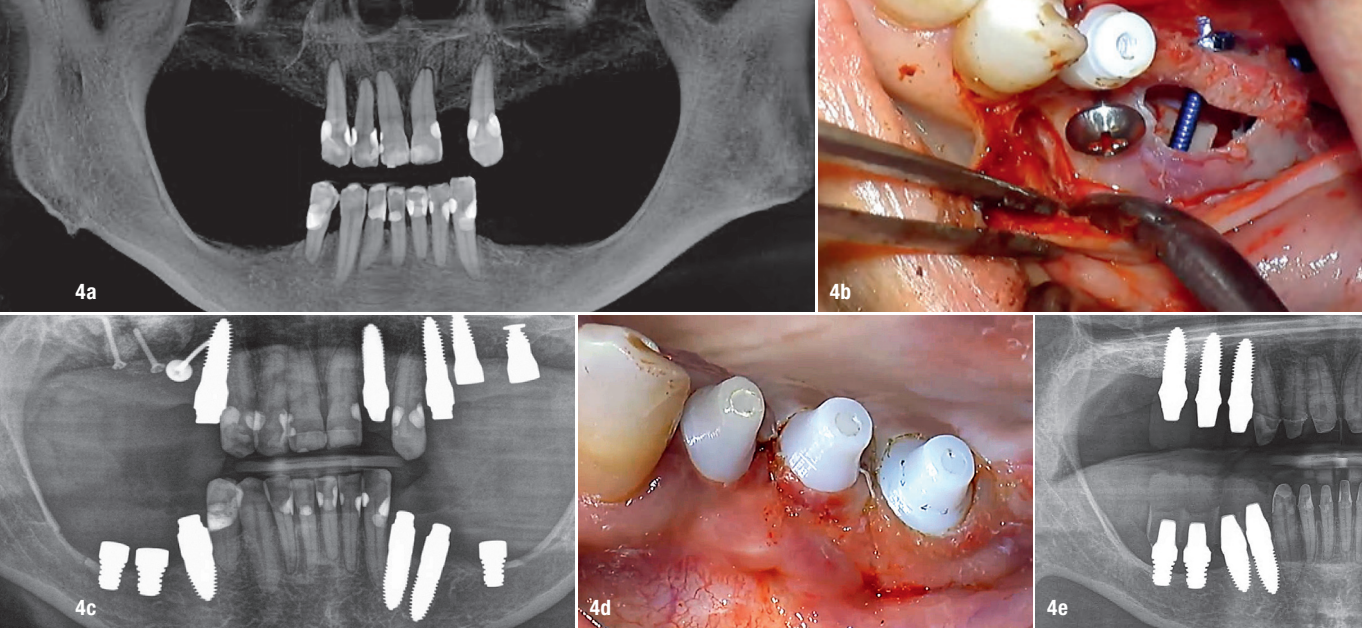


Fig. 4: Pre-op CBCT scan **(a)**, intra-op image of regions #17 and 16 after insertion of the osteosynthesis screws **(b)**, post-op panoramic radiograph **(c)**, situation after healing of the bone and implant placement in regions #17 and 16 **(d)**, panoramic radiograph recorded after implant placement in regions #17 and 16 and restoration with long-term temporary restorations **(e)**.

"Biological guided bone regeneration and ceramic implants", six further special techniques are discussed with a focus on the use of autologous materials.

Further special techniques of biological GBR

Dome technique according to Drs Simonpieri and Joseph Choukroun

This technique is used for cases of extremely low residual bone. A collagen sponge flattened to form a membrane is inserted cranially in a folded state, and the cavity is completely filled with PRF membranes. The folded membrane causes a thin bone layer to form a dome-shaped structure between the two membranes in two weeks, generating a stable cavity, necessary for the filling of the lamellar bone. After a healing phase of four to five months, implantation can then take place in a minimally invasive procedure (Figs. 1a–d).

Live donor bone

Live donor bone is used when the residual bone height is less than 3 mm or there are large perforations in the alveolar bone (Figs. 2a & b). As this example shows, well-vascularised bone almost completely replaced donor bone after four months (Figs. 3a–g).

Tentpole technique according to Dr Tobias Wilck

A lateral window in the maxillary sinus is fixed with long screws for osteosynthesis and positioned longitudinally in the skull, cranially. In the following example, an umbrella screw was additionally placed according to Dr Markus Schlee (Figs. 4a–e).

Osteosynthesis plate as a temporary placeholder

This technique can only be used in patients without a titanium intolerance. In the case depicted here, this method was used to compensate for the loss of height caused by peri-implantitis (Figs. 5a–d). The volume was constructed in a procedure using an osteosynthesis plate and donor bone, as well as the brushing technique with apical mattress sutures.

The open healing GBR concept according to Prof. Shahram Ghanaati

The research group of Prof. Ghanaati has developed a standardised concept of low-speed centrifugation, which allows reproducible treatment protocols and clinical results. Prof. Ghanaati has managed to show that the composition and bioactivity of PRF depends on the centrifugal force and that a significantly greater

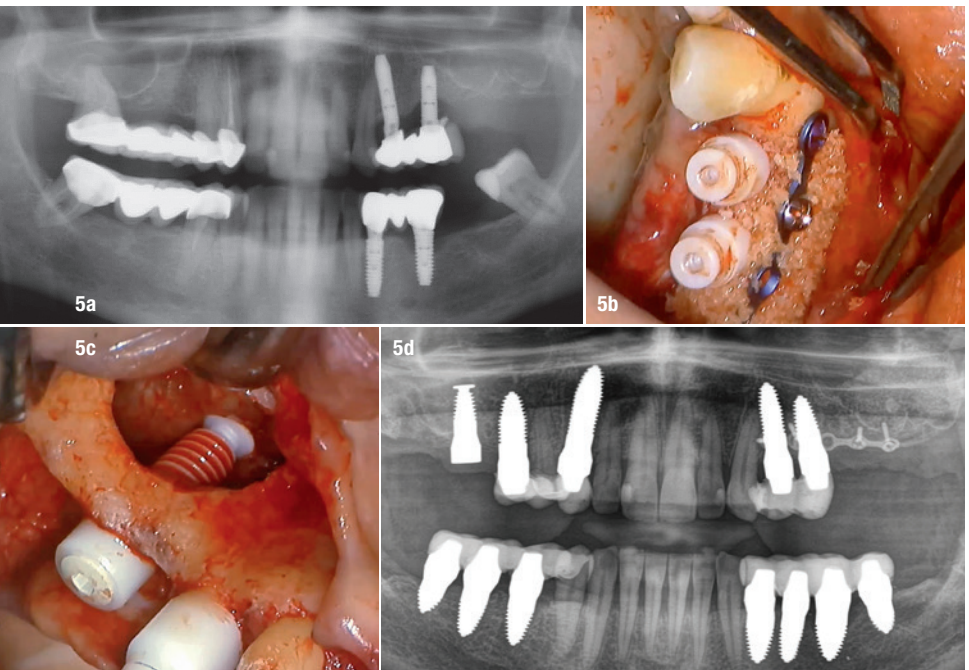


Fig. 5: Pre-op panoramic radiograph **(a)**, intra-oral image after fixation of the osteosynthesis plate and bone augmentation in regions #25–27 **(b)**, intra-oral image after placement of a sinus implant into region #26 **(c)**, post-op panoramic radiograph after implant placement in the upper and lower jaws **(d)**.

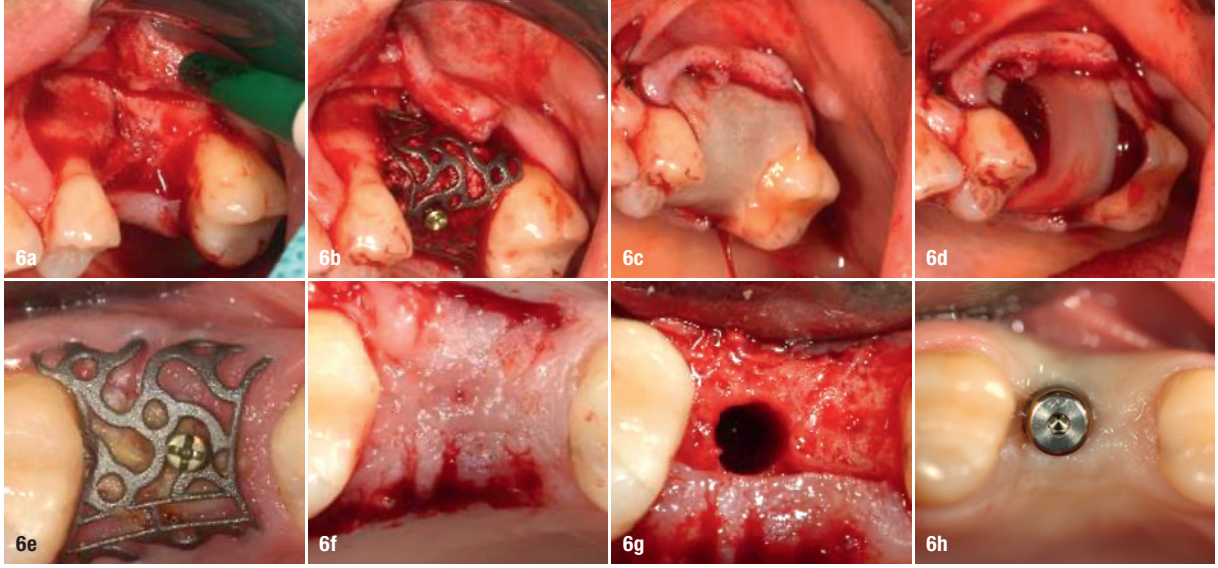


Fig. 6: Representative clinical image of the augmentation and implantation using a small titanium mesh after preparation of a full-thickness flap **(a)**, placement of the titanium mesh and fixation according to the virtual planning **(b)**, covering of the titanium mesh with a PRF-loaded collagen matrix **(c)**, a horizontally pressed solid PRF matrix is placed over the loaded collagen matrix **(d)**, two weeks after augmentation, newly formed soft tissue was observable under the mesh **(e)**, seven months after augmentation, the mesh was removed and healthy and thick soft tissue was observable under the mesh **(f)**, preparation of the implantation bed in newly formed bone with good mechanical properties **(g)**, healing abutment four months after implant insertion **(h)**.

number of thrombocytes and leucocytes accumulate at a low centrifugal force, thus releasing higher concentrations of different growth factors.[48–50] This extremely interesting, innovative and promising technique elegantly solves the old problem of augmentation coverage with almost complete loss of the keratinised gingiva. The flap is sutured at the basal level and the titanium mesh filled with donor bone is covered only with a collagen membrane and several layers of PRF (low-speed centrifugation) membranes. For initial protection, a sterile latex skin is sutured over the PRF. After healing, the titanium mesh is exposed and can be easily removed. The special feature of this concept is the keratinised gingiva found in the augmented area (Figs. 6a–h).

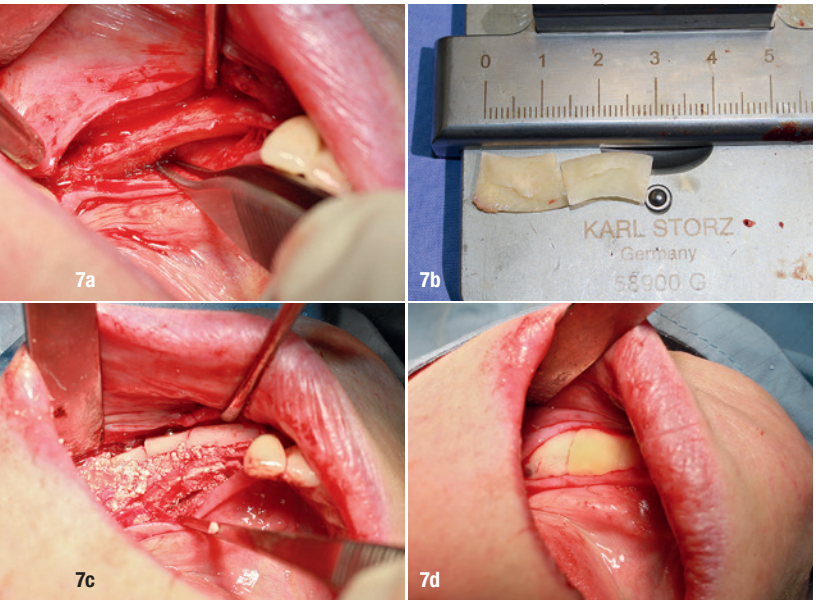


Fig. 7: Intra-oral image of the obviously resorbed alveolar bone in regions #37–33 **(a)**, situation after separation of the cortical plates **(b)**, intra-oral image after horizontal augmentation of the jawbone using Khoury plates **(c)**, coverage of the augmented bone with PRF membranes **(d)**.

Khoury layer grafting technique

This technique describes distance osteosynthesis with bone chips (Figs. 7a–d). The extension of the alveolar process/crest of the left mandible was obtained by removing a bone block from the left linea obliqua. The distance screws were inserted for osteosynthesis at a distance, and the defect was filled with bone chips and EthOss (EthOss Regeneration). The defect was covered with PRF membranes, and tight suture closure followed after mobilisation of the mucosa. After three follow-ups, the mucosa was tightly closed. The healing time will be six months in total. We assume that, after the healing phase, well-vascularised bone will be found.

Conclusion

In summary, it can be stated that innumerable biological GBR techniques can be applied. They allow the durable treatment of almost all patient cases. Together with the correct axial positioning of the implant and a prosthetic restoration of lege artis, long-term success depends exclusively on the increased blood supply of the augmented bone (see Mammoto's law).[51] Hence, all of the grafting techniques in this article aim at creating a well-vascularised lamellar de novo bone.

Literature

contact

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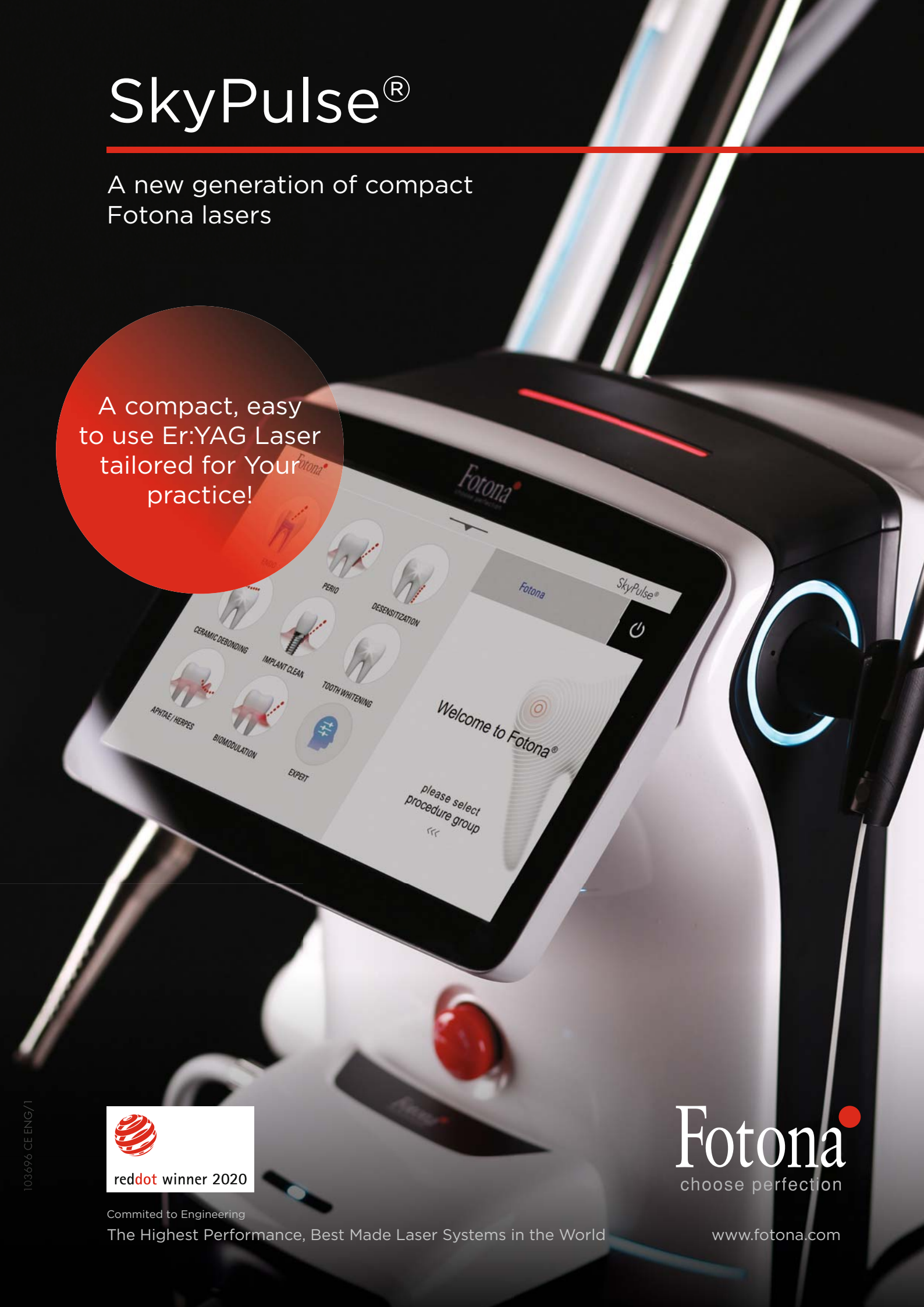

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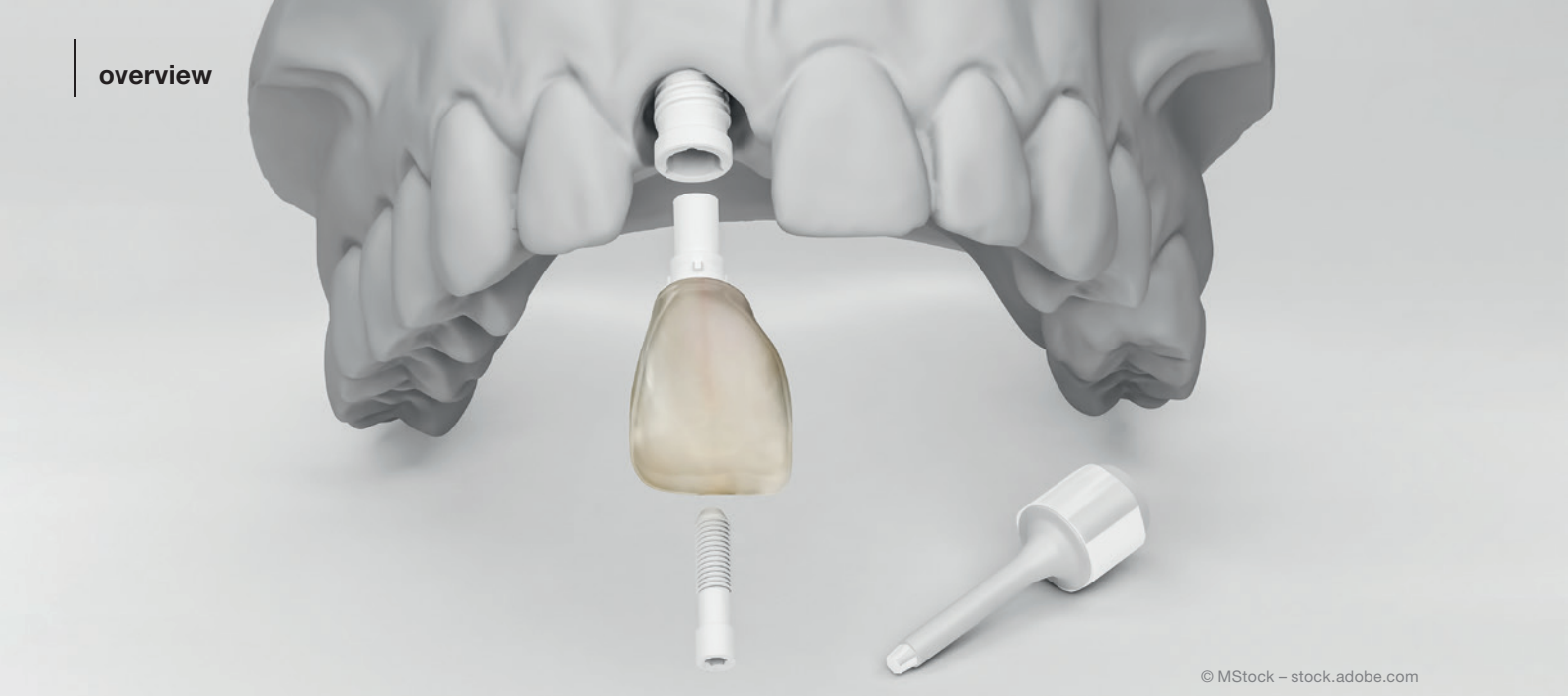

Zirconium-dioxide as preferred material for dental implants

A narrative review: Part II

Profs. Curd M. L. Bollen[1,2] & Maher Al-Masri[3]

[1] Professor for Implant Dentistry at the College of Medicine & Dentistry (Ulster University in Birmingham, UK);
[2] EACIm Ambassador to the UK and The Netherlands; [3] Professor and Dean at the College of Medicine & Dentistry (Ulster University in Birmingham, UK)

Part I

Editorial note: This is the second of a two-part article series. The first part, involving an introduction, a historical context and a chapter on composition, was published earlier this year in the 1/20 issue of ceramic implants. It may be accessed as an online version by scanning the QR code to the left.

	Titanium type IV	Y-TZP
Density (g/cm³)	4,5	6,05
Hardness (HV)	250	1,100–1,500
Strength (MP)	680	1,200
Elasticity (gp)	110	200–220

Table 1: Comparison between titanium type IV and Yttria-stabilised tetragonal zirconia polycrystal (Y-TZP).

Characteristics

Zirconia has several other interesting characteristics what makes it an ideal product to apply in dentistry, not only for crowns, but also for dental implants and implant abutments.

General

The dental implant company Straumann® made an internal comparison between their SLA-titanium (Sand blasted Long Grit Acid- etched) implant and their ZLA-zirconia (SLA but on zirconia) implant. Their data showed significantly better properties for the zirconia implants (Tab. 1).

Whereas alumina-oxide was a weak material that often led to fractures of the implants, zirconia tends to be stronger than titanium in the most relevant criteria. It is therefore a very suitable material for the production of dental implants. As mentioned already, zirconia is highly biocompatible, this is due to the rapid osteoblast adhesion and subsequent cellular proliferation that are responsi-

ble for an optimal bone implant interface.[9,10] Biologists thought that these features contrast with titanium, which affects cell viability and induces apoptosis, leading to a reduction in viable osteoblasts and a significant reduction in peri-implant bone quality.[11] In addition, zirconia showed no induction of any toxic effect compared to titanium. Tests were performed on fibroblasts, lymphocytes, monocytes, macrophages, connective tissues, immunological and bone tissues (Tab. 2).[12,13]

	Titanium	Zirconia
Ion-release/corrosion	Y	N
Toxicity	low	N
Plaque adherence	low	very low

Table 2: Biological comparison between titanium and zirconia.

In several studies on intra-oral plaque formation, only cocci and some short rods were found on zirconia surfaces by dark phase contrast microscopy. Pathogens, such as mobile micro-organisms (e.g. Peptostreptococcus micros) and spirochetes (e.g. Treponema denticola), were not detected on zirconia surfaces.[14] It also appears that the early adhesion and colonisation of bacteria on zirconium surfaces is much more limited than on titanium surfaces. Due to these characteristics, we see an extremely good soft-tissue reaction and a rapid healing of the soft tissues around intra-oral zirconia structures.[15]

Corrosion

Titanium is widely used in biomedical devices due to its recognised biocompatibility. However, implant failures and subsequent clinical side effects are still recurrent.[16] Body fluids and relative motion between implant and bone lead to synergistic degradation reactions, which cause failed implantation or adverse tissue reactions for implant materials used in human body. This was detected for several titanium alloys. This process can induce non-specific immuno-modulation and autoimmunity, leading to a proven sensitisation to titanium; it has been suggested that some autoimmune diseases (e.g. multiple sclerosis and rheumatoid arthritis) may be caused by this sensitisation.[17]

It has been also labelled that up to 6 % of the population is thought to have an allergic reaction to titanium.[18] This form of foreign-body reaction is also progressively associated with the loss of implants (non-integration or rejection) and the phenomenon of peri-implantitis. However, more scientific evidence is certainly needed here.[19] All these problems are rarely or not detected at zirconia implants.[20]

Osseointegration

Recent studies show little or no difference in the initial osseointegration between titanium and zirconia dental implants. However, when looking at this literature, it is clear that there is still a significant lack of long-term studies (randomised controlled trials) on zirconia implants.[21] When "periodontal-integration" (healthy and firm soft tissue vs integrated material contact) is evaluated, it was described that there is a better fibroblast adhesion to zirconia, leading to a stronger "cuff" formation around these implants. This results in reduced pocket depths with a predominantly non-inflammatory environment.[22,23]

Aging

At normal room temperature, zirconia is kept in a metastable tetragonal phase by the addition of stabilizing agents (such as Yttria). The aging of zirconia consists of the return to a more stable mono-clinic phase. This transformation takes place on the surface of ceramics of tetragonal zirconia. It has been shown that tetragonal to mono-clinic transformation at the surface of zirconium ceramics is promoted by the presence of water molecules in the environment (e.g. saliva in the oral cavity). Subjected to an increase in volume, this stress transfor-

mation induces the formation of surface micro-cracks and therefore an increase in surface roughness. Micro-cracks can lead to a deterioration of the mechanical properties.[24,25] On long-term they can become macro-cracks (chipping).

Radioactivity

Zirconia implants are slightly radioactive. Radioactivity of the ZrO_2 ceramics studied recently showed negligible radionuclide activity that can be considered lower than many hazardous radioactive appliances in our environment.[26] While a femoral head of about 100 g yields 0.5 mSv/year, a dental implant (2 g) is responsible for a dose of 0.01 mSv/year. By comparison, a transatlantic flight yields 0.16 mSV and the average normal exposure is 2.4 mSv/year. The additional radiation from implants (and crowns) therefore is not really worth mentioning.[27]

Material/Processing	Surface roughness
Glazed surface	0.42–0.76 µm
Surface finished with diamond burs	0.89 µm
Surface finished with diamond burs and polishing	0.49 µm
Only polishing	0.17 µm

Table 3: Surface roughness of zirconium crowns.

Manufacturer	Product
Nobel Biocare®	NobelPearl
Straumann®	PURE Ceramic, SNOW
Z-Systems®	Z5m, Z5c, Z5s …
Dentalpoint	ZERAMEX XT, P6
Oral Iceberg®	CeraRoot
SDS Swiss Dental Solutions®	SDS1.2, SDS2.2 …
Bredent®	WhiteSky
TAV Medical®	TAV White
CAMLOG®	CERALOG
ZiBone®	ZDI
Further companies include: VITA®, WITAR®, FairImplant®, Medical Instinct®, Champions® …	

Table 4: Main products on the zirconia implant market.

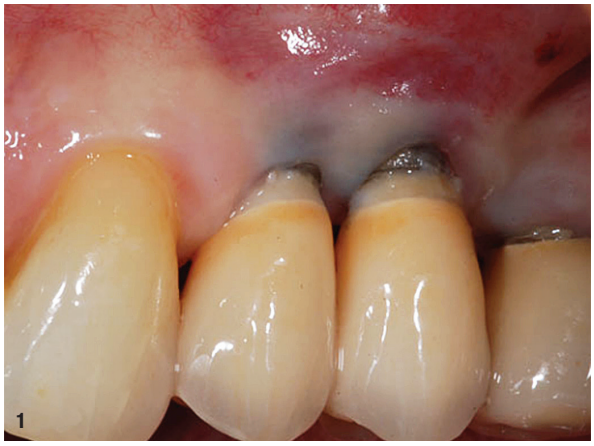

Fig. 1: Shimmering titanium in a thin biotype (© A. Sculean).[29]

Aesthetics

Since titanium can have a greyish shadow and twilight (Fig. 1), zirconia has proven its aesthetic values in implant dentistry. Most zirconia implants are available in an A2 colour. This gives them a significant advantage in patients with a thin biotype.[28] Implant companies hope to produce zirconia implants in more different white shades, adapted to the patient tooth colour, in the near future.

Surface roughness

Quirynen & Bollen found that 0.2 µm is the threshold surface roughness for microbial adhesion: an equal or lower surface roughness does not give any additional decrease nor increase in plaque growth, while a higher surface roughness is clearly linked to more plaque adhesion.[30] Several recent studies focus on the surface roughness of zirconia crowns in the oral cavity. When the surface roughness of crowns is investigated, the different finishing protocols determine the final roughness (i.e. the plaque-retention-potential; Tab. 3).[31,32]

The surface roughness of zirconium abutments is between 0.2 and 0.3 µm.[33] For zirconia implants, there is a difference between the screw section (1.2–1.6 µm) and the collar (0.3 µm). The smooth collar prevents plaque adhesion and stimulates perio-integration, while the rougher surface of the screw section promotes osseointegration.[34]

Surface free energy

The surface free energy of titanium is much higher than that of zirconia, so therefore more bacterial adhesion can be detected on titanium surfaces compared to zirconia surfaces.[35,36]

Market

There are several international companies in the market that produce or sell zirconia dental implants (Tab. 4). However, only a limited number of these companies/

products can show peer-reviewed research associated with their products. Mostly, in vitro studies or case presentations are available.

Future perspectives

The field for dental implants is constantly evolving. An implant that fits directly into a fresh extraction cavity may well be the future solution. There are currently more than 250 implant companies producing thousands of different implant types, all of which unfortunately do not fit perfectly into the bone cavity after extraction. Extraction and direct implantation with a perfect fitting implant could be the future.

BioImplant® (FACE YOUR FACE Handels GesmbH, Austria) is a dental implant specially designed for immediate implantation after extraction. It is fundamentally different from screw-type implants and can in no way be compared to them. The extracted root is scanned and moulded in zirconia: a copy of the lost root(s). The implant fits exactly into the tooth socket and therefore does not require operations such as grafts, augmentations with autologous/xenologous/synthetic bone. Eventually some PRP/L-PRF could be applied additionally. Only the periodontal ligament is removed, but never the bone. Since there is no surgical procedure (the implant is inserted into the tooth socket), there are no complicated guidelines to follow. Drill guides, bone replacements, membranes, and product-specific surgical sets and drilling sequences are therefore not applicable. BioImplant® is a one-piece implant, adapted in shape and colour to the patient's individual tooth, both single and multiple rooted. The prefabricated stump can be grinded at any time in the same way as a natural tooth.[37] This evolution in dentistry may be the necessary push to help turn current implant dentistry into a "white and metal-free" discipline.[38]

Discussion

Will titanium soon be completely replaced by zirconia as the implant material of choice? Probably not! The material has still many advantages: cheap and simple production making the implants economically "affordable", a huge volume of scientific publications over a period of more than 50 years and numerous specific designs of screws for various indications. That's why titanium will certainly remain the gold standard as an implant material for the next decade.

Therefore, it is legitimate to conclude this narrative review with the question: Is zirconia just a temporary "ecological" hype? We believe it is certainly not. We consider there is a clear niche for zirconia implants that is likely to grow further once the material is fully developed, especially for aesthetic reconstructions in the anterior region (in patients with a thin gingival biotype); for gingival recessions where a white coloured implant is a great advantage; for patients with a proven titanium allergy (confirmed by an ELISA-test); and for patients who prefer a complete bio-holistic/metal-free dental approach, excluding (tribo-)corrosion and conduction of temperature or radiation by metals.

Having reviewed all the above, further research is certainly required to enlarge our understanding of these different materials and their applications. Three themes in particular need further to be explored: firstly, how "undesirable" the use of titanium as a dental implant material is for the general health; secondly, what the correlation is between the corrosion of titanium and the development of peri-implantitis; and thirdly, what the long-term clinical results of zirconia are as an implant material.

Literature

about the author

Prof. Curd Bollen obtained his DDS in 1992 at the Catholic University Leuven, Belgium. In 1996, he received his PhD and in 1997, he finished his M.Sc. in Periodontology & Implantology. In 2016, he completed the MClinDent programme at the University of the Pacific in the US. As for his active clinical work, Prof. Bollen specialises in periodontology, implantology and halitosis. He recently joined the College of Medicine & Dentistry in Birmingham, UK, as an Associate Clinical Professor.

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Single-tooth restoration using an all-ceramic implant solution

Inserting a two-piece implant in the anterior region

Dr Thomas Mehnert, Germany

The latest generation of two-piece ceramic implants (zirconia) is considered an alternative treatment option to titanium implants owing to their excellent biological and material properties.[1–11] Their handling and workflow now meet the requirements of modern implantology.[12] In the following, a clinical case is described to demonstrate the use of a two-piece ceramic implant.

Clinical case

A 40-year-old female patient presented to our dental surgery with an irreparable tooth #21 (Fig. 1). The periapical radiograph revealed an approximately 7 mm periapical translucency with widening of the periodontal ligament in the upper third of the root (Fig. 2). Owing to the clinical conditions (high smile line and good oral hygiene), we decided to use a two-piece ceramic implant, ZERAMEX XT (Dentalpoint).

Surgical phase

After extraction of tooth #21, the apical granulation tissue was excochleated through a semilunar incision (Fig. 3). A two-stage procedure was performed to prevent failure of osseointegration of the ceramic implant and to preserve the soft-tissue structures (papillae and attached gingiva). A claspless prosthesis made from Valplast (Valplast International Corp.) served as a temporary restoration. The implant site in region #21 was uncovered after five months (Fig. 4). A two-piece ceramic implant (diameter: 4.2 mm;

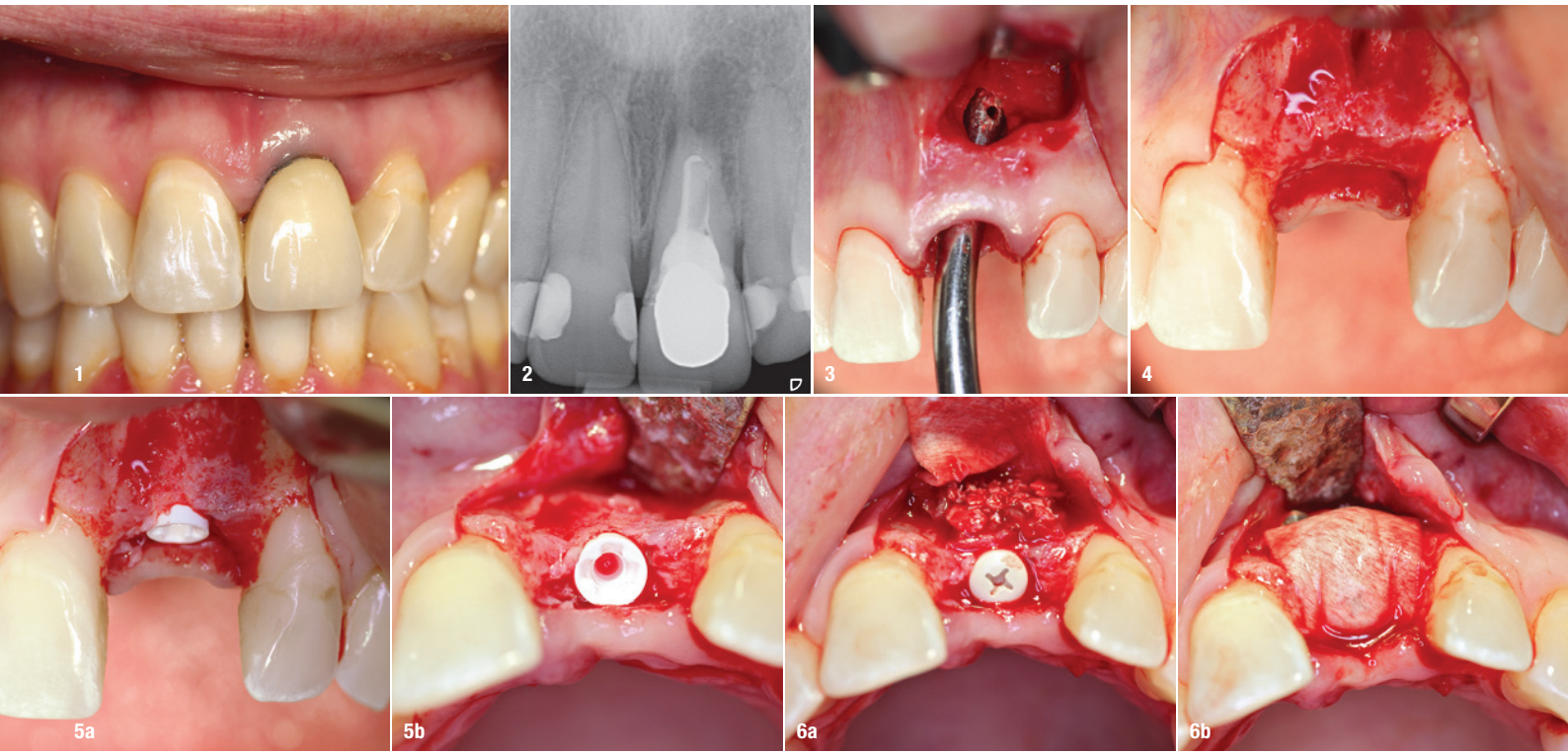

Fig. 1: Initial clinical situation. **Fig. 2:** Initial radiographic examination. **Fig. 3:** After the extraction, the apical granulation tissue was excochleated. **Fig. 4:** The implant site was uncovered after five months. **Figs. 5a & b:** A two-piece ceramic implant was inserted. **Figs. 6a & b:** Transversal bone augmentation was performed.

length: 12.0 mm) was then inserted (Figs. 5a & b). The guidelines for implant placement in the aesthetic zone and the drilling procedure specified by the manufacturer were observed.[13, 14] Both vertical and transverse insertion depth are decisive for prosthetic success. The implant can be placed between 1.6 mm and 0.6 mm supra-crestally because of a special thermal etching procedure in the collar region; the insertion depth is determined by the gingival height and the existing bone of the adjacent teeth. The implant positioning should be approximately 2–3 mm subgingivally because the abutments are added 1 mm above implant shoulder level. Transversal bone augmentation was performed with a mixture of autogenous bone chips (retrieved from the retromolar mandible), xenograft (Geistlich Bio-Oss, Geistlich Biomaterials) and guided bone regeneration (Jason membrane, botiss biomaterials; Figs. 6a & b). The exposure was performed after four months using a PEEK gingiva former (Fig. 7).

Prosthetic phase

A provisional crown made of GRADIA (GC), a micro-ceramic composite, was fabricated to achieve optimum contouring of the marginal gingiva in the highly aesthetic zone. A PEEK abutment (ZERAMEX Provisional RB; 180-day maximum period of wear), with a screw (maximum torque of 15 Ncm), acted as the base for the long-term temporary restoration (Figs. 8a & b). After eight weeks and adjusting the long-term temporary restoration in the basal area twice to optimise the emergence profile, the definitive zirconia crown (Ceramill substructure, Amann Girrbach; Creation veneer) was fixed to the customised abutment made of alumina-toughened zirconia (Figs. 9 & 10). After exact positioning (checked by probing or by taking a radiograph) the abutment is firmly fixed by utilising the VI-CARBO screw which is part of the ZERAMEX system. This unique screw made of carbon fibre-reinforced high-performance polymer is tightened to a torque of 25 Ncm. The final result is shown in Figure 11. The examinations after six and 12 months found no irritation of the soft tissue, and the BOI test was negative. The pink aesthetic score according to Fürhauser was 12 out of a maximum of 14 points (Figs. 12a & b).[15] The process of peri-implant bone remodelling was of particular interest. Examinations were performed with periapical radiographs (right angle technique) and DBSWIN software (Dürr Dental).

Bone resorption was detected six months after exposure (mesial bone: 0.6 mm; distal bone: 0.4 mm), and a gain of bone was observed 12 months after exposure (mesial bone: 0.0 mm; distal bone: 0.3 mm; Figs. 13a–c). In accordance with the findings in the relevant literature, bone resorption in our patient was the greatest in the first six months.[16] However, the literature findings are in reference to one-piece ceramic implants, in contrast to the two-piece implant system used in this case. This phenomenon of bone resorption is a relatively rare occurrence in implantology and should be confirmed by evidence-based

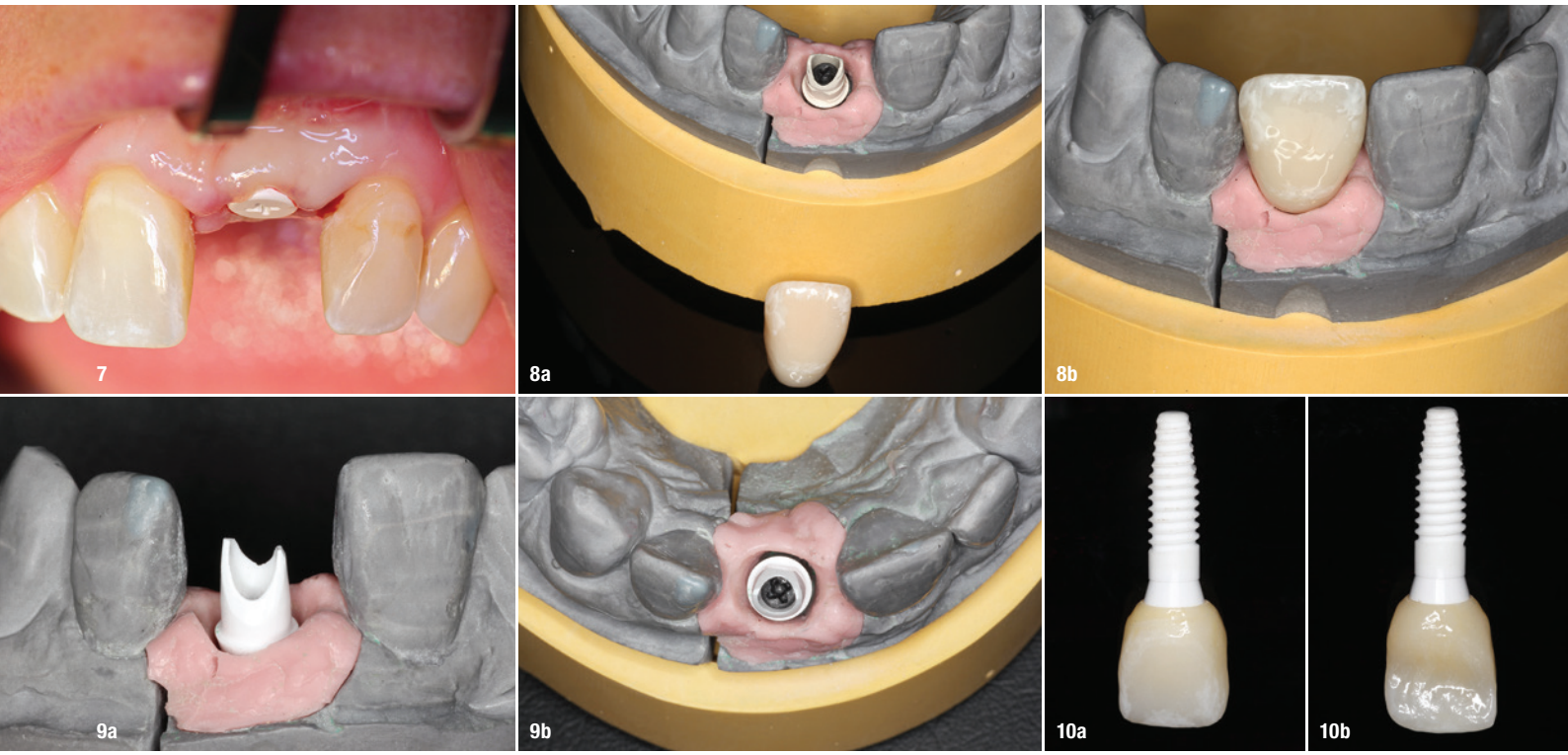

Fig. 7: Implant exposure after another four months. **Figs. 8a & b:** A PEEK abutment as the base for the long-term temporary restoration. **Figs. 9a–10b:** The definitive zirconia crown was fixed to the customised abutment made of alumina-toughened zirconia.

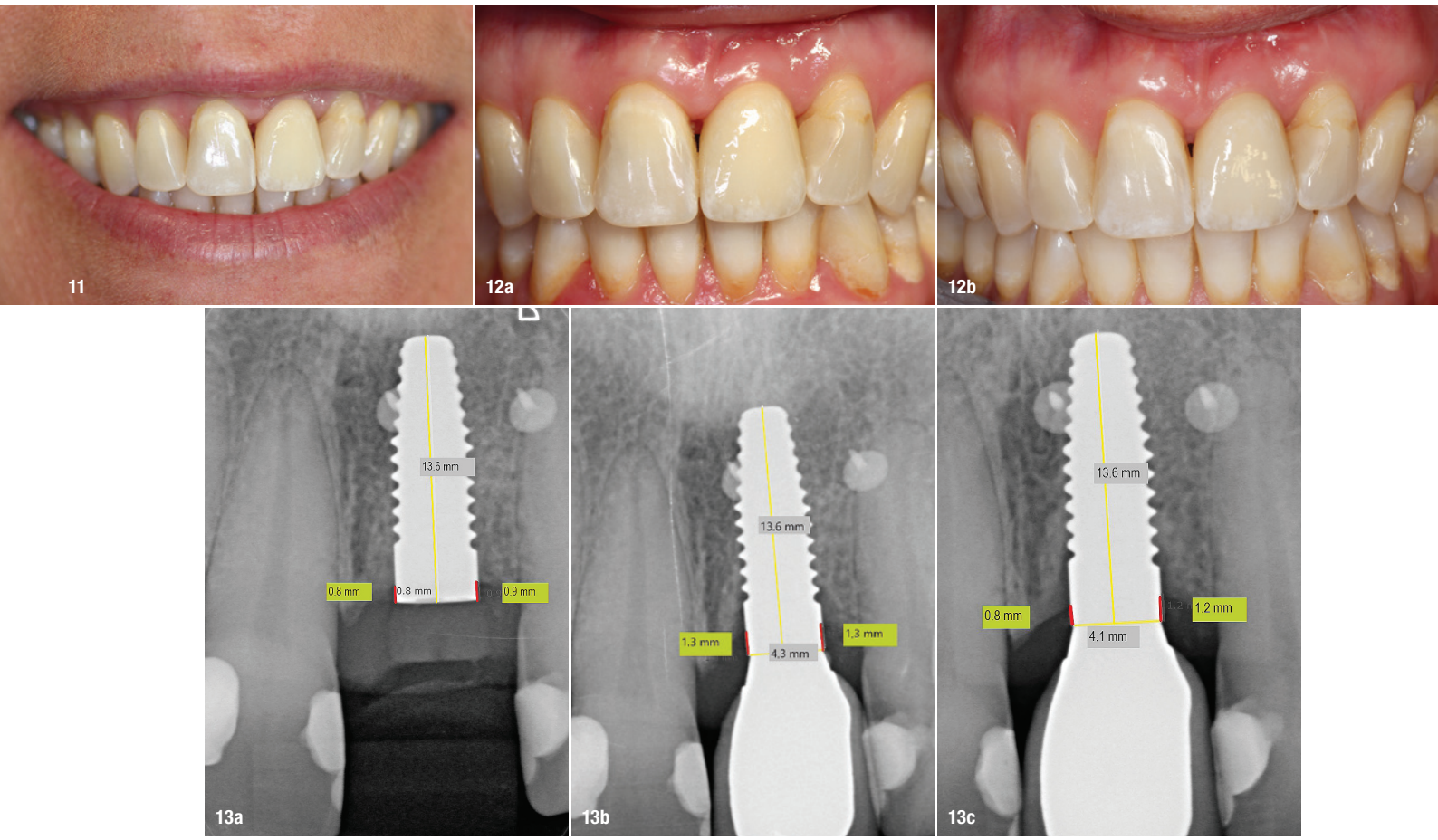

Fig. 11: The final result. **Fig. 12**: Clinical situation at the examinations after **a)** six and **b)** 12 months. **Figs. 13a–c:** Bone resorption was detected after six months and bone gain after 12 months. The yellow line represents the actual implant length (13.6 mm). The red lines indicate the mesial and distal distances from the top of the implant to the first bone contact.

long-term studies before a definitive conclusion can be drawn. Evaluations are in progress.

Summary

Ceramic implants are a viable alternative to titanium implants. Having experienced the advantages of zirconia ceramics yourself, you will appreciate them and will never look back. Besides providing the option of metal-free restorations, they offer a practical addition to the existing range of treatments for many risk groups, taking into account the respective indications. I would recommend user training courses for this relatively new, but somewhat different, material. This is a requirement that is increasingly addressed in the literature.[12, 17]

Literature

Acknowledgement: The author would like to thank dentist Frank van Doorn (Meckenheim in Germany) and master dental technician Jürgen Hopp (Mund Zauber Zahntechnik in Meckenheim) for their kind support in the field of prosthetics.

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Ceramic versus titanium implants

Three-year follow-up and a split mouth study

Drs Simion Bran, Manea Avram, Onisor Gligor Florin, Horia Opris, Gabrial Armencea & Mihael Baciut, Romania

In this study, we followed up the comparative tissue reaction to titanium dental implants versus ceramic dental implants. Both types of dental implants used were mainly those produced by TAV Dental. Only two-piece dental implants were used in this research. The following parameters were evaluated in each step of the procedures: quality of the prosthetic attachment, gingival attachment, dental plaque adherence, and primary and secondary stability. In all of these cases, implant uncovering and prosthetic loading were done ten weeks after implantation. In the two cases described here, there were no observable complications after implant insertion.

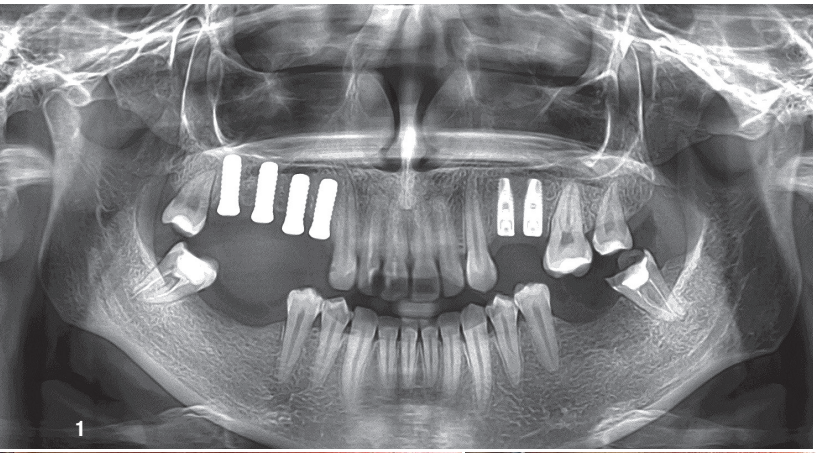
The two cases

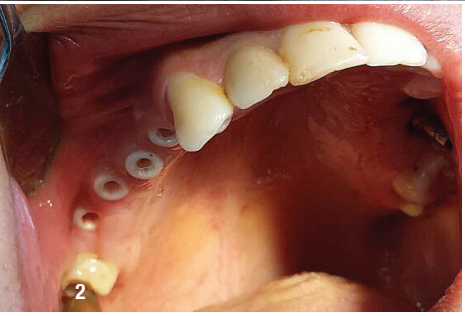
The patient of the first case described had four zirconia dental implants (TAV Dental) inserted in the right side of the maxilla. These implants were 4.2 mm in diameter and 10.0 mm in length. In the left side of the maxilla, she had two titanium implants (Silhouette, TAV Dental) inserted. These implants were 3.75 mm in diameter and 10.00 mm in length. Loading was performed ten weeks after implantation. At that point, no inflammation at soft-tissue level was observed and there was perfect gingival attachment (Figs. 1–3).

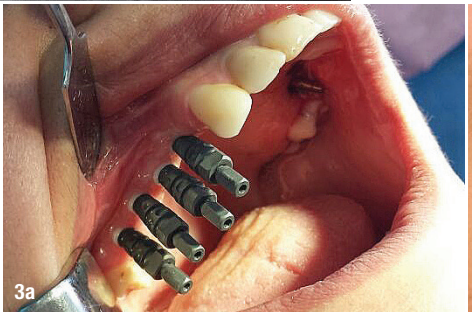
The patient of the second case described had two zirconia implants (TAV Dental) inserted in the left maxilla. These were first-generation implants with a diameter of 4.2 mm and a length of 12.0 mm. In the mandible, titanium dental implants (Biomicron) of 3.75 mm in diameter and 10.00 mm in length had been inserted and functioned for a total of 14 years. A radiograph was taken at ten weeks after uncovering and loading. The impression was done by means of the open-tray technique. The patient received a metal–ceramic prosthetic build-up. Mechanical failure of a titanium implant occurred after 14 years of function and 2.5 years after loading of the zirconia implants (Figs. 4–7).

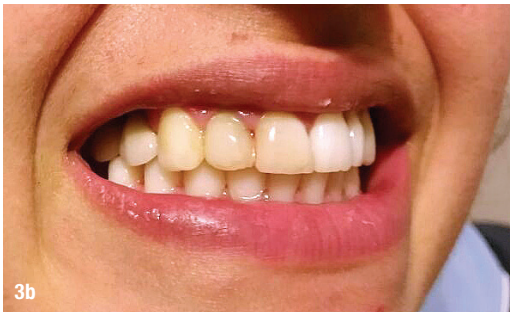
Findings

In our three-year follow-up of the cases presented, we found that the gingival attachment was better for the zirconia implants than for the titanium ones. Also, the inflammatory response was better for the zirconia implants. There was less peri-implantitis and less bone loss for the duration of the follow-up. The osseointegration process

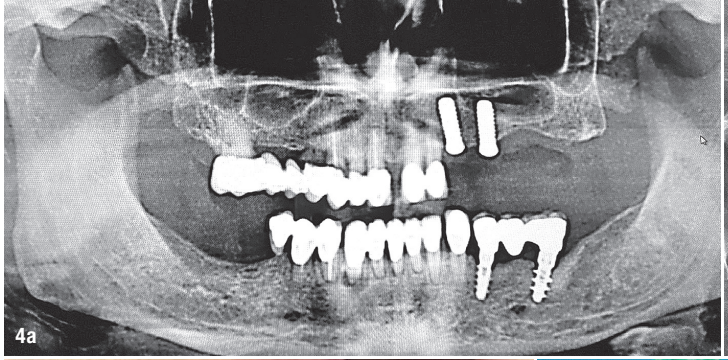


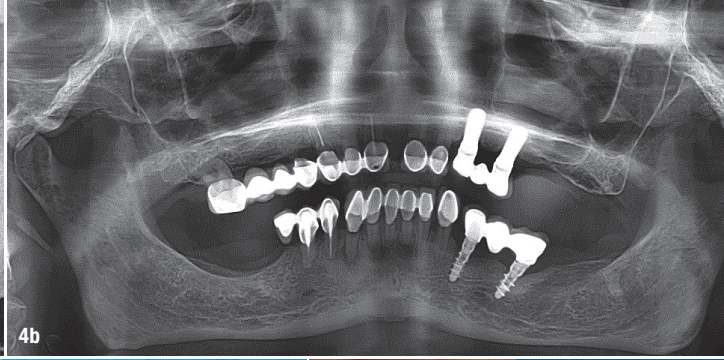


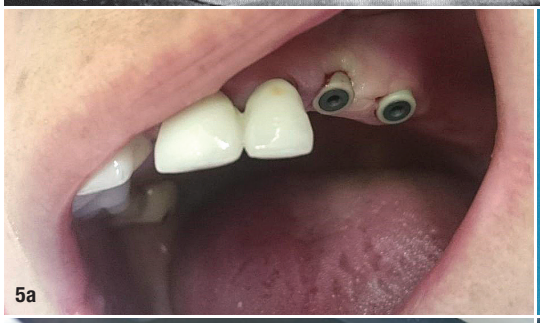


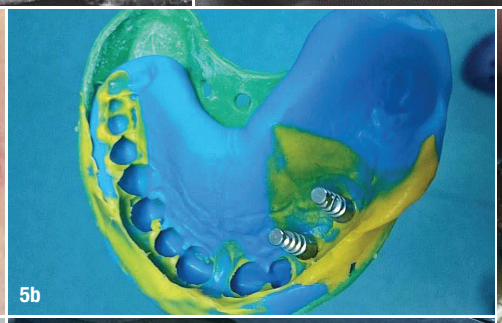


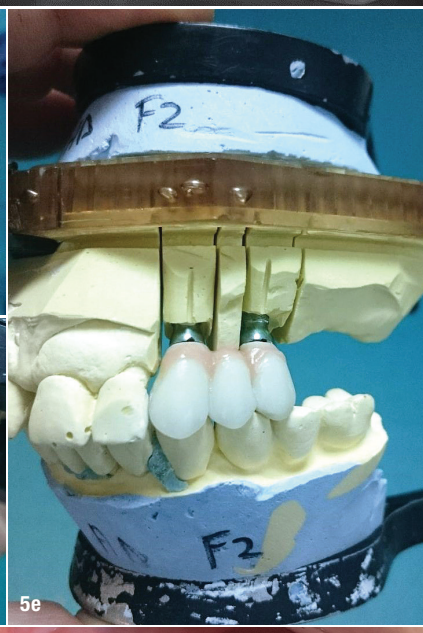
Case 1—Fig. 1: Initial radiograph of the patient with zirconia implants in the right side of the maxilla and titanium implants in the left side.**Fig. 2:** Ten weeks after implantation. Clinical examination revealed no inflammation at the soft-tissue level and perfect gingival attachment. **Fig. 3a:** Impression with open-tray technique. **Fig. 3b:** Final prosthetic result.

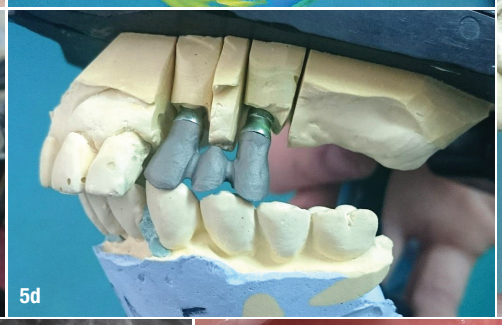


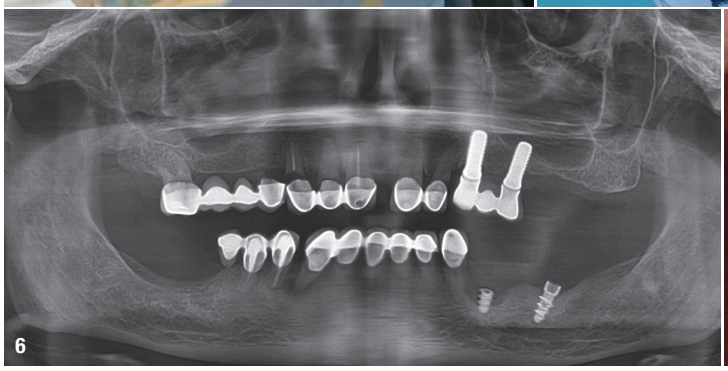


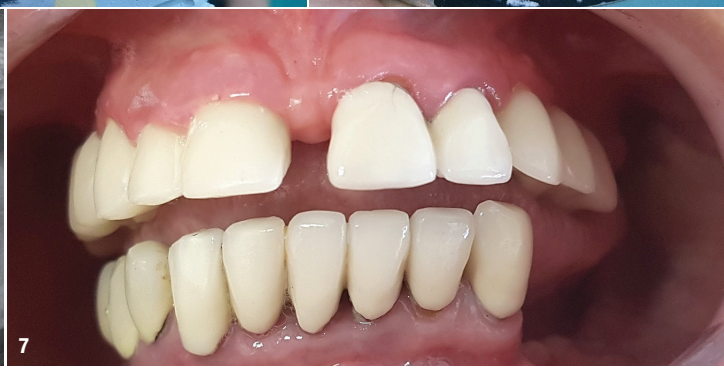








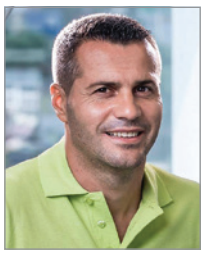




Case 2–Fig. 4a: Radiograph showing the situation after implantation of two zirconia implants in the left maxilla. The mandibular titanium dental implants functioned for a total of 14 years. **Fig. 4b:** Radiograph at ten weeks after uncovering and loading. **Fig. 5a:** Uncovering. **Fig. 5b:** Impression with open-tray technique. **Figs. 5c–e:** Metal–ceramic prosthetic build-up. **Fig. 6:** Mechanical failure (fracture) of the titanium implant in region #34 (after 14 years of function) 2.5 years after loading of the zirconia implants.**Fig. 7:** Clinical intra-oral aspect after the prosthetic restoration of the maxillary right implants and failure of one of the mandibular right implants.

of the zirconia dental implants was comparable to that of the titanium implants. Prosthetic loading can be done safely for both types of implants at ten weeks. The mechanical resistance of the zirconia implants and their superstructure was similar to that of the titanium implants. For example, the second case showed failure of one of the titanium dental implants.

about the author



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Ceramic implants: an alternative or a primary choice?

Clinical aspects and operating procedures

Dr Riccardo Scaringi, Dario Viera & Dr Michele Nannelli, Italy

Introduction

Today, grade 2 titanium is considered the standard material for prosthetic implant rehabilitation in all situations that may arise in the dental field. The excellent bone integration, good tissue biocompatibility, resistance to corrosion and biomechanical stress mean that titanium implants are an optimal clinical solution, including with regard to the standardisation of surgical protocols that have made it possible to obtain solutions with an acceptable result even in the hands of less experienced practitioners.[1] In light of this, one might wonder: what is the reason for using zirconia implants and in what circumstances could they be a primary choice compared to titanium implants? Since the introduction of titanium replacement materials, there has been an evolution in ceramic materials, culminating in zirconia, due to its mechanical properties associated with the characteristic biological responses resulting in high biocompatibility and low affinity to bacterial plaque. Zirconia also offers excellent tissue mimesis thanks to its whitish colour that simulates the colour of teeth.[2]

In 1969, Sandhaus was the first to make aluminum oxide (AL_2O_3) implants;[3] in 1974, the Tubingen implant, made of polycrystalline alpha-alumina, was introduced and clinically tested.[4] Despite the excellent bone integration results, there was the drawback of implant fracture due to factors related to the mechanical properties of alumina itself, as it has low bending strength. This problem is largely resolved with the use of zirconia, a material which replaces the values of titanium[5] Long-term success not only requires osseointegration but, above all, an excellent response to soft tissue by creating a mucous barrier around the implants in order to develop a kind of seal between the marginal bone and oral cavity. It is well-known that, after implant insertion, the formation of soft tissue around the implant collar is characterised by the gradual transition from a clot to granulation tissue and consequently the formation of an epithelial barrier that turns into the maturation of connective tissue.[6] Any gaps that may remain between the implant and connective tissue could promote bacterial growth. The epithelial barrier contains Langerhans cells and local immune defence cells.[7] The peri-implant epithelium adheres to the implant through hemidesmosomes and internal basal lamina of the lower region of the interface between epithelium and implant, with poor adhesion to the titanium surface.[8] The rapid epithelial growth at the expense of the connective tissue generates gaps where the seal is not guaranteed, with consequent bacterial colonisation. In addition, if epithelial growth were to occur along the implant axis during healing, osseointegration would not be adequate, resulting in consequent bone resorption.[9]

Additional studies were conducted to determine appropriate surface treatment with regard to implant shape and the possibility of having one-piece or two-piece implants that could obtain comparable data to that obtained for titanium implants.[10] The demand for aesthetics in the anterior regions of single and multiple restorations highlights the disadvantage of having submucosal areas with greyish shades that emphasise the need to combine zirconia abutments and crowns, allowing greater translucency compared to titanium with metal-ceramic.[11, 12] The low adhesion of oral cavity bacteria to ceramic surfaces makes their use beneficial, also enhancing the use of zirconia coronal insert implants.[13] Yttria-stabilisation of tetragonal zirconia polycrystal (Y-TZP) has made it possible to obtain an endosseous implant able to withstand breaking loads sometimes higher than Titanium.[14] One-piece implants were the first to be introduced in clinical practice because of their optimal biological and functional integration and, despite the prosthetic limitations, they are still recommended in implant sections reduced to less than 4.0 mm. Their prosthetic peculiarity means that they are suitable for partial edentulism, even in aesthetic frontal regions and thin biotypes, and in areas where the masticatory load is at its maximum. The strong prosthetic limitation is an important element, especially in cases of interconnection where the disparallelism could generate difficulties in the construction of the primary structure. In fact, the abutments, which are usually represented by a conoid-like geometry or similar, are difficult to treat with diamond drills in the oral cavity because the polycrystalline structure could undergo stress due to modification of

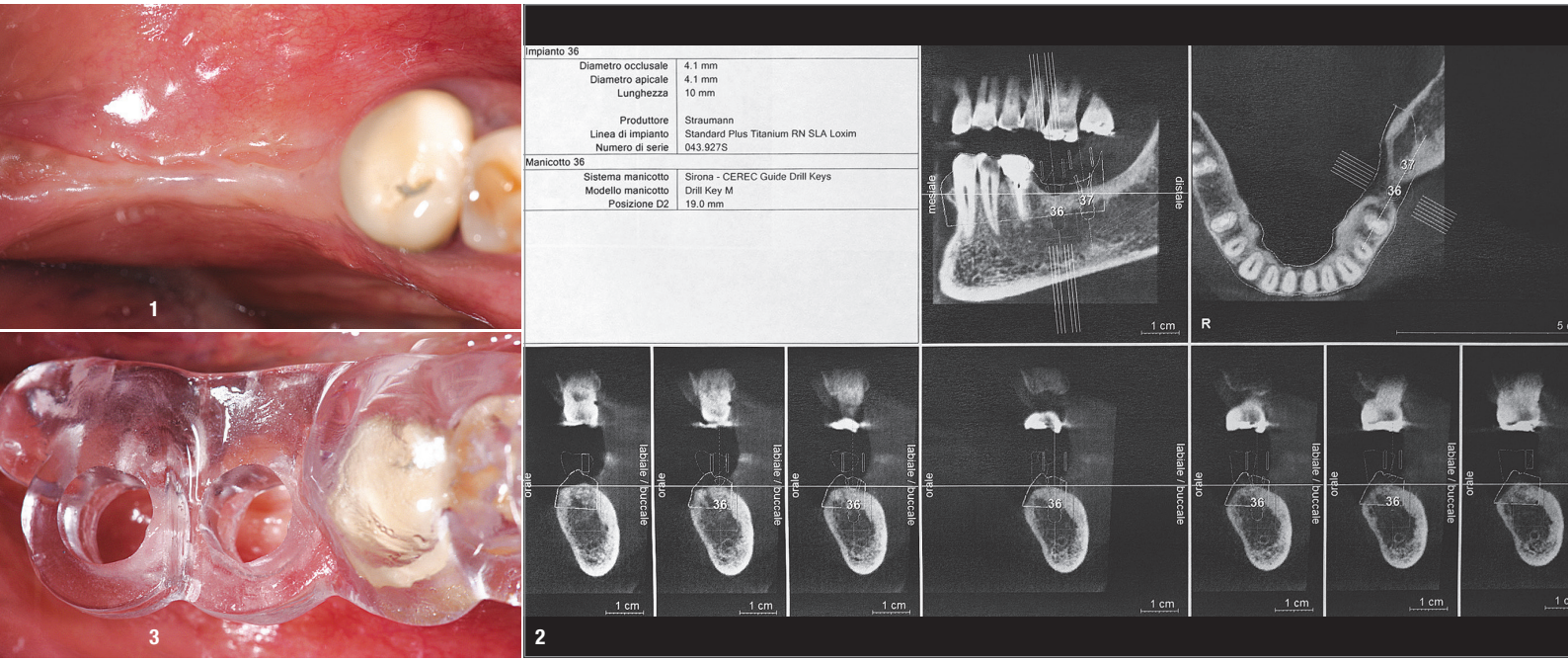


Fig. 1: Pre-surgical situation, shows the lack of connective tissue and residual bone atrophy. To be taken into account when comparing the result obtained after completion of the implant restoration. **Fig. 2:** Representative axial sections of CBCT at sites of surgical interest. **Fig. 3:** Positioning of the surgical template for correct implant placement in the transverse space and axial direction.

the internal lattice, leading to the fracture of the implant itself. In addition, the presence of an abutment limits the regenerative potential of the site and forces the abutment to become exposed, with inevitable immediate, and even indirect, load caused by the movement of the tongue and related to chewing and functional cycles.[15]

The presence of two-piece zirconia implants represent an evolution compared to one-piece implants, providing the possibility to customise a dedicated abutment or to choose among a range of abutments, which, although limited, provides the clinician with a prosthetic variable which is able to optimise the prosthesis according to aesthetics and biomechanics. We are fully aware of all the limitations of implant geometries in titanium implants but, above all, we know that the micro-gap generated between implant and abutment leads to a bacterial build-up that causes the soft and hard tissue to suffer.[16, 17] This has led some authors to restudy the behaviour of the respective implants, without making substantial notes on the differences between titanium and zirconia implants for both prosthetic connections.[18–20] When analysing two-piece implants, it is important to establish that the abutment can be held within the implant by cementing or screwing. The screw-retained connection is the most common one on the market, can be easily reproduced in the laboratory and can be made of different materials, ranging from titanium to gold, PEEK and carbon-reinforced PEEK. Although not in contact with tissues, in the holistic view, the metal screw does not define the restoration as Total Metal Free. Carbon-reinforced PEEK is a PEEK (Polyether Ether Ketone) screw reinforced with carbon fibre, having the following characteristics:

- Radiotransparent, i.e. not visible on radiographs;
- Elasticity modulus > 160 GPa;
- Flexural Strength > 1,100 MPa;
- Tensile Strength 2,000 MPa;
- Biocompatible according to ISO 10993.

In terms of intrinsic structure, we find that the carbon fibres have a continuous longitudinal trend at 60 % inserted in a 40 % PEEK matrix; this promotes adequate stability and high resistance to the stress to which it will be subjected during screwing, in the abutment retention phase and during chewing.

Clinical case

In the case in question, the female patient ASA 1 presented with edentulous molars in the third quadrant. The patient had already undergone implant-prosthetic rehabilitation with the insertion of two titanium implants which, after a short period of function, began to show pain and bleeding according to the patient. Despite maintenance treatment administered both at home and professionally, the clinical situation did not improve and, after a few months, the patient had to remove the entire implant restoration, resulting in circumferential bone resorption at both implants (Fig. 1). One year after the extraction, we decided to re-examine the edentulous area by subjecting the patient to CBCT (Fig. 2). The diagnostic examination showed vertical bone resorption while maintaining an adequate size for the in-

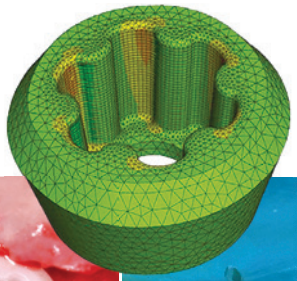
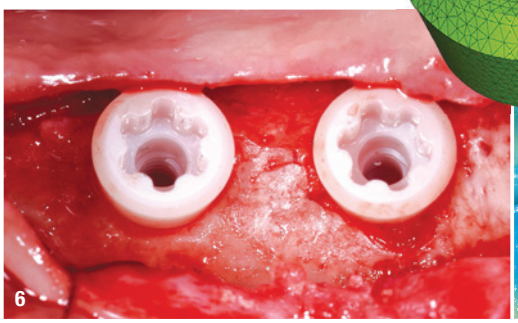
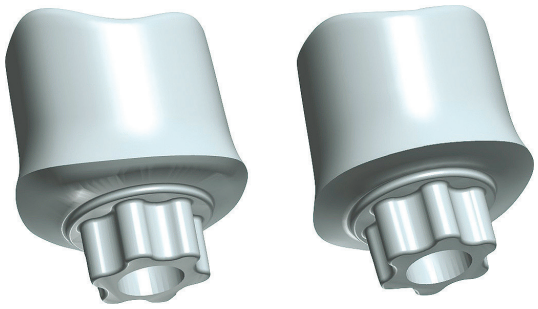
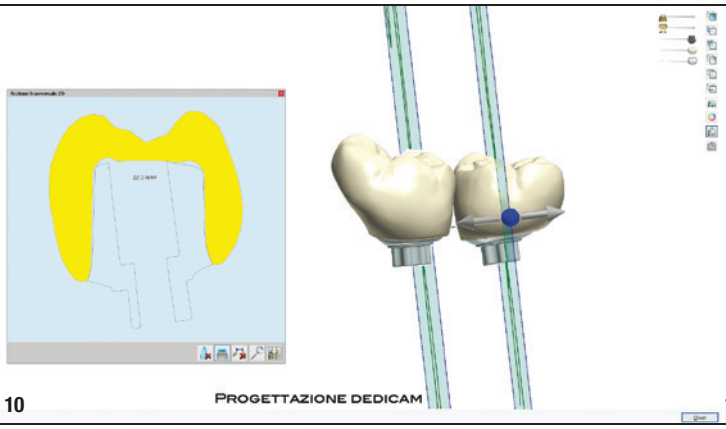





Fig. 4: Selection of the CERALOG zirconia implant (BioHorizons Camlog). The image shows the handpiece mounter in order to control the implant insertion for torque and speed. **Fig. 5:** Detail of the Hexalobe connection and its representation using a mathematical finite element method, showing the reduction of mechanical stress related to zirconia in the connection cavities. **Fig. 6:** The need for the residual connective tissue to be preserved has dictated open flap surgery, even if with less trauma. **Fig. 7:** Impression copings according to the tear-off technique using silicone.

sertion of two 10 mm implants and leaving adequate safety space from the mandibular canal. The bone quality proved to be D3 type. In our therapeutic protocol, we prefer a digital approach and, where possible, we prefer to produce a surgical template in order to optimise the position between the implants and the antagonists, with a view to optimising the result (Fig. 3). Given the previous implant failure, we have given the patient an alternative in the choice of materials compared to the previous project, offering the possibility of performing a Total Metal Free (TMF) treatment. Evaluating the choice of implant was aimed at making it possible to use a two-piece zirconia implant due to the relative vertical dimension present with respect to the antagonists, the abrasion marks on the residual teeth and the relative bone quality. Moreover, during the treatment of a relapse, I believe that any practitioner wants to minimise the risk of another failure. The decision was made to go with a new generation implant with some special features that were suitable for resolving the case.

Materials and methods

The zirconia implant chosen for the patient is produced by moulding, in contrast to other zirconia implants made

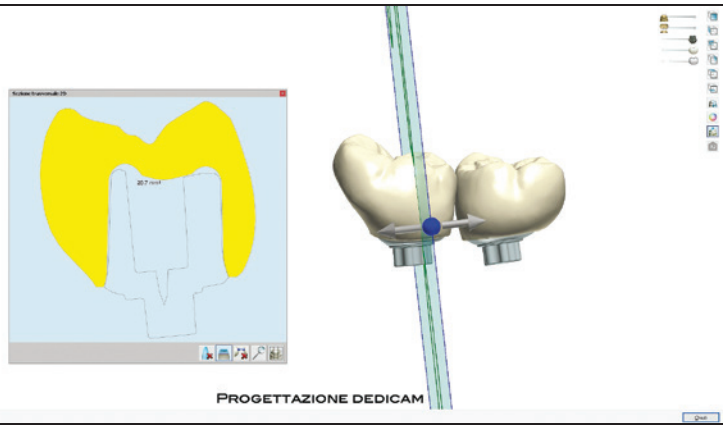
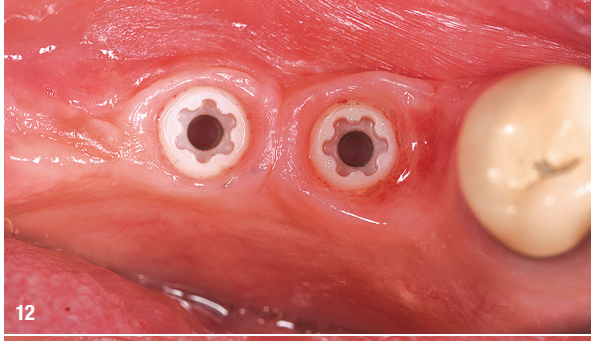


Fig. 8: Same view from another angle that amplifies the view of crowns and abutments. The Dedicam milling centre is able to make products by confirming the abutment connections in accordance with the parent company's protocols. **Fig. 9:** Full view of the abutments; note the framework beyond the connection that highlights the anatomical shape of the abutment base. **Fig. 10:** This detail relates the through-hole to the anatomy of 37, while the image on the left, in addition to a numerical reference value, shows the part of the crown and abutment. **Fig. 11:** Same image, only dedicated to 36, the numerical value shows a larger crown.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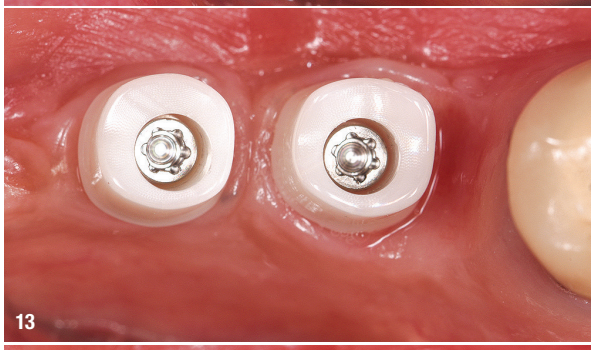
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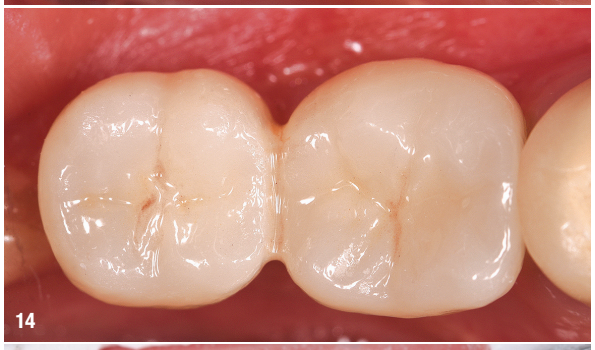
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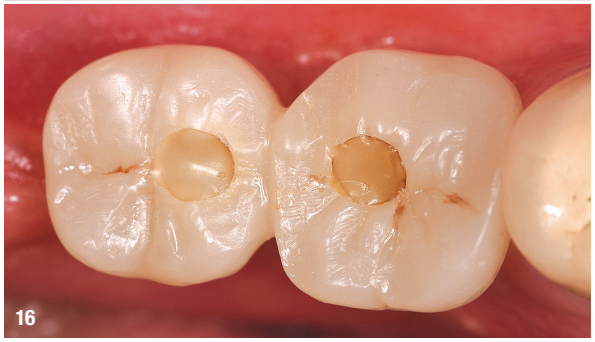
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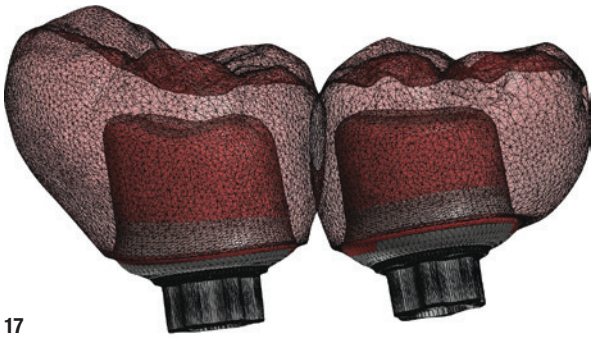
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Fig. 12: From this image, it is possible to compare the gain of keratinised tissue surrounding the implant collar. You can also see the optimal tissue health which is typical of zirconia implants. **Fig. 13:** The designed and fabricated abutments are placed on the implants and stabilised with a 15 Ncm torque. The abutments were supplied with titanium fixation screws. **Fig. 14:** The crowns were housed and cemented using temporary resin cement so as to be able to act over time if necessary. High precision between structures requires special care during the cementation phase because of the thickness that could prevent them from fitting perfectly, resulting in inaccuracies in occlusal contact points and possible residues in the borderline areas of the abutments, which are often in the aesthetic submucosa area. In this case, we prefer to insert refractory threads that are removed after cementation, limiting the inconvenience of residual cement. **Fig. 15:** Fabrication of a screw-retained, bonded provisional restoration. Given the available space, conventional modelling of two molar elements is preferred. **Fig. 16:** Positioning involves screwing in the through screws and sealing the holes with composite. **Fig. 17:** Digitally modelling the crowns also involves making abutments by subtraction, depending on the material that will be used for the final crowns and abutments.

by drilling (CERALOG, BioHorizons Camlog; Fig. 4). Ceramic injection moulding (CIM) results in an implant whose geometrical and surface structure was created in a mould prior to sintering and hot isostatic pressing (HIP). The variable geometry, smooth on the collar and rough in the endosseous area, optimises soft tissue healing and bone integration. The internal corner-less connection (Hexalobe) also promotes abutment passivation within the implant, improving the fixation action of the screw for better torque transmission to a ceramic implant (Fig. 5). Positioning took place according to the assisted guided surgery technique. Although it could be performed following the flapless technique, we preferred to elevate a flap in order to better condition the tissues around the implant collar due to the initial peculiarity of the tissues present and to exaggerate their transformation after healing (Fig. 6). After a healing period of three months, we took the first impression to make a screw-retained provisional restoration held for two months. Only after a new radiographic finding, we made the final structure following a new impression to establish the exact shape of the conditioned tissue. In both cases, the impression was made in a comparable way based on the use of silicone, with a generic tray. To date, the further changes made to the systems have made it possible for this step to be digitised as well, streamlining some procedures (Fig. 7).

After developing the impression, the dental technician digitally acquired data in the laboratory that enabled the underlying elements and abutments to be modelled. The final anatomical design of the crowns is produced by taking the chewing function as a basis, performed by subtracting from the anatomy of the underlying abutments (Figs. 8–11). The material used determines the variability of the thickness present in the residual spaces, emphasising an aesthetic, resistant result. The shape of the

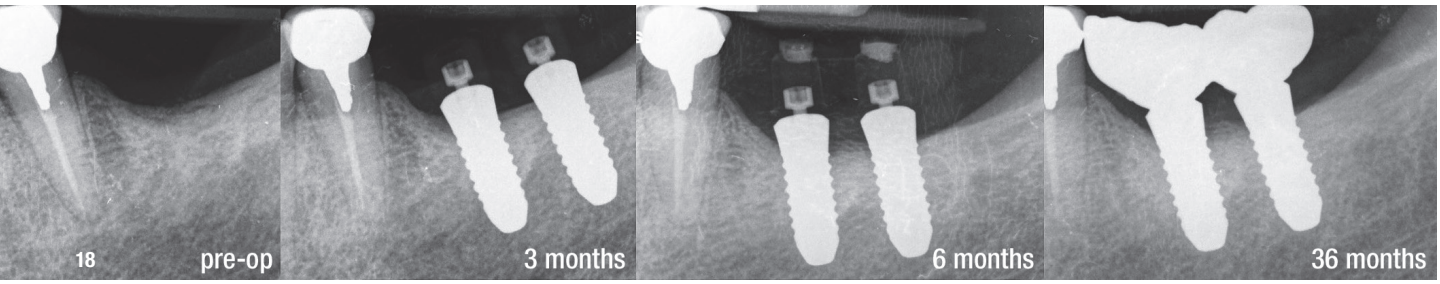

Fig. 18: In addition to CBCT, we always produce intraoral images with a centring machine, so that we can evaluate the changes that will be generated over time; more specifically, follow-up will be 36 months.

Tissue-Level implant allows the collar to be placed in a variable position while maintaining soft tissue stability without affecting the aesthetics of the prosthetic restoration (Fig. 12). Therefore, the entire prosthetic design must take into account the various factors that all contribute to final success (Figs. 13 & 14) and ensure easy long-term maintenance.

Conclusions

We can identify some aspects worthy of particular attention with regard to the use of zirconia implants and, in this specific clinical case, we evaluate them in both the surgical and prosthetic phases. Although worthy of particular attention, some features are typical of implant surgery and it is worth noting that:

- Surgical positioning should be performed using drills in excellent condition, at a low rpm and high torque, paying attention to cooling the surgical site;
- We believe that conditioning with provisionals for a reasonable period can also determine a preload of the implant that allows the implant to heal for a time period which is adequate for the anatomy and a little longer than usual, making it possible to improve bone trabeculation and full cortical maturation (Figs. 15 & 16);
- Analog impression copings are disposable and cannot be hot-sterilised. Their good retention makes it possible to detect correct insertion by engaging the Hexalobe connection (Fig. 7);
- In the phase of the provisional restoration, the screwed technique is undoubtedly the most versatile, making it possible for the provisional restoration to be removed while preserving the soft tissues;
- Today, the digital flow implemented enables a more widespread and versatile use, facilitating communication with the patient and speeding up some practices. Moreover, the clinician can simplify the surgical act using guided surgery;
- Another important element for the final result is making sure that dental technicians are adequately trained in handling such high-performance and technologically-advanced materials, knowing their limits and uses in order to optimise the result with Total Metal Free implantology (Fig. 17).

In this case, the connection of the elements required a change of engagement due to the peculiarity of the implant system. The same change is impractical in the final phase. Perhaps this is a limitation of the system that is still in development for the prosthetic component, aiming for a screwed, bonded solution. The three-year follow-up encourages the implant type to be more widely used, even though it is limited in terms of time and procedure (Fig. 18). In terms of aesthetics, the two-piece zirconia implant is an excellent alternative to conventional implantology with titanium implants. A recommendation to the surgeon is to only use zirconia implants after appropriate clinical training.

Acknowledgements: Thanks to Mr. Dario Viera, dental laboratory owner and dental technician who, with his technical skills and in-depth knowledge of materials, made obtaining the results described in this document possible.

Literature

about the author

Dr Riccardo Scaringi is a Professor of specialisation courses in dental implant prosthesis and digital support technologies, at various national universities. He is a frequently invited speaker at national congresses on topics related to surgical prosthetics. He is also an active member at the most prestigious international scientific associations in the field of technological and digital surgery. Scaringi is the author of various scientific publications and texts.

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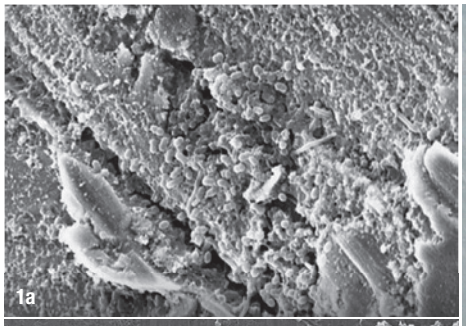
Dr Franco Giancola, Italy

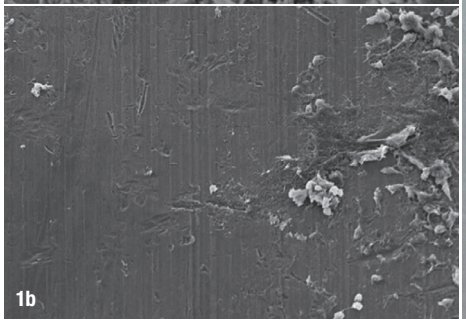
Ageing patients—risks and opportunities

Life expectancy in the world population is gradually increasing thanks to better living conditions, more widespread healthcare and greater economic resources. The ageing of the individual is accompanied by changes in some bodily functions, such as a decrease in sensory activities, flexibility, nutrition, blood circulation and cognitive abilities. Normal tissue involution, poor hygiene and insufficient care often lead to periodontal disease with tooth loss and bone atrophy, often aggravated by osteoporosis and concomitant systemic disease. The elderly patient, despite physiological decay, wishes to remain autonomous, be socially active and enjoy life. The management of the geriatric patient requires greater caution owing to the fragility of tissue and the often compromised metabolic functions, but it represents a great opportunity for modern dentistry. Elderly patients are more motivated to recover chewing and smiling because they allow them to stay young, be more independent, have a greater self-esteem and remain socially integrated. Dental implants have allowed elderly patients a better quality of life and greater independence. Unfortunately, traditional titanium implants bring with them pitfalls, as they favour the accumulation of bacterial plaque and the release of metal particles that lead to the onset of peri-implantitis, unaesthetic greyish gingival margins, loss of implants, unpleasant breath and debilitating systemic disease (chronic fatigue syndrome, allergies, fibromyalgia and metabolic decompensation).

Zirconia as a medical prescription

Zirconia, unlike titanium, has poor bacterial adhesion and fewer inflammatory phenomena; therefore, the breath is always pleasant and the gingival tissue well adhered to the implant collar. In elderly patients, mouth hygiene is easier and more effective in the presence of zirconia crowns and implants. The simple use of a toothbrush, implant brushes and rinses with mildly aggressive washes (grapefruit seed or calendula extracts), the mouth is always clean and healthy (Figs. 1a & b). Zirconia is osteoconductive and it allows calcium to deposit on its surface, thus favouring excellent implant osseointegration, and the calcium tends to consolidate over time even in the presence of osteoporosis (Fig. 2). Furthermore, zirconia is an inert material; it does not irritate the immune system and does not disturb the metabolism, which is often already compromised owing to the patient's age or systemic disease (Fig. 3). The new-generation zirconia implants now make it possible to rehabilitate any clinical situation with a fixed prosthesis. In the elderly patient, even if not self-sufficient, it is therefore possible to guarantee good oral hygiene and health and no pres-





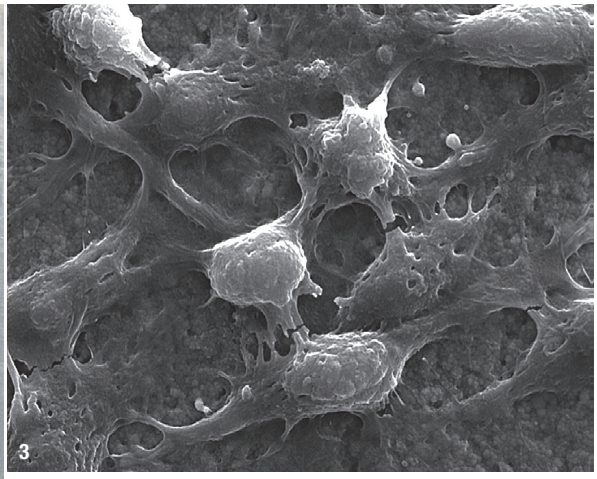


Fig. 1: Homogeneous layer of cocci and filamentous bacteria covering the surface of titanium **(a)**, a small number of bacteria on the surface of zirconia **(b)**.[1] **Fig. 2:** Bone-to-implant contact at eight weeks.[2] **Fig. 3:** Scanning electron microscope image of osteoblasts in culture on the surface of zirconia after 48 hours of incubation (5,000× magnification).[3]

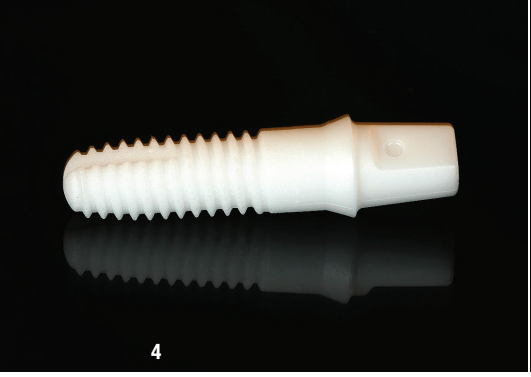


Fig. 4: Features of the standard ZiBone implant. **Fig. 5:** Features of the Zircasso implant. **Fig. 6:** Features of the ZBI Ceramica.

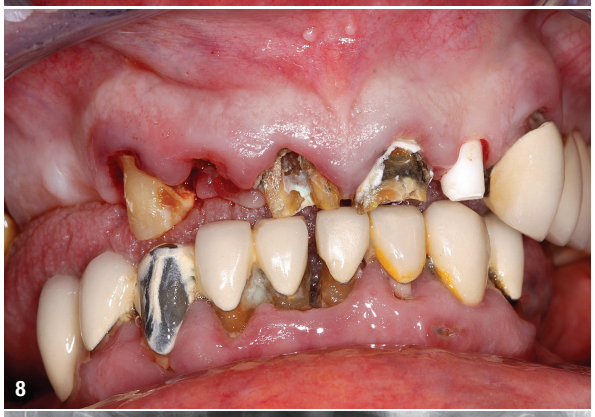
sure sores or accidental ingestion of removable prostheses. Any informed and conscientious dentist who wants to help their elderly patient to maintain or restore health should prescribe zirconia implants, as they are healthier and safer.

Biology-driven implantology

The approach to the elderly patient requires not only highly biocompatible and immune-compatible materials but also multidisciplinary management. First of all, it is necessary to analyse the sociocultural context and the expectations of the patient or of the family members who take care of him or her. It is advisable to know the general health conditions and diseases that the patient suffers from and, in agreement with the specialist, to provide for any precautions or changes to the therapeutic prescriptions. It must always be remembered that the elderly patient is more delicate, is more easily decompensated and has longer healing times; therefore, treatment must be less traumatic and must not require too much cooperation. Implant planning must be very accurate and include essential, fast and safe steps. It is desirable to prefer flapless techniques and placement of monobloc implants in areas of sufficient bone quantity and quality. Excessive trauma with lifting of mucosal flaps, delayed two-piece implant placement and complex techniques for bone augmentation could expose the patient to complications that are difficult to manage, such as bleeding, metabolic decompensation or bacterial infection.

One-piece ZiBone implants

The ZiBone implant system (COHO Biomedical Technology) has different types and sizes of one-piece implants, ideal for single-session rehabilitation of the alveolar ridge for elderly patients. The manufacturer produces three types of one-piece implants: the standard ZiBone implant, the Zircasso implant and the ZBI (Zirconia Bioactive Implant) Ceramica. The standard ZiBone implant is cylindrical in the coronal portion and conical at the apex, which has vertical grooves that act as a bone reserve (Fig. 4). The orientation of the threads allows easy screwing in of the implant without excessively damaging the surrounding bone. The Zircasso implant, marketed by Zircosol, has regular V-shaped coils and a pointed apex that favours screwing (Fig. 5). The implant is ideal for post-extraction positioning and immediate loading. The roughness and depressions of the surface of the fixture favour its osseointegration. The ZBI Ceramica, unlike the other two implants, was designed to be inserted by impact without screwing in in compliance with the bone microarchitecture (Fig. 6). The ZBI Ceramica has coronal protrusions for immediate mechanical retention and an



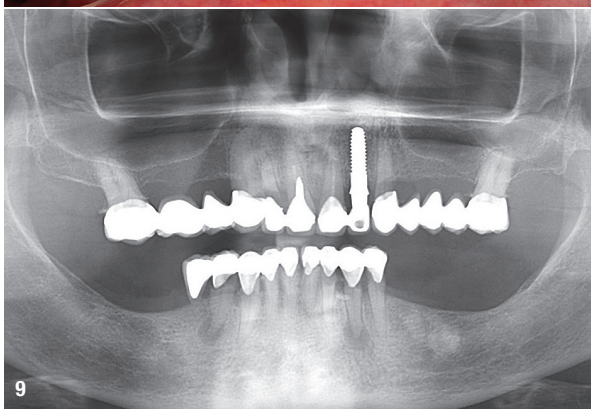
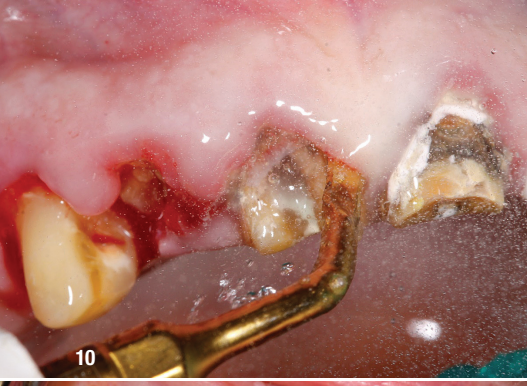
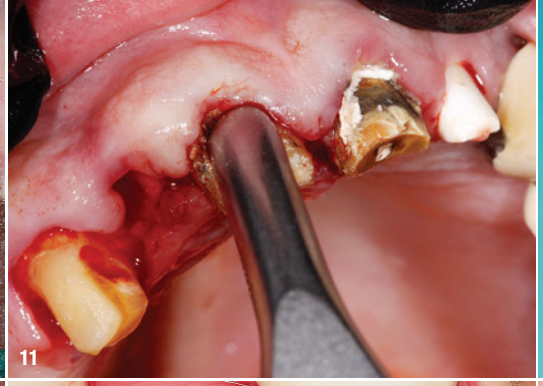
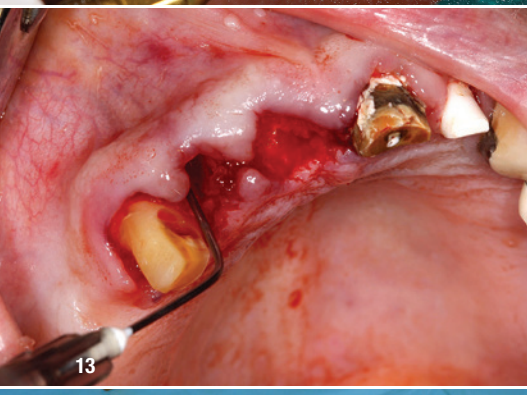
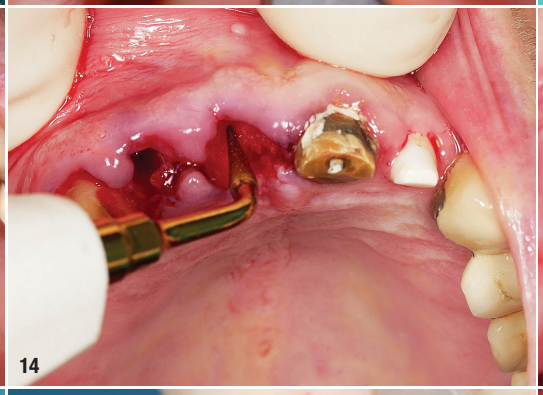


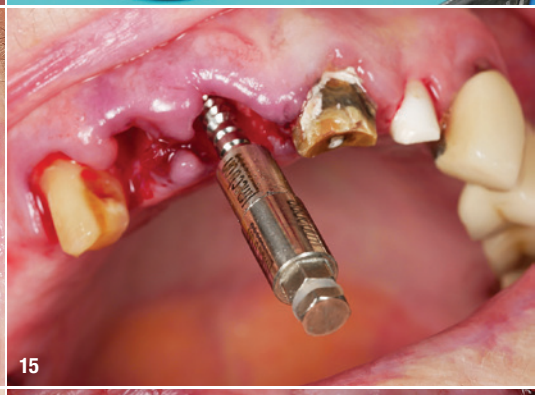
Fig. 7: Frontal view of the arches at the dental examination. **Fig. 8:** Clinical situation after removal of the prosthesis. **Fig. 9:** Dental radiograph four years after the placement of a zirconia implant (ZiBone; 4 × 14 mm).











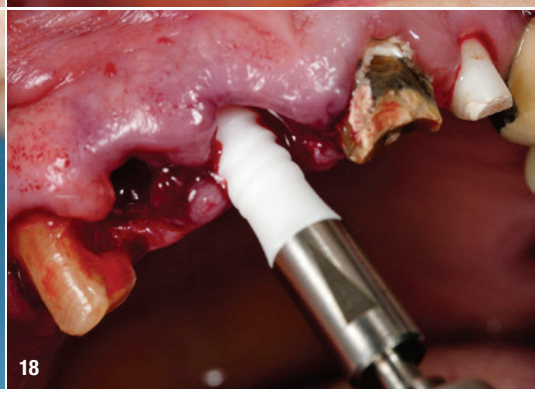


Fig. 10: Detachment of the dental root from the bone by means of a piezo-surgical technique. **Fig. 11:** Atraumatic tooth extraction. **Fig. 12:** Withdrawal of oxygen–ozone gas mixture (MEDICAL 99 IR, Multiossigen). **Fig. 13:** Disinfection of the extraction socket by local application of ozone. **Fig. 14:** Initial preparation of the implant site with a pointed diamond piezoelectric insert. **Fig. 15:** Screw for non-traumatic bone expansion before implant placement in region #11. **Fig. 16:** Surgical kit of the ZiBone implant system. **Fig. 17:** Zircasso implant mounted on automatic adapter. **Fig. 18:** Screwing in of the Zircasso implant.

apical through slot for better biological integration (secondary retention). The preparation of the implant site is performed with the piezoelectric technique (or zirconia burs with slow rotation and without irrigation) and the implant positioned with light taps with an osteotome and hammer. The ZBI Ceramica is ideal for the rehabilitation of the upper jaw in bone of D3 or D4 density according to the Misch classification, as is often found in elderly patients with osteoporosis.

Clinical case

The 88-year-old female patient, apparently in good health, presented owing to the appearance of mobility of the maxillary fixed prosthesis and discomfort in the area corresponding to the maxillary incisors. The removal of the prosthesis revealed a softening of the dentine of the affected teeth, and the examination of the radiograph showed periapical infection (Figs. 7–9). The patient, satisfied with the result obtained from the placement of a zirconia implant four years earlier, asked for removal and replacement of her damaged teeth with bioceramic implants. In consideration of the patient's advanced age, it was decided to perform atraumatic extraction of the affected teeth and immediate implant placement.

Dislocation of the tooth roots was performed with dedicated piezoelectric inserts (PIEZOSURGERY, Mectron) and appropriate forceps (Figs. 10 & 11). The extraction sockets were suitably cleaned with alveolar excavators and disinfected with local application of medical ozone at a concentration of 20 mg/ml (Figs. 12 & 13). The preparation of the implant sites was performed initially with a diamond piezoelectric insert and subsequently with different techniques depending on the implant to be placed (Fig. 14). For the socket of tooth #11, bone condensation was initially carried out using the Dr Sentineri's technique bone expander kit (Mectron; Fig. 15) and subsequently with slow screwing in of the Zircasso implant (4.1 × 10.0 mm; Figs. 16–18). For the socket of tooth #12, however, the preparation was carried out using slowly rotating zirconia burs (250 rpm) without irrigation and a ZBI Ceramica (4 × 9 mm; Figs. 19–24) was subsequently positioned using impact. At the end of the operation, the

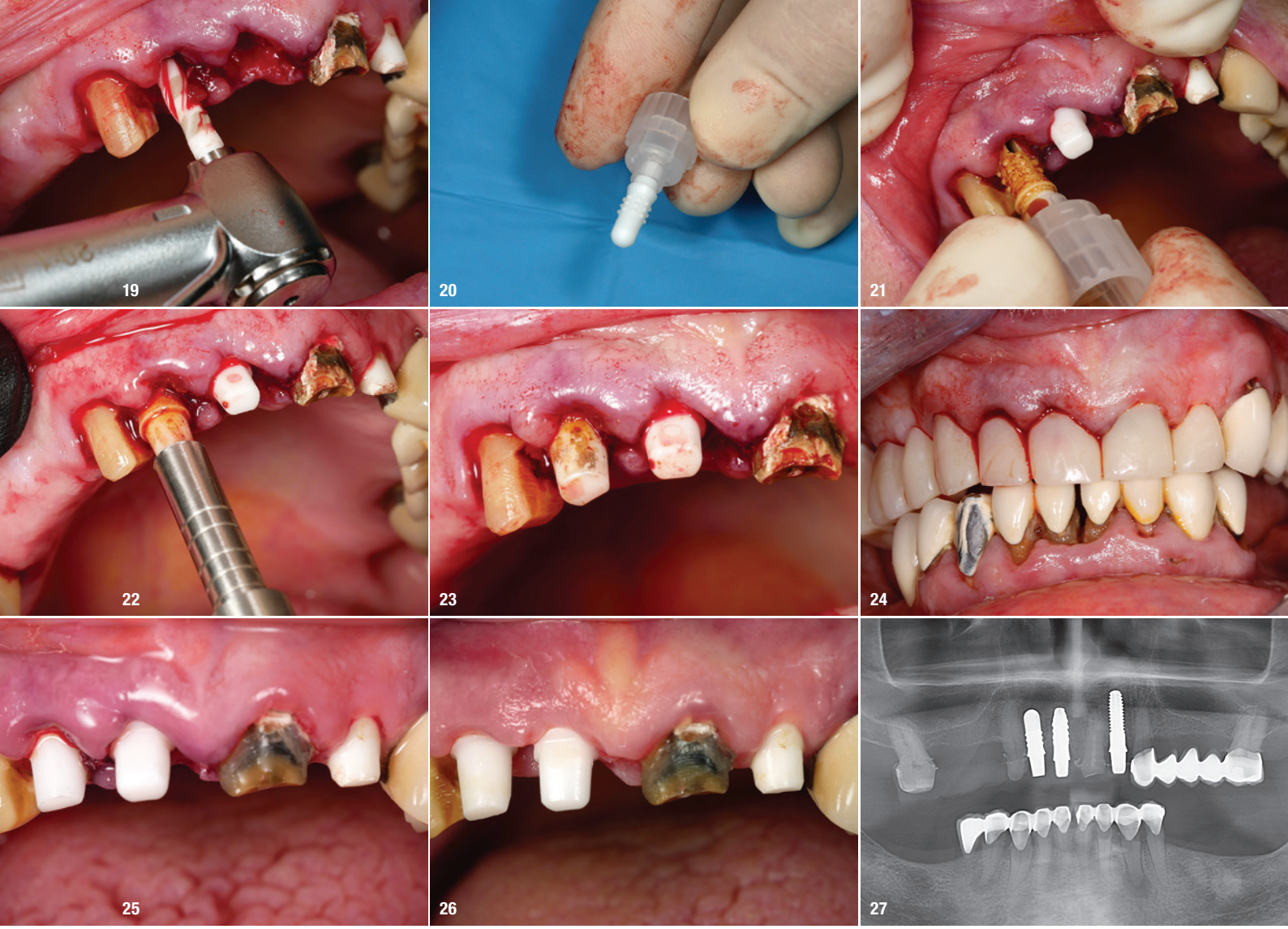


Fig. 19: Preparation of implant site #12 using zirconia burs. **Fig. 20:** ZBI (Zirconia Bioactive Implant) Ceramica. **Fig. 21:** Placement of the ZBI Ceramica into the prepared socket. **Fig. 22:** Compaction of the implant using an osteotome and hammer. **Fig. 23:** Final position of the implants. **Fig. 24:** Adaptation of the prosthesis immediately after surgery. **Fig. 25:** Clinical situation after one week. **Fig. 26:** Condition of the peri-implant tissue after two months. **Fig. 27:** Radiographic control of the implants.

implants were protected by means of a temporary resin prosthetic product previously prepared in the laboratory and relined in the office. At the check-up after seven days, the patient reported that she was very satisfied and had no pain, swelling or bleeding but only slight tenderness (Fig. 25).

Conclusion

Dentists are often afraid of treating elderly patients, as they often think that treating these patients might be riskier and that implant failure would be more likely to occur. However, clinical experiences show that, if elderly patients are managed well, treating them is rewarding and satisfying to dentist and patient alike. Monobloc zirconia implants (such as those of the ZiBone implant system) and minimally invasive techniques reduce intervention times and post-surgery discomfort significantly and lead to good periodontal integration and implant stability (Figs. 26 & 27).

Literature

about the author

Dr Franco Giancola is a Rome-based dentist who specialises in implantology. He organised the first Italian congress of ceramic implantology, held in Pescara, Italy, in 2016. He is also the director of the first International Master Class of Ceramic Implantology, which is set to take place in Rome in Italy at the beginning of next year. Dr Giancola is the author of the book *Impianti Ceramica: La Sfida Vincente*.

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Ceramic implants—where do we stand?

A scientific literature review

Dr Pooja Nair, Switzerland

Fig. 1: The Straumann® PURE Ceramic Implant System.

Dental implants made of titanium and titanium alloys are considered a gold standard in implant dentistry due to their exceptional mechanical properties and long-term clinical success.[1] However, the main drawback of a titanium implant is its dark grey colour, which may occasionally be visible through the peri-implant mucosa, hence influencing aesthetic outcomes, specifically in thin mucosal areas and anterior region. Therefore, a ceramic implant is turning out to be a more and more popular treatment option designed in anticipation of achieving a better aesthetic outcome.

What is ceramic/zirconia?

The entry of zirconia transformed the market as a promising material with good mechanical properties, high biocompatibility and excellent aesthetics, all of which encouraged researchers to investigate its possible use as a material for endosseous implants.[2] The one used in the production of dental implants is yttria(Y_2O_3)-stabilised tetragonal zirconia polycrystal (Y-TZP) which has proven to be an attractive metal-free alternative to titanium as it exhibits more significant corrosion and wear resistance, an excellent flexural strength[2–5] and furthermore, the compressive strength of zirconia implants is adequate in occlusion, and it can withstand occlusal loads for a more extended period.[6] Straumann® has established an innovative manufacturing process followed by a rigorous 100 % proof test in which every single implant from the Straumann® Implant System is tested mechanically before leaving the production site.

Is zirconia as good as titanium?

One of the most essential criteria for the success of implant treatment is osseointegration, which is the direct structural and functional interface between the living bone and surface of a load-bearing implant.[7] Bone apposition takes place on different types of implant surfaces and greatly depends on the implant surface topography. The highest level of bone-to-implant contact (BIC) is associated with moderately rough surfaces.[8] Therefore, it was crucial to obtain appropriate values of sur-

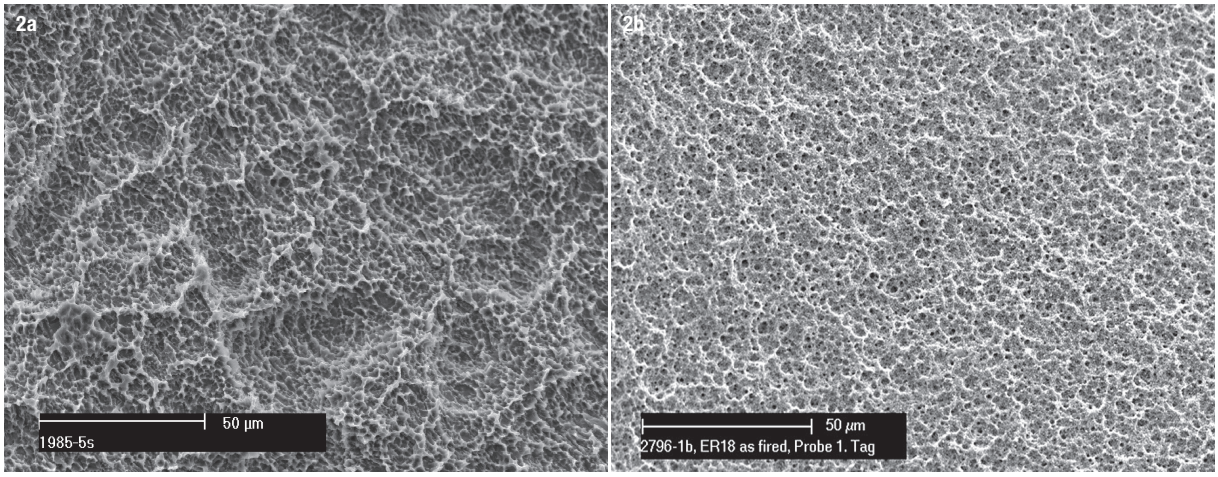

Fig. 2a: The SLA surface of Straumann titanium implants. **Fig. 2b:** The ZLA surface of the Straumann® PURE Ceramic Implant System.

face roughness on the zirconia implants. The surface of the Straumann® PURE Ceramic Implant System (ZLA®) is characterised by roughness values similar to those of Straumann implants with SLA® surface[9] widely known from optimal surface topography that enhances BIC and facilitates osseointegration.[10–15] In preclinical studies, ceramic implants with ZLA® surface demonstrated similar healing and osseointegration as observed for the SLA® surface.[16,17] Also, removal torque values were equivalent to titanium SLA® implants.[14] These reports were further confirmed by clinical investigations demonstrating survival rates of the monotype implants from 97.6 to 100 % after one year. These are values within the range of reported one-year survival and success rates for a titanium or titanium alloy implants.[18–21] A recent multi-centre study reported survival and success rates of 97.2 % after five years (manuscript in preparation).

Is it biocompatible?

The biocompatibility of an implant material depends on its chemical, physical, and structural properties that may influence the cell response at the tissue-material interface. Roughened Y-TZP was found to be an appropriate substrate for the proliferation and spreading of osteoblastic cells.[22] Zirconia did not exert a cytotoxic effect on osteoblasts in vitro and made the cells capable of growth and development.[23] When compared to titanium surfaces, the zirconia surface showed increased fibrinogen adsorption, platelet adhesion, activation, and thrombogenicity.[24] Studies on bacterial adhesion on the zirconia surface determined that plaque formation on this surface might be less.[25,26] Also, a significantly reduced three-species biofilm thickness, human biofilm mass, and human plaque thickness was seen in vitro when compared to SLA surfaces.[27] A higher degree of soft tissue integration around the ceramic implant than titanium was observed[28] and an ideal papilla-crown proportion around zirconia implants was reported in a 3-year follow-up study.[29]

What about aesthetics?

Most patients perceive treatment as successful when they are satisfied with the overall aesthetic appearance after the procedure. The Straumann PURE Ceramic Implant System is ivory-coloured, which resembles natural tooth roots which is an advantage in patients with a thinner mucosal biotype or a high lip line smile.[30–32] The review of peri-implant soft tissue colour suggested that the colour outcome might be influenced by both the implant and the abutment material. Ceramic components, when compared to metallic ones, appear to provide an improved colour matching between peri-implant soft tissues and soft tissues around natural teeth.[33] Excellent aesthetic outcomes and papilla formation around ceramic implants have been reported in several clinical studies,[20,21,31] even for challenging indications.

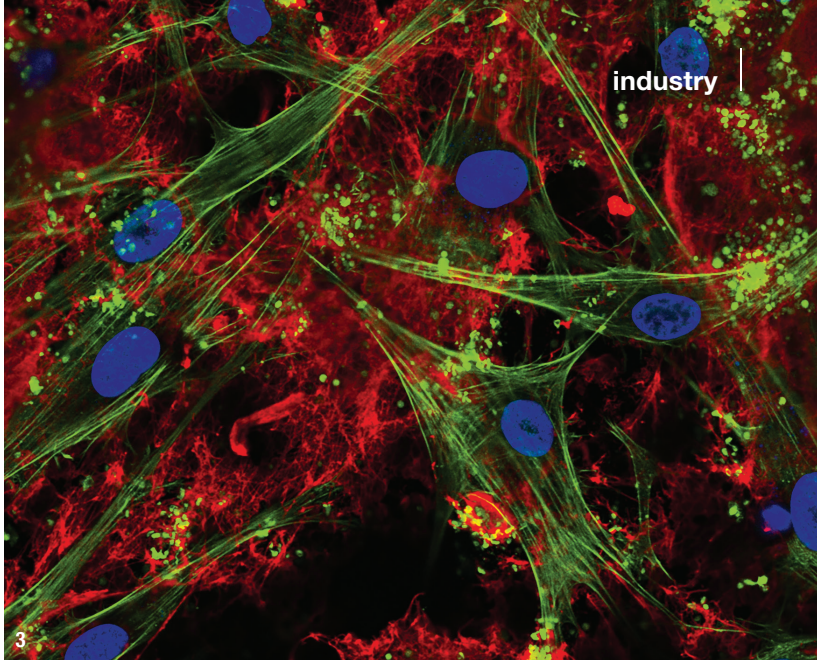

Fig. 3: Confocal laser scanning microscopy visualising seeded bone cells and pronounced fibrin network on the ZLA® surface after incubation in human whole blood. Fibrin network (red), actin cytoskele-ton (green), nuclei (blue). *Image courtesy: © Dr M. Rottmar*

Is it clinically proven?

Ceramic implants have rapidly demonstrated numerous benefits on par with titanium as an implant material in various clinical trials.[12,34,35] They have had FDA approval since 2007, and the ceramic material has been used to make dental implants in Europe since 1987. As the technology and methods have evolved with titanium implants and undeniably the field of dentistry overall, many amendments have also been executed to the concept of ceramic implants that have significantly improved their standard.[36] Ceramic implants become more and more popular treatment option, and the amount of published scientific evidence supporting their clinical application is continuously growing.[12,19,34] There is more than enough data to confirm the long-term sustainability of zirconia dental implants, even by conventional standards.[35] The Straumann® Ceramic Implant Systems are the result of more than 12 years of uncompromising research and development. They combine quality and precision, strength, clinical success, and flexible treatment protocols in an innovative solution that helps you to meet the needs of your patients. Moreover, the above discussed clinical evidence on excellent clinical performance confirms that ceramic implants can be considered a safe and predictable treatment alternative.

contact

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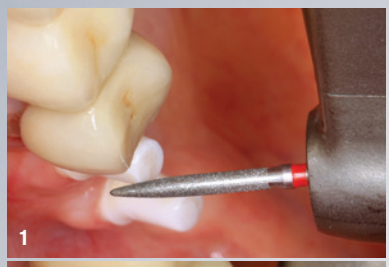
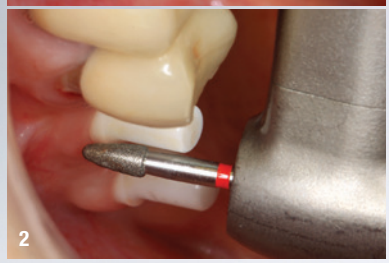
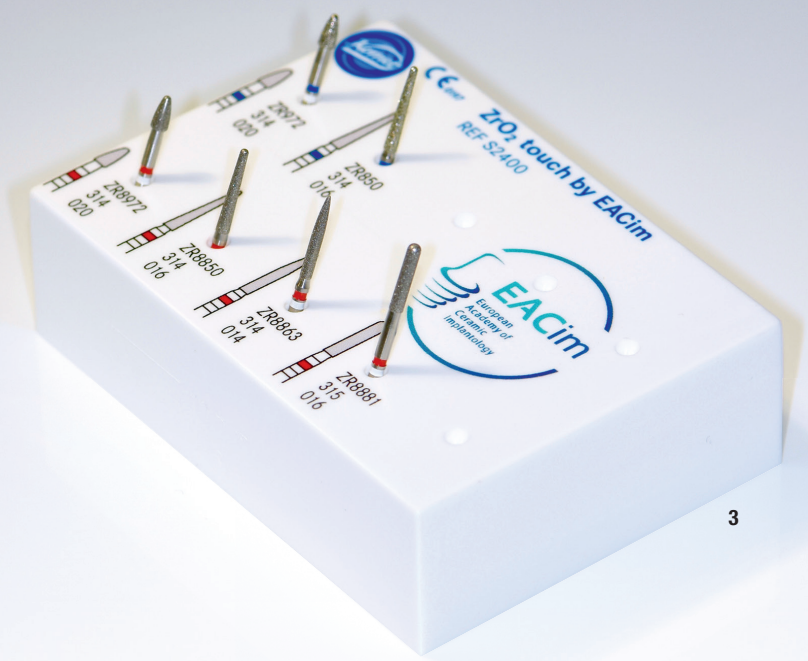
Literature







New ZrO_2 touch by EACim bur kit

Designed by EACim for EACim members

Dr Philippe Duchatelard, France

Zirconia is the hardest material used to make dental implants. Its 3D positioning when used in its monobloc form determines prosthetic success without impinging on biological requirements. It is common to have a vestibular edge of the shoulder corrected in order to avoid over-burial and follow the mucosal margin for aesthetics or a vestibular edge of the abutment to respect a more palatal or lingual insertion axis and spare the vestibular bone wall. These corrections must be limited in volume and time in order to avoid permanent damage to the zirconia and jeopardising of its mechanical strength by hindering crystallographic healing.

The new S2400 ZrO_2 touch by EACim bur kit from Komet, the leading manufacturer of dental burs, offers white-ringed burs specifically designed for working on all-ceramic restorations. The coating is made with a diamond grain concentration of more than 80% compared with conventional burs with a reinforced binder. This allows zirconia to be machined without generating sparks, reducing the formation of cracks or intergranular fissures to a minimum and optimising the cutting performance as a result. Users can choose between two types of granulometry: red (fine crystals of 46µ in size) and blue (medium crystals of 126µ in size). The bur with the red ring comes in four different shapes designed with a view to the usual clinical situations of retouching. Since the red-ringed burs will be used in the great majority of cases, they compose the first line of the kit. Technically, it is preferable to alternate between grit sizes to control the thickness of the corrections, given the performance of these burs and to avoid overheating. The kit includes two polishing options in both grit sizes, which allows the user to achieve a perfectly polished surface finish. It is recommended that the user work with the burs of the new kit at the optimal speed of 160,000 rpm, with low contact pressure (< 2 N) and under maximum spray coolant (minimum of 50 ml/min). There is no silicone polisher, in order to avoid any swarf pollution of the mucosa.

The photographs above show the ZR8863 (Fig. 1) and the ZR8972 (Fig. 2) burs in clinical application. The complete bur kit (Fig. 3) made by Komet is exclusively available to EACim members only.

contact

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France
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CLOSE TO NATURE

ZIRCONIA IMPLANTS

TAVDental
PRECISION. PASSION. PARTNERSHIP

www.tavdental.com

TAV Dental

State-of-the-art dental zirconia products

Zirconia healing caps, zirconia locators, multi-units with zirconia ring and last but not least zirconia implants are just some of the special products TAV Dental is manufacturing using the advanced ceramic injection technology. The passion behind developing zirconia products for dental implantology is to provide patients with products that are much healthier for their bodies along with the advantage of uncompromising aesthetic results. Zirconia products from TAV Dental are designed by a highly professional and dedicated team and manufactured using high-end ceramic injection moulding technology, resulting in state-of-the-art products to improve patient's quality of life. The vision of our team is to redefine—better than ever—the quality and the performance of dental zirconia products and to make our premium zirconia lines a global standard.

TAV Dental
Shlomi, Israel
www.tavdental.com

COHO Biomedical Technology

A total, functional and aesthetic solution

Dental treatment has entered an era of aesthetic functional restorations. With the ZiBone zirconia implant, ZiBone offers a metal-free implant system that meets the highest aesthetic demands. Zirconia is increasingly being used today as a suitable material for dental restorations for a variety of reasons: it has a natural white colour, it allows for great healing of the surrounding soft tissues and leads to excellent osseointegration, it convinces with outstanding biocompatibility, and it causes no allergic reactions. Zirconia allows doctors to treat their patients with a material that is superior to titanium in many ways. Furthermore, ZiBone has succeeded in making special improvements to the surface of the ZiBone implant based on years of clinical use and scientific evidence. As a professional manufacturer of zirconia products, ZiBone understands that a single zirconia implant cannot solve all issues. ZiBone therefore provides a line of zirconia instruments that help dentists to master complex surgeries and periods of postoperative care.

COHO Biomedical Technology CO., LTD.
No. 21 Dafeng Street, Luzhu District
Taoyuan County 338, Taiwan (R.O.C.)
www.zibone.com

COHO auf Seite 48
falls Z-Systems lang

Dentalpoint

Zeramex launches new products

In order to be able to provide optimum restoration of anterior teeth in the lower jaw and lateral incisors in the upper jaw, the Zeramex XT implant system portfolio now also includes implants with an endosseous diameter of 3.5 mm. The new Small Base (SB) implants are available in lengths of 8, 10 and 12 mm. In addition to the already familiar Regular and Wide Base platforms with endosseous diameters of 4.2 mm for the RB implant and 5.5 mm for the WB implant, these new products complete the Zeramex XT implant range. The SB implant system has also been expanded with the addition of new abutments. Zeramex Docklocs® Abutments are the first 100 % metal-free, reversible screw-in abutments for removable dentures. They are available in heights of 2, 3 and 4 mm. A smaller adhesive base is now available to further optimise the digital workflow. Like the existing Zerabase adhesive base, the new Zerabase X is available with and without abutment bases for single crowns or bridge restorations (engaging/non-engaging) as well as for all SB, RB and WB platforms. The new SB implants, Zeramex Docklocs® Abutments and the new Zerabase X adhesive base are all available now.

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8957 Spreitenbach, Switzerland
digitalsolutions@zeramex.com

SDS Swiss Dental Solutions

SDS1.2 and SDS2.2 ceramic implants launched in the US

The concept of Biological Dentistry with ceramic implants according to Dr Karl Ulrich Volz is the central component of the SWISS BIOHEALTH CONCEPT. Another major part of this concept—our ceramic implants—are now available in the US. Made in Switzerland, the new SDS implants SDS1.2 and SDS2.2 are now FDA-approved and available from our North American office. These new and continuously improved implants comprise all the little improvements and ideas of the last years, directly out of the SWISS BIOHEALTH CLINIC of Dr Volz in Switzerland and other SDS specialists in Europe. The SDS USA Inc. is located in Plymouth, MA, and offers clients the same level of service and expertise as in Europe. Our first four SDS user courses successfully took place in New York, Denver, Santa Monica and New Orleans. Other USA courses will follow soon. Additionally, SDS offers the monthly SDS user course with Dr Karl Ulrich Volz as well as other courses on Biological Dentistry and Biological Medicine in the SWISS BIOHEALTH EDUCATION Center. The dates for the 2021 SDS courses in the USA will be published shortly on www.swissdentalsolutions.us

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Plymouth, MA 02360, USA
www.swissdentalsolutions.us

Fotona

Peri-implantitis treatment with TwinLight

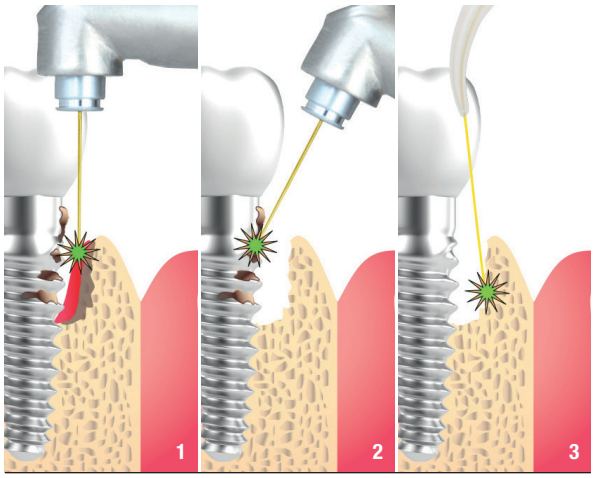


Fig. 1: Removal of the soft-granulation tissue and ablation of the infected bone with Er:YAG. **Fig. 2:** Removal of the bacterial biofilm on the implant surfaces with Er:YAG. **Fig. 3:** Bacterial reduction and biostimulation of the bone tissue with Nd:YAG.

Fotona's dual-wavelength LightWalker dental laser system is the ideal tool for effective minimally-invasive treatment of peri-implantitis. The system's TwinLight (Er:YAG and Nd:YAG) treatment option successfully addresses infection control, detoxification of implant surfaces, regeneration of lost tissues, and plaque-control regimens with no mechanical or chemical trauma, no danger of thermal damage to the surrounding bone and no significant alterations of the implant surface. First, the Er:YAG laser is used to remove microbial composition on the implant and to treat the damaged alveolar bone around the implant. Following Er:YAG treatment, the Nd:YAG laser wavelength is used for bacterial reduction and biostimulation. Inflammation, swelling, and bleeding of soft-tissue lesions, can be handled without surgery, and healthy peri-implant tissue assures greater long-term implant success.

Fotona d.o.o.
Stegne 7
1000 Ljubljana, Slovenia
www.fotona.com

CAMLOG

Natural aesthetics with the CERALOG® Implant System

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.

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

IDEAL CONNECTION
Hexalobe – the ideal implant–abutment connection for ceramic implants. The torque is transmitted tangentially to the implant, which allows a much higher torque compared to hexagonal connections, and also more rotational stability.

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

bredent medical

Highest primary stability—now with conical-parallel connection

The new copaSKY implant line from bredent is particularly distinguished by the stable and retrievable conical-parallel-walled interface, which enables easy removal of the prosthetics. The unique neck design and short implant–abutment connection also allows ultrashort implants. Due to the deposition of bone chips on the backtaper, a subcrestal implant position can also be selected. copaSKY uses the same surgical tray as all other SKY implants. And the enhanced prosthetic offering one connection that fits all diameters of implants, simplifying storage and reducing inventory. The material of choice is BioHPP, which provides a natural chewing sensation and built-in shock absorber effect to protect implants. Also new is the form-fit connection for bolted bridge components. The high accuracy of fit directs the lateral load directly onto the abutment, i.e. the risk of screw loosening and fractures is greatly reduced. The integrated angled screw channel provides excellent aesthetic results when transversally threaded.

bredent medical GmbH & Co. KG
Weißenhorner Straße 2
89250 Senden, Germany
www.bredent-implants.com

AD

evtl CIF

Straumann

The first step to harmonious soft tissue healing

The Straumann® Ceramic Healing Abutments offer favourable conditions for soft tissue attachment due to the zirconia, with blood circulations similar to that around a natural tooth[1,2] and a more mature and pronounced soft tissue integration than with conventional materials.[3–7] Their well-proven zirconia material also helps surgeons and prosthodontists looking for less plaque attachment due to the smoother surface compared to titanium,[2,3,8,9] and supports soft tissue healing from the day of surgery. In a nutshell, the first ceramic healing abutment in Straumann history offers clinicians the opportunity to have a complete ceramic prosthetic workflow using the ceramic abutment for the healing phase and Straumann cares ceramic options for the final restauration; achieving health, function and aesthetics from the day of surgery.

Note: References can be found on www.straumann.com/ceramic-healing-abutments.html

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

COHO hier hin (siehe rechts) falls Z-Systems zu lang für diesen Spot

TBR Dental

Acquisition opens new perspectives in Spain

Driven by the development of the Z1 Tissue Level implant and the Index digital workflow, TBR Dental integrates SAS Exclusivas Dentales, S.L. into its group and consolidates its long-term presence in Spain. Based in Valencia and with more than 30 years of experience in the Spanish market, SAS Exclusivas Dentales supports dental professionals in their search for technical excellence through a practical and local approach. The company's portfolio offers specialised and innovative products with a perfect knowledge of the needs of the dental community. "We are pleased to welcome Sally Bustos and Sergio Aldazosa, directors of SAS Exclusivas Dentales, to the TBR Dental Group. Their involvement, their experience and the dynamism of their talented team have enabled SAS Exclusivas Dentales to become an important player in the Spanish dental market", explains Julien Benhamou, CEO of TBR Dental. Today, TBR Dental and SAS Exclusivas Dentales are pushing forward the deployment of unique and exclusive products in a Spanish market that is as dynamic as ever.

TBR Dental Group
24, impasse René Couzinet
31500 Toulouse, France
www.tbr.dental

EACim
European Academy of Ceramic Implantology

EACim congress \ April 17, 2021
Hotel Le Plaza \ Brussels

Theme: LARGE RECONSTRUCTION WITH CERAMIC IMPLANTS

Conferences in English with simultaneous translation into French

WITH THE PARTICIPATION OF:

Pr. Eric Rompen | Dr. Rouven Wagner | Dr. Paul Petrungaro | Dr. Andrea Enrico Borgonovo | Dr. Sammy Noumbissi | Pr. Marcel Wainwright | Dr. Saurabh Gupta

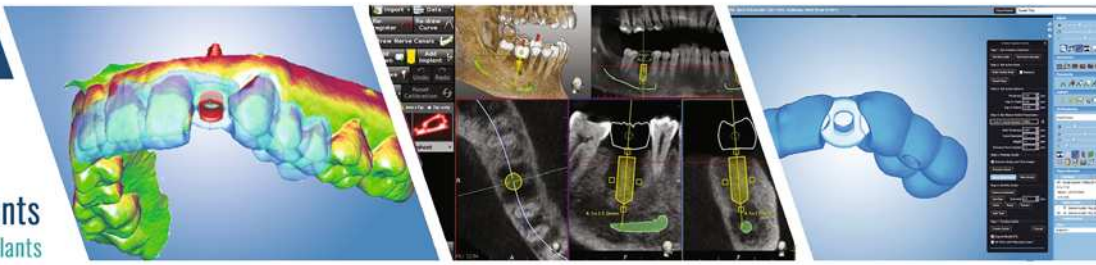
Pr. ERIC ROMPEN \ Respective places of ceramic and metallic implants in a global oral rehabilitation practice in 2021 \
Dr ROUVEN WAGNER \ Complex prosthetic restorations with the ceralog system \
Dr PAUL PETRUNGARO \ Achieving Natural Soft Tissue Esthetics utilizing Zirconia Implants for Immediate Restoration Procedures In the Esthetic Zone \
Dr ANDREA ENRICO BORGONOVO \ Use of Ceramic dental implants in oral rehabilitation: clinical and experimental results with 14 years follow-up \
Pr. MARCEL WAINWRIGHT \ Predictable, reliable and biological solutions with ceramic implants \
Dr SAURABH GUPTA \ Digital Workflow in Zirconia Implant Dentistry: The Future Is Here \
Dr SAMMY NOUMBISSI \ Zirconia Ceramic Dental Implants are Here to Stay: Ten Years of Scientific and Clinical Observation \
Pr. CARLO MAIORANA \ Evolution of implantology. Future prospects and conclusions of the congress \

More information: **eacim-ceramic-implantology.com**

Workshop EACim 2021

April 16, 2021
16 avril 2021

Digital workflow and ceramic implants
guided versus navigated surgery with ceramic implants



An optional Workshop will be held the day before the congress, on april 16, 2021 in Brussels (from 2 pm until 5:30 pm).

HOTEL LE PLAZA \ Brussels
www.leplaza-brussels.be

ONLINE REGISTRATION

http://www.cosyn.eu/subscribe/index_eacim_EN.html

Information: info@cosyn.eu \ Phone: +32 477 41 32 98 or +32 9 222 7117

Dental implants rethought

Patent

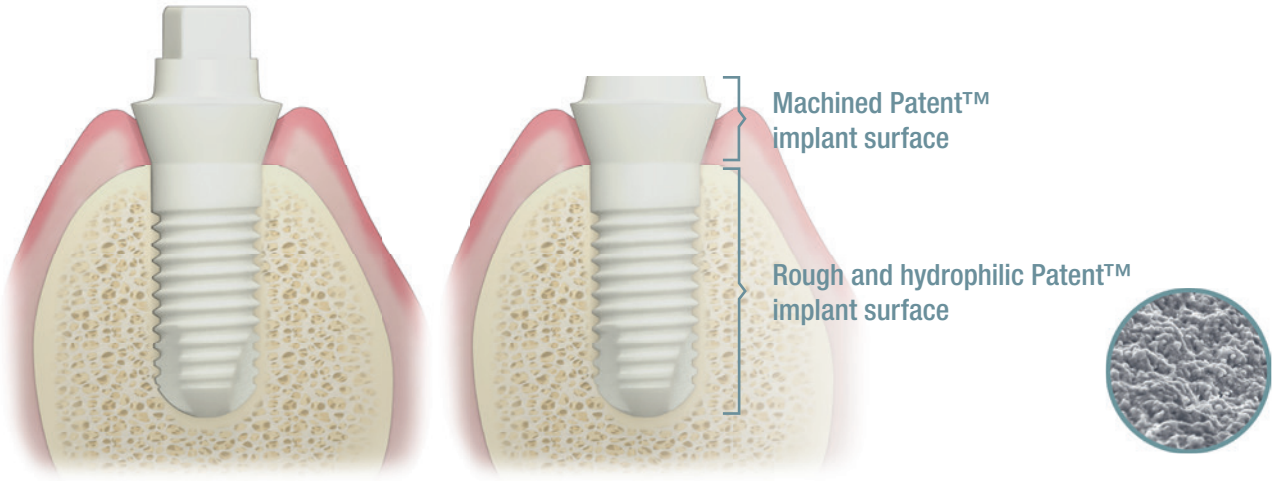
Available in both one- and two-piece configuration, the novel Patent™ dental implant system is based on the central idea that "less is more"—fewer surgical steps and no screws or other components that are not necessarily needed. In this interview, Frédéric Wehrli, Director of Product Management, reveals the details about the fully customisable ceramic implant system.

"You snooze, you lose" or "the last shall be first"—what applies more to you? Why are you only now entering the market again?
As the old saying goes, "timing is everything"—not missing the perfect time and being rewarded with the perfect thing in return is of utmost importance. As opposed to our competitors, the Patent™ dental implant system underwent a successful "proof of concept" and is now mature enough to be marketed. Furthermore, we believe that now is the perfect time to share this great technology with the industry and our patients. Today's patients demand sustainable well-being and we are the only ones able to guarantee this.

Ceramic implants still constitute a niche on the dental implant market. One of the main criticisms is that there is still a great lack of long-term clinical studies and scientific documentation. What's your take on that?
You are right in saying that ceramic implants still occupy a niche in the dental implant market. Yet even before the COVID-19 pandemic, one of the most important global trends in dentistry was the increasing desire of patients to improve their overall systemic health and well-being. As a direct consequence, patients are looking for "metal-free" alternatives. When it comes to research, Zircon Medical Management is a ceramic implant manufacturer that has dedicated its efforts to generating long-term, peer-reviewed clinical data. We want to make sure that we can provide solid evidence of success both to the dentists using our Patent™ dental implant system as well as to their patients.

Where is your implant system positioned?
Our Patent™ dental implant system represents the beginning of a new era for dental implants. We will continue to focus our efforts on relevant research and develop-

"Today's patients demand sustainable well-being and we are the only ones able to guarantee this."



ment in order to sustainably provide well-documented solutions for our clinicians and our patients in the long term. The two-piece Patent™ dental implant system is the only commercially available system with published long-term clinical studies for this specific implant design (according to Röhling et al.) that show successful results.

What's the backstory of your company?
The idea for our Patent™ dental implant system (formerly ZV3) was born 18 years ago. In 2006 we received CE certification and the manufacturing process was patented. In 2009 we introduced the two-piece implant. In 2014 a retrospective study of the University of Groningen in the Netherlands with our one- and two-piece implants was published. This was followed by the publication of a prospective study in 2017 by the University of Düsseldorf conducted over the course of two years with our two-piece implant system. As I mentioned earlier, this is the only prospective study available on two-piece ceramic implants. Both studies show success rates of over 96 per cent. We also have a large number of documented clinical cases, which are also peer-reviewed. Hence, today we can look back on a long history with a mature "proof of concept" and more than 10,000 placed implants.

What sets your system apart?
Our system has several striking features that our customers benefit from. The entire implant system is reduced to the minimum in order to reach its maximum potential. The initial investment for users is relatively low because, since only a few instruments are required and there is no need for additional implant components. The implant design concept is biomimetic and therefore our customers do not require additional training, which helps to reduce actual chair times and the overall number of treatment visits. We also have a patented manufacturing process by which we are able to manufacture ultra-strong, hydrophilic implants. We believe that these are the reasons why there is such a great deal of documented success in our long-term studies.

For which indications is your system suitable?
With Patent™ you can treat all restorative conditions such as single crowns, bridges, telescopic reconstructions and bar constructions. This offers the restorative dentist a vast spectrum and a high degree of flexibility without having to invest heavily in prefabricated components and instruments.

There is a growing trend that dentistry plays a crucial part in the general and systemic health of patients. What's the significance of ceramic implantology in this context?
Most clinicians have known for some time now that there is a direct link between oral health and general, systemic health and well-being. Technological and medical advances have made it possible to prolong and improve life and, as a result, the "older" part of the world's population is growing rapidly. These people demand a better and more vital quality of life. Today, many patients reject older technologies and lean towards "metal-free" solutions instead. Ceramic implantology can meet these demands.

Your system appears to be quite sophisticated and well-documented. Where and how can potential users get to know it?
Thank you very much. We are very proud of our history and scientific heritage. We will continue to build on our success and provide even more solutions in the future. We invite all dentists and dental technicians to learn more about us at www.mypatent.com. There you will find an abundance of information on our products and how you can reach us.

Thank you for the conversation, Mr. Wehrli.

contact

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Laser-assisted prophylaxis around zirconia implants

France-based dentist Dr Fabrice Baudot has specialised in periodontics, laser-assisted surgery and implant dentistry and has a particular interest in zirconia implants. In this interview with *laser*, Dr Fabrice Baudot, founding member and scientific leader of the European Academy of Ceramic Implantology (EACim), explains why dental lasers have become an essential part of his daily practice and sheds light on the clinical benefits of combining laser-assisted surgery and ceramic implantology.

Peri-implantitis is an increasing problem today. It is especially associated with titanium implants. What treatment benefits does the laser offer in this context?
Indeed, peri-implantitis is a real scourge for which we do not yet have good therapeutic solutions. Dr Stefan Renvert said in his 2012 book, "As in all pathologies, the best form of treatment is very often prevention and peri-implantitis is no exception."[1] From this point of view, the Er:YAG laser can provide us with certain solutions for the daily practice. The cause of peri-implantitis might be multifactorial, but the microbiological aspect and the contamination of implant surfaces by biofilms seems to be a key point. With its well-demonstrated bactericidal properties, the Er:YAG laser is an excellent complementary instrument to conventional instrumentation for regulating the development of biofilm around implants and cleaning contaminated implant surfaces.

> "Indeed, peri-implantitis is a real scourge for which we do not yet have good therapeutic solutions."

When it comes to oral surgeries, we usually exploit the photo-ablative effects of the Er:YAG laser, which are used for the micro-ablative cleaning of implant surfaces and the removal of inflammatory tissue, and which allow us to clean so-called peri-implant wounds. If we compare the Er:YAG laser to air polishers, which appear to be the reference for cleaning implant surfaces, the Er:YAG laser shows similar results on rough titanium surfaces, but without leaving powder debris on the surgical site. It can be argued that it is as effective and at the same time cleaner than conventional instruments. As opposed to other lasers, the Er:YAG laser is the only laser that can safely treat hard and soft tissue simultaneously without generating uncontrolled thermal effects. It can particularly be used on bone without the risk of thermal damage and even in confined spaces, as is often the case in dental implantology. In peri-implant maintenance, we exploit the photoacoustic effects, leading to an emulsifying of biofilm without altering the delicate tissue–implant interface. The shock waves generated by Er:YAG radiation with a wavelength of 2,940 nm cause a 3D expansion of the irrigation solution, and the agitation effect of the solution destabilises the biofilm in a way well beyond what conventional instrumentation is able to achieve. These repeated preventive measures which are tailored to the patient's individual physiology make it possible to maintain peri-implant homoeostasis without altering the surrounding tissue environment. The treatment protocols are very simple to follow and clinical application only takes a few minutes.

Ceramic implants are not particularly associated with peri-implant inflammation. Are there useful laser applications designed for ceramic implants too? What is possible and what isn't?
I use the Er:YAG laser for peri-implant maintenance on a daily basis. This concept of clinical application is based on the emulsion of biofilm that develops around the transgingival part of implant restorations and even beyond, in cases of peri-implantitis. A 1997 article by Dr Kenneth S. Kornman made me realise the importance of exposing

pathogens to defence systems to preserve periodontal and peri-implant homoeostasis.[2] The Er:YAG laser and its photoacoustic effects enable the meeting between the pathogenic agents and the immune defence system, as explained by Kornman in his article. In an excellent journal article, Belgium-based Prof. Eric Rompen elaborated on the importance of implant materials regarding the nature of tissue attachment.[3] Only titanium and zirconia allow hemidesmosome attachment, creating a kind of barrier against biofilm. Other materials used for transgingival connections, such as gold or fired ceramics, do not favour attachment. A real pocket is formed around this type of connection, which can pose a risk factor for the development of peri-implantitis. Deep laser-assisted peri-implant maintenance is particularly indicated around gold or UCLA-type fired ceramic connections.

> "I use the Er:YAG laser for peri-implant maintenance on a daily basis."

With zirconia and titanium connections, the attachment is of better quality and the use of the Er:YAG laser is less justified when it comes to maintenance. When treating established peri-implantitis, the Er:YAG laser with its micro-ablative properties makes, in my opinion, a real difference compared with conventional instrumentation. It disinfects the treated sites without altering the adjacent surrounding tissue. Numerous studies have shown its safety on titanium, but there are, as far as I know, very few studies showing the effects of the Er:YAG laser on zirconia implants. I have only *in vitro* experience under an operating microscope of the use of the Er:YAG laser on zirconia implant surfaces (Z-Systems and CERALOG) because I have not had to deal with any cases of peri-implantitis around these implants. According to my observations, the implant surface of zirconia implants appears to be completely inert to Er:YAG radiation and reacts much less than titanium. The organic materials which are present on a ceramic implant surface are literally vaporised owing to the micro-ablative effect of the Er:YAG laser, leaving a perfectly clean and visibly unaltered surface as a result. It therefore appears that the Er:YAG laser is very effective in cleaning ceramic implants.

Are there any material-specific factors that need to be particularly considered when treating ceramics with lasers?

In my opinion, the only laser that is truly effective and safe in peri-implant spaces is the Er:YAG laser. As has been done for titanium implants, the effects of laser radiation should be tested at different power levels, under different circumstances and for different exposure times. Micro-ablative effects on zirconia should be observed by means of a scanning electron microscope (SEM) and possible surface alterations, especially in the microtexture, should be evaluated. One thing that seems fundamental to me is the aspect of the thermal rise of zirconia under the effect of Er:YAG radiation. There is only one *in vitro* SEM study, which evaluates the effect of radiation from three different lasers on zirconia.[4] The carbon dioxide laser seems to alter the surface of zirconia, and the Er:YAG laser penetrates the surface of zirconia. The diode laser appears to be more suitable, but this study has not been confirmed yet by other studies. The clinical application of the diode laser seems to me, when looking at it *in vitro*, much more problematic than the Er:YAG laser, especially in areas close to the bone as is systematically the case in implantology. The risk of collateral thermal effects especially on the bone is of major concern with diode laser radiation.

Alterations of the implant surface under the effect of laser radiation appear to occur only at powers well beyond those effective in destroying biofilm and organic material. Owing to its peak water absorption, the wavelength at 2,940 nm of the Er:YAG laser is effective at the lowest energy levels and therefore cannot, in clinical use, significantly alter the implant surface. The important thing is to be able to manipulate Er:YAG radiation under visual control at high magnification to optimise power settings at the lowest effective energy levels and at tangential incidence to the surface to limit the concentration of energy transmitted to the implant support and thus limit the potential effects of the radiation on the implant surface to be treated. The clinical experience and mode of use of the laser is fundamental and deserves to be widely studied to confirm the safe clinical efficacy of lasers on zirconia implant surfaces.

Literature

about the interviewee

Dr Fabrice Baudot is a French dentist specialised in periodontics and implantology. He currently leads a practice that is specialised in laser-assisted microsurgery. His therapeutic approach is always based on minimally invasive surgery. Dr Baudot is frequently invited to speak at international dental conferences, and he is the author of numerous scientific publications.

contact

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Interviewee details

Fig. 1: View into the meeting room, where the autumn conference of the International Society of Metal Free Implantology was held on the last weekend of September. **Fig. 2:** At the members' meeting of the International Society of Metal Free Implantology, Dr Karl Ulrich Volz (left) was elected as the new president of the expert society. He takes over from Dr Dominik Nischwitz (right), who will serve as vice president from now on.

Foundations for the future laid at members' meeting of ISMI

Jürgen Isbaner, Germany

Owing to the travel and other restrictions that have arisen from the COVID-19 pandemic, the annual meeting of the International Society of Metal Free Implantology (ISMI), originally scheduled to take place in May in Berlin in Germany, was postponed, and with it also the regularly held members' meeting. On the last weekend of September, however, an autumn conference of ISMI was organised in the Swiss Biohealth Clinic in Kreuzlingen in Switzerland, and within this context, the postponed members' meeting took place.

At that meeting, the expert society took the opportunity to reposition itself. The managing board of ISMI highlighted the most recent positive developments of the society and the many contributing factors, among them stable membership growth, attractive continuing education offerings and effective efforts in public relations. In addition to the novel challenges that followed the establishment period of ISMI, the members' meeting was concerned with staffing matters and developing broader strategies for the future. Besides the clinical experiences of practitioners, ISMI is aiming to place a stronger focus on the scientific research on the use of ceramic implants. For this reason, it has granted € 10,000 towards funding of a scientific study. The managing board of ISMI and the newly formed board of directors, under the direction of Frankfurt am Main-based Prof. Shahram Ghanaati, will be planning and executing this project. Additionally, it was discussed how membership of the professional association as well as the topic of ceramic implantology in general can be made more attractive, particularly to younger generations. How this can be achieved will also be the topic of discussion in future ISMI board meetings.

With its newly expanded leadership team, ISMI feels confident and well prepared for the tasks that lie ahead. After the successful autumn conference, which is planned to be an annual event from now on, attention is now being directed towards preparation for the annual meeting of ISMI, which is set to take place on 7 and 8 May 2021 in Düsseldorf in Germany.

The new management of ISMI is composed of Dr Karl Ulrich Volz as president and Dr Dominik Nischwitz as vice president. Additionally, the board of directors is composed of Prof. Ghanaati, Dr Johann Lechner, Dr Benjamin Roth and Dr Tobias Wilck. For more information, visit **www.ismi.me**

contact

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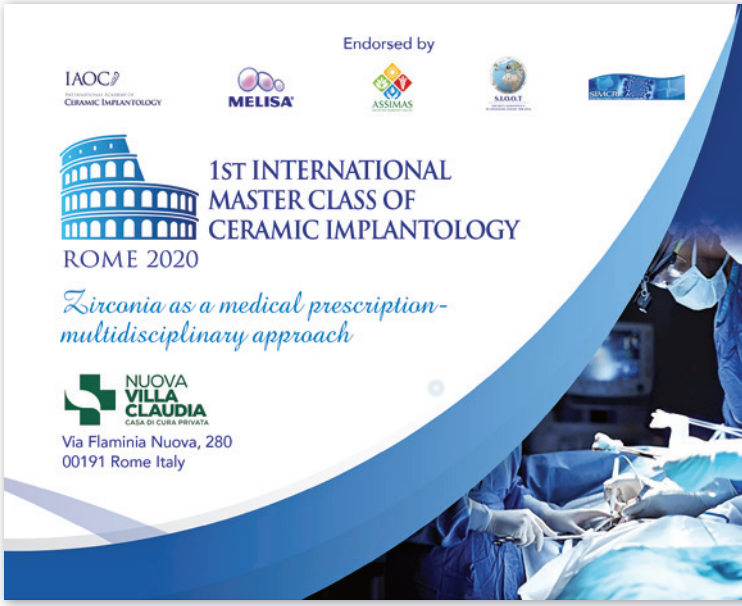
1st International

Master Class of Ceramic Implantology

In late December of 2020, the first of several training events of the 1st International Master Class of Ceramic Implantology will be held at the New Villa Claudia polyclinic in Rome in Italy. Three further training courses will follow in January and February of next year. Dr Franco Giancola will helm the event as scientific director. In the four training courses, various important aspects of ceramic implantology will be discussed. Different ceramic implant systems will be compared, zirconia within the context of regenerative medicine will be discussed, the topic of minimally invasive implantology will be covered and prosthetic possibilities with all-ceramic implants will be addressed. The overriding objective will be to further the awareness and understanding about the global increase in diseases related to metal hypersensitivity and to train dentists in the effective clinical application of bio-inert zirconia implant systems. Register for the event online at **www.zirconiamedical.eu**. For more information, contact info@ceramic-implantology.com



Source: COHO Biomedical Technology

ESCI is getting

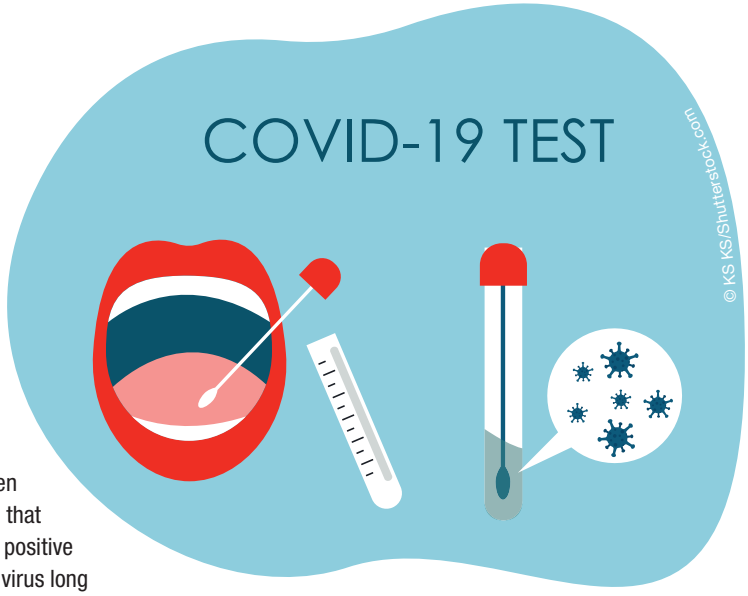
A new face

The European Society for Ceramic Implantology (ESCI) has appointed Dr Frank Maier (Germany) and Prof. Andre Chen (Portugal) as new members of its Board of Directors. It also welcomes the manufacturing companies TAV Dental, ZiBone, Metoxit and CeramTec as new industry partners. Moreover, since the professional association considers dental technicians the most important partners of dentists in the care of patients with ceramic implants, dental technology has been incorporated into ESCI as an independent "ESCI Division Dental Technician". Also, ESCI has developed the "ESCI Ambassador" programme and already installed first ambassadors in order to take individual regulations of different countries better into account. Furthermore, with its website **www.esci-online.com**, ESCI aims at establishing a Europe-wide and active community, generating added value for members, developing special content about ceramic implants and offering continuing education. The content featured on ESCI Online is created by ESCI members or provided by industry partners, and is published only after it has been reviewed by the Scientific Advisory Board. With an updated further training concept, ESCI members obtain in-depth knowledge on surgical techniques via face-to-face courses held in the ESCI training centres as well as extensive e-learning courses on the ESCI online platform. In cooperation with their educational partner Dental Campus, ESCI offers its members free access to more than 120 lectures, 60 clinical cases and over 680 surgical videos.

Source: European Society for Ceramic Implantology (ESCI)

Poor oral hygiene could affect

Accuracy of SARS-CoV-2 tests



A study conducted at a hospital in Tokyo has found that poor oral hygiene could lead to prolonged viral shedding in patients with COVID-19. The researchers evaluated the course of treatment of eight COVID-19 patients who were admitted to the Department of Neurology at Tokyo Metropolitan Neurological Hospital between 30 April and 14 May 2020. In the study, it was observed that patients with inadequate oral health regimes returned positive results in polymerase chain reaction (PCR) tests for the virus long after their clinical recovery, leading the researchers to believe that oral hygiene could affect the accuracy of testing for the virus. In response to the findings, the researchers are proposing that effective toothbrushing and gargling could improve the accuracy of COVID-19 testing and reduce the duration of hospital stays. The study, titled "Effects of oral care on prolonged viral shedding in coronavirus disease 2019 (COVID-19)", was published online on 24 July 2020 in *Special Care in Dentistry*, ahead of inclusion in an issue.

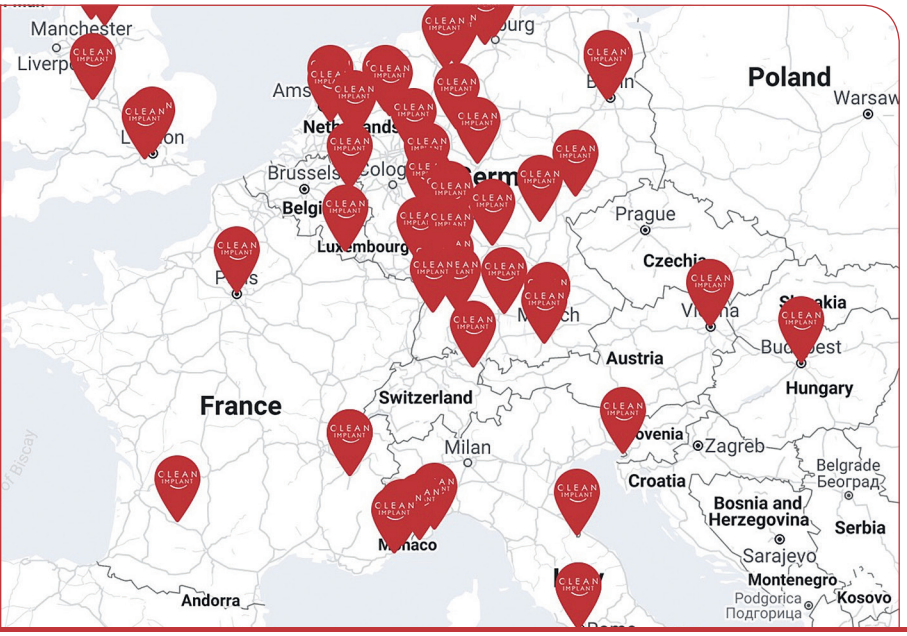
Source: Dental Tribune International

"CleanImplant Certified Dentists" in 19 countries

Initiative creates safety for implantologists and patients

For many years, CleanImplant has been performing quality assessment studies on sterile packaged implants in accredited testing laboratories. The "Trusted Quality" seal for clean implants can only be awarded after an independent evaluation of test results has successfully been completed in a strict peer-review process. "Alarming contamination on many other test samples should raise concerns for every practitioner," says Dirk Duddeck, dentist and founder of the non-profit CleanImplant Foundation. Study results show quite clearly that neither the exposed market position of manufacturers nor the country of production or the price alone can provide any certainty that the implants sold are actually clean. Significant residues of detergents, silicon compounds or polyacetal—even on ceramic implants—from the production and packaging process have been found on sterile packaged samples. "We've also seen metallic particles with nickel- or copper-containing compounds on dental implants. Implant quality seems to be getting out of hand—and we are no longer alone with this criticism. Three years ago, we launched an initiative for residue-free implants on the internet. We never dreamed that we would have almost 100,000 dental professionals following us on Facebook in such a short time". In the meantime, implantologists from 19 countries are registered as a "CleanImplant Certified Dentist". They can be sure that they only use implants that have been tested as clean. On the new website **www.cleanimplants4you.org**, launched as an information campaign directed at patients, a list of practices that have already joined the initiative can be found. For more information, go to **www.cleanimplant.org**.

Source: CleanImplant Foundation CIF GmbH



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50th DGZI International Annual Congress— Visions in Implantology

6–7 November 2020
Bremen, Germany
www.dgzi-jahreskongress.de

2nd EACim Congress

16–17 April 2021
Brussels, Belgium
www.eacim-ceramic-implantology.com

6th Annual Meeting of ISMI

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

10th IAOCI World Congress

20–22 May 2021
Las Vegas, NV, USA
www.iaoci.com/iaoci2021

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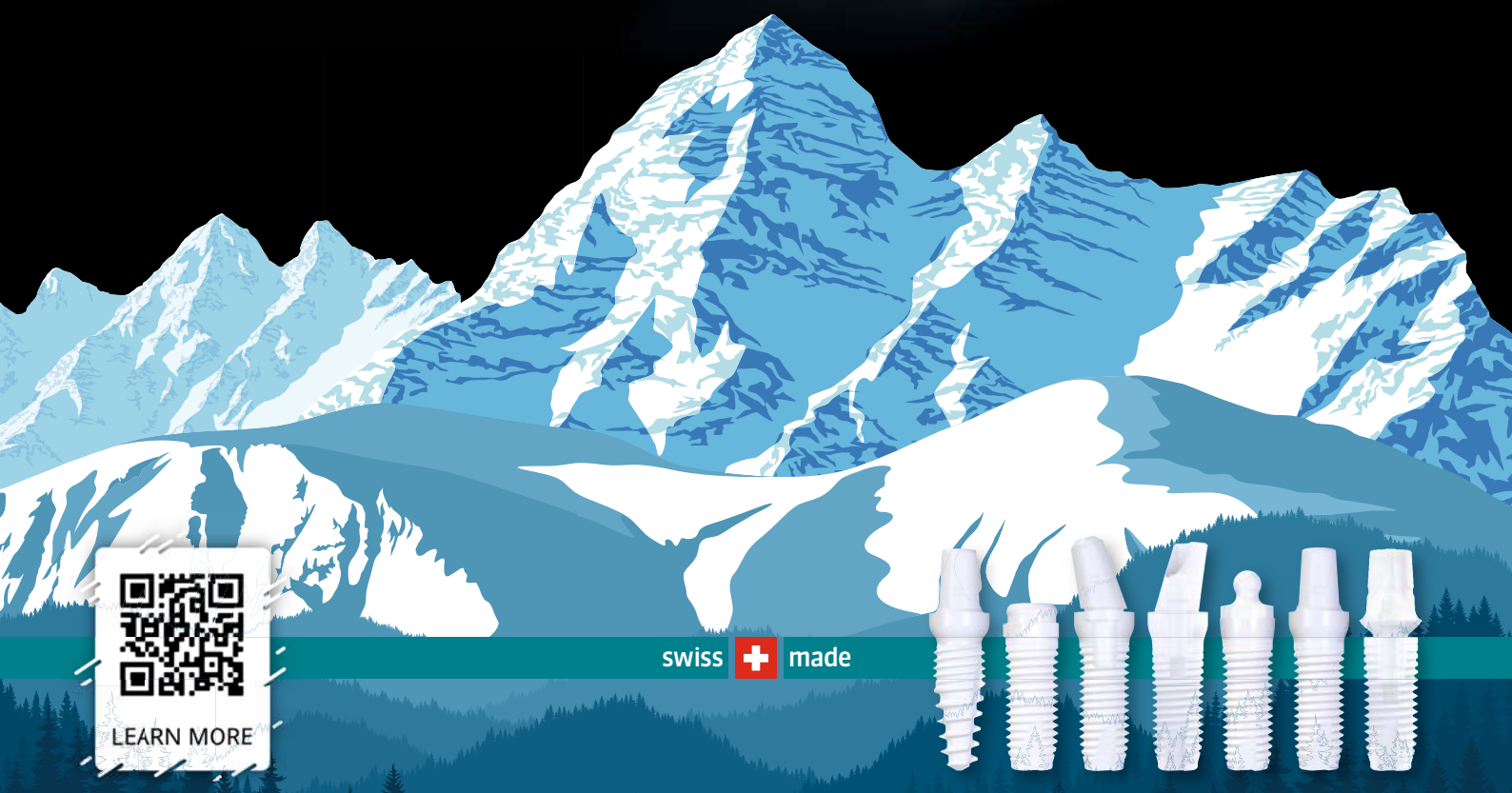

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