Biocompatibility:
A biomimetic approach for single tooth replacement

Wiki-implants
Learn how to avoid problems in difficult cases

Immediate implant placement: a risky surgical technique?

A behind the scenes look at the EAO’s 4th Consensus Conference
‘Immediate implant placement: a risky surgical technique?’, by Nicolas Picard

This case report describes a young patient who presented at the clinic with an aesthetic problem following the placement of an implant 18 months earlier. Her medical history revealed no particular pathology. She was a smoker (five cigarettes a day). Clinical examination revealed the presence of localised gingival recession at the labial surface of the left central incisor, associated with an almost complete absence of attached gingiva. The presence of a veneered prosthetic abutment and a fracture of the enamel edge were also noted. The patient wished to significantly improve the aesthetic appearance.

Her dental history revealed that a root fracture had been diagnosed following the removal of an existing crown. An immediate implant was placed without the use of GBR. The patient reported that the gingival displacement began during the final crown fitting. No temporary crown had been placed beforehand.

There were several factors behind this aesthetic failure. The first was the choice of surgical technique. Immediate implant placement in patients with a thin morphotype and thin buccal bone plate is known to carry high aesthetic risks. At the time of examination it was noted that the patient had both a thin gingival morphotype and a thin buccal bone plate at the contralateral central incisor. It can be assumed that the situation was the same for the extracted tooth.

The thickness of the buccal bone plate directly influences the amount of bone resorption associated with the extraction. Additionally, a root fracture (the reason for the extraction) is likely to cause a loss of integrity of the buccal bone plate. Finally, the decision to place an immediate implant without bone regeneration is another surgical choice that contributed to the unsatisfactory result. Studies have shown that extractions naturally induce bone resorption, especially if the buccal bone plate is thin. The use of a filling material can limit bone remodelling and thus help achieve a good aesthetic result.

Further factors contributing to the patient’s clinical situation included the 3D implant positioning and the type of implant chosen. Radiological examination clearly showed a buccal implant position which was incompatible with maintaining the buccal bone plate. The vestibular position of the implant meant that there was no bone on its entire facial surface. There was a clear failure to provide sufficient distance to maintain the buccal bone plate. Choosing an implant of appropriate length was also critical. It needed to be long enough to allow proper bone anchorage, but required careful placement to achieve appropriate palatal orientation. This was made more difficult because of the natural concavity of the vestibular patient. In this case, the choice of a such long implant contributed to this poor final position.

The combination of immediate placement and poor implant positioning led to an unacceptable aesthetic result for this young patient. This outcome then leads to consideration of how the situation could be improved. The first question is whether the implant should be preserved and a tissue graft attempted. Because of the lack of keratinised gingiva, a simple connective tissue graft would not be sufficient, even if it increased in the thickness of soft tissue. Additionally, attempting a connective tissue graft in this location could be problematic because of the high risk of graft necrosis in the exposed part, leading to an even more unfavourable aesthetic result.

A better choice would be to remove the implant, and to do this as far as possible without raising a flap, in order to minimise surgical trauma. As in the case of an extraction, a healing period of 6 to 8 weeks would be required to obtain complete closure and soft tissue maturation. A CT scan would then be performed to assess the possibility of placing a new implant that was optimally positioned. Bone regeneration would be considered alongside the implant placement, with or without a connective tissue graft, depending on the clinical situation. A healing period of four months would be required before performing the second-stage surgery. After this, a screw-retained temporary crown would be fitted to ensure the maturation of different gingival volumes. Finally, anatomical impressions would need to be taken to obtain an emergence profile that was consistent with that of the temporary crown.

Immediate implant placement is an attractive technique for the practitioner as it can yield quick aesthetic results. However, as attractive as it seems, it is a very risky technique if the only parameter taken into account is speed, and the high risks of aesthetic failures are ignored. It is therefore essential to have a good overview of all the parameters that will be involved in achieving an aesthetic result, particularly in the aesthetic zone. Using a comprehensive checklist prior to surgery would be one way of objectively evaluating the feasibility of the treatment approach and the predictability of the aesthetic result achieved.
Welcome to the latest edition of Inspyred. We have put together a selection of articles that we hope you will find both thought-provoking and useful in your practice. The cases featured range from a discussion of complex all-ceramic restorations in the aesthetic zone, to a technique for refurbishing damaged implant-supported fixed dental prostheses. The Alternative Voice column explores what can go wrong if a patient is inappropriately selected for immediate implant placement. It describes the importance of assessing both the feasibility of the technique in each case, and the predictability of the outcome.

Other articles look at the role of collagen matrices in soft tissue augmentation, and the importance of taking biocompatibility into account when selecting materials. You can also read the latest ‘wiki-implant’ case, where colleagues share their problematic cases.

In February the EAO held its 4th Consensus Conference in Pfäffikon SZ, Switzerland. These unique conferences – which are funded by the EAO without any industry support or influence – enable experts to work together to reach agreement on key topics in our field. The goal is to answer carefully focused questions about different clinical scenarios. The findings are then shared freely for the benefit of the whole profession. Our ‘behind the scenes’ article describes what actually happens at a consensus conference, and some of the challenges that participants face.

You’ll also find details about three important forthcoming EAO events in this edition. The first is this year’s annual scientific meeting, which will take place in Stockholm from 24–26 September, exploring the theme ‘Challenges in implant treatment’. The Scientific Committee has put together an extremely impressive and compelling programme featuring many leading experts in their fields, along with rising stars and younger researchers. There will be many new features this year, as well as a wonderful social programme. Book early to secure your place!

In spring 2016 the EAO will launch its most ambitious educational project to date: the EAO Education Programme. This unique programme will be delivered over three years, and will combine live surgery modules at six of Europe’s leading university dental departments with online mentoring between modules. Please visit the EAO website (www.eao.org) to find out more and to register for updates.

Following the EAO’s successful Master Clinician Course in March, a rolling programme of these two-day courses has now been introduced. You’ll find details of the second one, an advanced course in prosthetic implant dentistry, on the back cover.

We hope you enjoy reading Inspyred and we would love to hear your feedback and receive suggestions for future articles. Please email us at inspyred@eao.org to tell us what you think, how we can improve, and what you would like to see included.

We would like to wish all our readers a wonderful summer, and look forward to seeing you in Stockholm in September!

Isabella Rocchietta and David Nisand

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Background

Surgical correction of soft tissues is often required during implant therapy for both functional and aesthetic reasons. Ridge augmentation with soft tissue can be necessary to achieve an aesthetically pleasing result and to rebuild the natural ridge contour, particularly during second-stage surgery. Autologous grafts from the palate, such as subepithelial connective tissue grafts (SCTG), are regarded as the current gold standard in these cases (Chambrone et al., 2010, Roccuzzo et al., 2002, Thoma et al., 2009, Esposito et al., 2012). However, it has been demonstrated that harvesting SCTGs might cause additional discomfort, because of secondary healing (Del Pizzo et al., 2002) and there can also be a risk of post-operative or intra-operative bleeding due to violation of the palatal artery, especially in shallow palates (Reiser et al., 1996). Therefore, a range of collagen matrices – mainly based on human or porcine dermis – have been designed and evaluated, both pre-clinically and clinically, to replace autologous grafts (Jung et al., 2004, Ghanaati et al., 2011, Richter et al., 2007, Nunez et al., 2009, Gapski et al., 2005). These offer several advantages, including unlimited availability, reduced morbidity and shorter treatment times. They need to be volume-stable for a certain period of time to serve as a scaffold for cell ingrowth, and to allow vascularisation, and should ideally be replaced by the body’s own tissue without any foreign body reaction. Intactness/maintenance of the collagen structures, combined with porosity and absence of foreign material after tissue preparation, are crucial to the success and biocompatibility of these matrices. Potential shrinkage of the materials – especially when left exposed – is a potential major drawback.

Figures 1–3, taken using scanning electron microscopy, show the different composition of three different collagen matrices. Mucograft® (Figure 1: Geistlich Pharma AG, Wolhusen, Switzerland) is composed of collagen types I and III processed into a bi-layered matrix with one thin, low-porosity compact layer and one more porous three-dimensional spongy layer. Figure 2 (Mucoderm®; Botiss Dental, Zossen, Germany) shows a porcine acellular dermal matrix (ADM) without artificial cross-linking. Figure 3 (Derma®; Tecnoss Srl, Turin, Italy) is also a porcine ADM, but with a more dense layering of collagen fibres and hardly any pores. These differences in manufacturing and structure might lead to different possible indications and clinical behaviours. More clinical studies are needed to compare and to better understand the indications and behaviour of different soft tissue substitutes.

Clinical case

After submerged healing, a patient presented for second-stage surgery in the area of the upper left first premolar. The patient had a high smile line and major aesthetic concerns. As a result, it was decided to augment the buccal ridge volume during second-stage surgery (Figure 4). A porcine ADM (Derma®) was used due to its space-maintaining properties and slow adsorption kinetics. After split thickness flap preparation on the buccal aspect, the 2mm thick rehydrated matrix (5mm wide x 7mm long) was placed into the pouch to increase soft tissue volume and to built up the natural curvature (Figure 5). The flaps were adapted with double-sling sutures (6–0 Polypropylene; Figure 6). Twelve months after ridge augmentation, sufficient ridge volume had been achieved, providing pleasing aesthetic results as well as healthy peri-implant soft tissues (Figures 7 and 8).
References


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Biocompatibility: A biomimetic approach for single tooth replacement

Biocompatibility refers to the ability of a material to perform its desired function with respect to a medical therapy, without eliciting any undesirable local or systemic effects in the recipient or beneficiary of that therapy, but generating the most appropriate beneficial cellular or tissue response in that specific situation, and optimising the clinically relevant performance of that therapy (Williams 2003; David 2008). Although many dental materials provide acceptable long-term results, research suggests that they do not always elicit the most beneficial response. For instance, acrylic restorations are frequently used in implant dentistry, even at the submucosal level around the very delicate implant-abutment interface. This is despite the fact that we know there is no mucosal attachment on acrylic restorations. As a result, recession and marginal bone loss is higher around acrylic restorations compared with other materials, and gingival indices are worse (Baucic et al., 2002; Rompen et al., 2006). Equally, gold, most metal alloys and feldspathic porcelain do not form any mucosal attachment, and when used as abutment material cause an additional apical shift of the barrier epithelium, as well as marginal bone loss (Welander et al., 2008; Abrahamsson et al., 1998). Epithelial and connective tissue cells can only attach to titanium, zirconium and aluminium oxides (Rompen et al., 2006).

Nowadays, thanks to their biocompatibility and favourable aesthetic and mechanical properties, yttria-stabilised tetragonal zirconia polycrystalline (Y-TZP) ceramics are used for most implant abutments in the aesthetic zone, with good results (Della et al., 2008; Denry et al., 2008; Kelly et al., 2008). Customised zirconia abutments can create a better transition between the integrated implant and the restoration, and in clinical settings have demonstrated similar survival rates to titanium alternatives, even for posterior restorations (Lops et al., 2013; Zembic et al., 2013).

After implant placement, a biocompatible abutment with a customised design can act as a scaffold for the surrounding tissues to heal around. Favourable hard and soft tissue healing is linked to the stabilisation of tissues in a three-dimensional biologic space created around the abutment (Degidi et al., 2013). However, if this abutment is unscrewed, the surrounding tissues are disturbed, and mucosal attachment is disrupted. Despite this, animal and clinical research has shown that the subsequent (re)connection of implant components causes minimal soft and hard tissue recession (Canullo et al., 2010; Rodriguez et al., 2011; Degidi et al., 2011; Degidi et al., 2014; Grandi et al., 2014). Thus, from a theoretical point of view, the most biocompatible way to restore an implant is to connect an individually designed abutment immediately after placement or uncovering, and to avoid disconnecting it again. This is not always feasible from a technical point of view, because of the time that is needed to fabricate such a customised abutment. One way to overcome this issue is to use guided implant surgical and prosthetic planning and stereolithographic surgical guides to transfer this planning to the patient (Van de Velde et al., 2010; D’haese et al., 2012). If the implant position and rotation is adequately transferred, a customised abutment can be fabricated before the implant surgery, based on the planning.

A one-piece zirconia abutment can never achieve aesthetics that are similar to the natural dentition. Instead, the use of ceramic layering, which offers better optical properties than zirconia, is recommended at equigingival or 0.5mm subgingival levels. This can be achieved using a cemented crown, or for screw-retained restorations by layering feldspathic porcelain.

Another limitation of zirconia is the difficulty of achieving durable bonding because of its high chemical inertness (Blatz et al., 2007). As a result, different mechanical and chemical surface pretreatments have been recommended to improve the bonding effectiveness of composite cements to zirconia. Surface grinding using diamond burs; chemical etching using hydrofluoric acid; and the application of lasers were previously used to roughen the surface of zirconia ceramics. None of these techniques seemed to be effective (Derand et al., 2000; Blatz et al., 2007; Atsu et al., 2006; Ural et al., 2010). Instead, it seems to be important to create both a (micro)mechanically prepared surface and a chemically activated surface. For instance, tribochemical silica sandblasting with 30- and 110-μm silica-coated aluminium oxide (Al2O3) particles has been shown not only to roughen, but also to chemically activate zirconia, thus making it more receptive to chemical bonding via silane coupling agents (Chen et al., 2011). If successful bonding can be achieved, restorative approaches can help by provisionalising abutments using a ‘one-abutment-one-time’ concept. Direct bonding on abutments opens the door to biomimetics in implant dentistry.

Tommie Van de Velde graduated in 2001 from the University of Ghent, Belgium. He then undertook a 3 year full-time Master in Periodontology and fixed Prosthodontics at the same university. In 2008, he was granted a PhD with the subject: ‘Innovative protocols in implant dentistry’. From 2004–2012 he worked as Assistant Professor at the Department of Periodontology and Oral Implantology at the University of Ghent. He owns a multidisciplinary office in the city of Antwerp and practises exclusively in the fields of periodontology, implantology and aesthetic oral reconstruction.

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Case presentation

A 24-year-old female patient was referred for replacement of her failing right maxillary central incisor. The incisor presented with a fistula and underlying root resorption as a consequence of trauma seven years beforehand (Figure 1). As the pink and white aesthetics of the incisors and surrounding tissues was considered to be satisfactory, the aim was to replace the central incisor with minimal impact on the hard and soft tissue dimensions. A second goal was to retain as much autologous tissue as possible and only replace the failing root with biologically friendly materials. The treatment plan called for the extraction of the central incisor and simultaneous placement of an implant with a definitive zirconia abutment, to which the crown of the original tooth would be cemented. The patient provided informed consent and treatment commenced.

Guided implant planning was used to find the optimal implant position from both a surgical and a prosthetic perspective (Figure 2). The software (Simplant, Materialise, Belgium) also allowed the design of a customised abutment, in this case based on the dimensions of the original tooth. An .stl file with the information on the three-dimensional position and anti-rotation of the implant was provided to fabricate the surgical guide and customised zirconia abutment.

Prior to implant surgery, an individualised impression coping and a pressed lithium disilicate coping (e.max, Ivoclar Vivadent AG, Principality of Liechtenstein) were made to fit the zirconia abutment (Figure 3). The idea of taking an impression after implant placement originates from the knowledge that the final position of the implant will minimally deviate from the planned position. Bonding the e.max and the buccal shield of the original tooth after implant placement counteracts these mistakes.

A 4mm diameter x 3.4mm platform x 15mm long implant (T3 Tapered Implant, Biomet 3i, Palm Beach, USA) was placed through the surgical guide into the extraction site with a final torque of 70.5 Ncm (Figure 4). The customised zirconia abutment was fitted on the implant, and an impression was made to bond the buccal shield of the original tooth to the abutment in the dental lab (Figure 5). The zirconia abutment was sandblasted (Cojet, 3M ESPE, USA) and additionally surface-activated with a silane primer (Monobond Plus, Ivoclar Vivadent, Principality of Liechtenstein). The e.max was bonded (Variolink II, Ivoclar Vivadent, Principality of Liechtenstein) to both the zirconia abutment and subsequently to the reduced buccal part of the original tooth. The e.max interface allowed work on the abutment to be carried out using a conservative restorative approach. If required, after healing and stabilisation of the tissues, the original tooth could be cut back and replaced with a porcelain veneer bonded on to the e.max without unscrewing the abutment. In cases where the aesthetic outcome is poor, this versatile method also allows the abutment to be unscrewed and work to take place using a more classical approach at implant level.

In the meantime, a connective tissue graft was harvested from the palate and placed on the facial aspect of the edentulous site to increase the thickness of the buccal mucosa (Figure 6). Figure 7 is the final image taken on the day of surgery, showing the screw retained zirconia abutment and the bonded tooth. The patient was recalled after 1 week, 3 weeks and 3 months. Figures 8 and 9 show the peri-apical radiographs after surgery and 3 months, along with a lateral and frontal view of the biocompatibly provisionalised central incisor.
References


21. Williams D. Revisiting the definition of biocompatibility, Medical Device Technology 2003;14(8).

Join us in Stockholm!

The 24th EAO Annual Congress will take place in Stockholm, Sweden, from 24–26 September 2015

The meeting will explore the theme: Challenges in implant treatment

- participate in Europe’s largest and most prestigious scientific meeting for professionals working in the field of dental implantology
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- all delegates are warmly invited to join us for a welcome reception at Stockholm City Hall (above) on 23 September from 18:30. This will take place in the Blue Hall, where the annual Nobel Prize banquet is held
- the 2015 EAO Members’ and Speakers’ Dinner* will take place at the world-famous Vasa Museum (above). Guests will also be able to enjoy a private tour of the museum
Wiki-implants

Discover other people’s failed cases and learn how to avoid the same problems yourself!

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**Loss of bonded veneer**

**Gender:** Female  
**Age:** 56

**Initial situation:** Patient presented with severe attrition of the anterior dentition, especially of the upper incisors. This was due to a lack of posterior support.

**Prior treatment:** A new vertical dimension was installed through an implant supported bridge. The patient wanted to keep the old bridge in the first quadrant for financial reasons. The anteriors were restored with composite. For aesthetic reasons, six lithium disilicate veneers were created from canine-to-canine in the upper jaw. During treatment the patient was still showing signs of bruxism.

**Complication:** The patient returned to the practice one month after the veneers had been bonded, following the failure of the veneer on tooth 12, (even though this has been bonded *lege artis* using a rubber dam and the protocol specified by the manufacturer of the composite resin cement). The patient complained of bruxism, even during daytime.

**Resolution:** Investigation of the articulation and occlusion patterns showed the cause of the problem. On lateral deduction to the right side, there was a premature contact on the incisal edge of the veneer on tooth 12. It is recognised that bonded restorations have minimal resistance to debonding when there is a shear force load. Once diagnosed, the veneer was rebonded according to the protocol. The canine in the lower right quadrant was reconstructed using direct composite. This simple direct approach restored the canine guidance. A splint was created to maintain the restored anatomy. Recall at two weeks and six months confirmed that the patient had reduced bruxism and no further complaints were reported.

Case sent in by: **Alexander Declercq**
Behind the scenes:
A report on the EAO’s 4th Consensus Conference

The European Association for Osseointegration’s 4th Consensus Conference took place in Pfäffikon SZ, Switzerland, from 11–14 February. More than 60 leading researchers and clinicians met to discuss hot topics in the field of implant dentistry, and to formulate consensus reports on these. By the end of the meeting, each group had reviewed and refined the wording of a series of scientific papers describing the topics they had been asked to discuss. In addition, each group produced consensus reports featuring the following elements:

- a summary of their scientific papers
- the major conclusions they had reached
- a consensus statement
- a list of clinical recommendations
- a list of recommendations for future research

Four themes were identified by the Scientific Committee, and the three-day event was structured around these themes. Groups of participants were assigned to each theme, and the committee asked each group to prepare a series of papers on specific sub-themes which they then discussed in detail before drawing conclusions. Individual rapporteurs were tasked with researching and writing each of the papers, which were distributed to other group members before they arrived in Pfäffikon.

The conference featured an intense timetable with participants working from 8am until 11pm or beyond. The work was structured around sessions involving the individual groups, plus a daily plenary session that everyone participated in. During the plenary sessions, the chairperson of each group provided an update on emerging conclusions and current challenges for each of the themes their group was developing. This enabled other participants to ask questions or request that additional factors were taken into account. The groups used this feedback to develop more refined versions of their papers and to work towards a final set of conclusions and a consensus report on their topic.

A huge amount of work took place before the conference started to ensure that everyone had the information they needed when they arrived. Each of the rapporteurs prepared a detailed scientific paper in advance of the meeting, and these formed the basis of structured discussions with their colleagues. Preparing the papers included carrying out a systematic search to identify all relevant scientific literature. In many cases, a combination of keyword searches and hand searches led to over 1,000 potential source papers being identified. These then had to be carefully sifted using strict criteria to identify the core research that most precisely matched the topic under review. Depending on the subject matter, different rapporteurs either prepared a systematic review or narrative review of the available literature.

One of the distinguishing features of the EAO’s Consensus Conferences is that they are funded entirely by the EAO with no support from industry. This unique approach means there is no commercial influence – either overt or covert – on the findings. Participants also give their time voluntarily in order to attend the conference.

Group 1: The patient undergoing implant therapy

During Group 1’s first work session, rapporteur Bodil Lund presented her paper on ‘Perioperative antibiotics in conjunction with dental implant placement: a systematic review’. Dr Lund explained that she had identified 846 possible papers, of which nine primary studies and seven systematic reviews had been considered for review. By the time papers with a high risk of bias had been excluded, three primary studies and two systematic reviews remained. Analysis of these suggested that it would be necessary to prescribe antibiotics to 33 patients to prevent one implant failure.

This initial conclusion led to two interesting debates. The first was whether this ratio of 1:33 implied that there was a low benefit of prescribing antibiotics, or whether it would in fact encourage dentists to prescribe them. The prevailing view of the group was that there was little evidence for the efficacy of antibiotics in straightforward cases: one participant said there was a need to ‘Do away with the myth that antibiotics do anything in simple cases’. While some members of the group thought treating 33 patients to save one implant implied antibiotics were only of moderate benefit, another observed that a dentist placing 500 implants per year could expect to save around 15 costly implants, and could be motivated to prescribe them on this basis.

The debate continued with a discussion of what criteria were appropriate for including or excluding papers in the systematic review. One of the criteria selected was that implant follow-up occurred three or more months after treatment. Some members of the group felt it was unnecessary to limit follow-up to three months or more, particularly as the paper was concerned with the short-term effect of antibiotics. Further debate about the two systematic reviews which had been evaluated revealed that they were both from the same research centre. Additionally, many of the patients treated fell into traditional ‘higher risk’ groups for implant treatment: for example a higher proportion were smokers or had received immediate implants. By contrast, a third systematic review, which was considered to be well designed and well executed, had been excluded on the basis that follow-up had occurred two months after implant placement. The group agreed that this new paper should be included in...
the current systematic review and a new statistical analysis carried out to evaluate the efficacy of antibiotics following implant placement.

A recurring theme throughout the conference (and within all four groups) was the importance of identifying evidence for a treatment protocol that is relevant to the question being asked. Often, the inclusion or exclusion of a paper, based on rational principles, can imply an interpretation that is not clinically sound as a result of factors such as poor study design, non-typical patient selection, or simply because of the initial questions it set out to answer (which may be only obliquely relevant to what the current study is trying to evaluate).

Having worked in their individual groups during the day, everyone came together in the evening for the first main plenary session. The chairs of the four groups presented a summary of the progress each group had made that day. Björn Klinge talked through the three papers being considered by Group 1. He described the paper on antibiotic prophylaxis as a ‘hot topic’ and talked about how the group had agreed to remove time-limited follow-up as a criteria for excluding articles. On this basis, Bodil Lund had incorporated a third paper which had previously been excluded and had carried out further statistical analysis. This had led to a change in the number of patients that needed to be treated with antibiotics to 50 in order to save one implant. Professor Klinge also talked about the criteria his group had used to assess the reviews they had incorporated into their draft papers. These had been evaluated using AMSTAR (A Measurement Tool to Assess Systematic Reviews) and GRADE (Grading of Recommendations Assessment, Development and Evaluation). Both grading systems are relatively new and are emerging as challenge to the Cochrane approach to preparing systematic reviews.

Group 2: Computer supported diagnosis, fabrication and assessment processes

The first paper that Group 2 discussed was prepared by rapporteur Marjolein Vercruyssen and was titled ‘How are computer-supported planning and execution integrated in implant therapy: examinations, planning, execution, indications: a narrative review’. This explored an area that is changing rapidly as new software and hardware solutions are developed and brought to market, typically with little or no associated evidence-base.

As was the case in all the other groups, the first round of discussions focused on clarifying the scope of the paper and determining whether the evidence considered was comprehensive enough to answer the questions it had set out to ask. Once all three of the group’s papers had undergone preliminary discussion, sub-groups worked on each of them to refine the wording and, if appropriate, incorporate additional research findings which would elucidate a particular aspect. Library assistants (postgraduate students from the University of Zurich) were on hand to obtain additional papers that the groups needed to refer to.

Dr Vercruyssen’s paper was a narrative review that took a clinical approach which included an overview of the workflow involved in computer-supported planning, along with other aspects such as possible errors and pitfalls that are associated with the use of this technology. It described different imaging and scanning protocols that are available to plan guided implant surgery, and included detail about the advantages and disadvantages of the different options.

One of the issues raised during the discussion of this paper by the group was the role that software played in processing scanned images. These images often have to be superimposed to provide an accurate picture of the relative position of a planned prosthesis and the patient’s anatomy. The ‘danger of automation’ was discussed, whereby processes that the software performs automatically are unlikely to flag up errors if they occur. As a result, if the dentist fails to identify a mistake (such as inaccurate superimposition) there could be serious consequences for the outcome of the final treatment. Automated processes also assume the patient meets average criteria, and in reality there is no such thing as an average patient.

Other factors to take into account included how the dentist would proceed with surgery if the guide broke during treatment, or if it flexed and the drill position changed as a result. The group stressed that clinicians should only use guided surgery if they could also treat the same case competently without using a guide. They also acknowledged that their final text would need to be written carefully to avoid giving the impression that inexperienced clinicians could use guided surgery to treat complex cases which they lacked the clinical ability to treat conventionally.

The discussion illustrated the great care that is required to formulate advice that is unambiguous, accurate, and which will avoid potentially dangerous misinterpretation.

Generating final conclusions

During the course of the conference, all four groups discussed the evidence they had gathered for each of their topics, refined their literature searches, then drew increasingly focused sets of conclusions. By the time everyone left on Saturday lunchtime, a broad consensus had been reached on each of the four topics and their corresponding sub-themes. In some cases, the conclusion was that ‘more research is required’ or ‘there is insufficient evidence to either recommend or suggest avoiding this treatment protocol’.

Following the meeting, the group chairs continued to work with their members to refine the written reports that they had started. Over the coming months these were reviewed, edited and checked by group-members until they reached a stage that they were ready for submission to Clinical Oral Implants Research. In tandem, the EAO’s Junior Committee worked with the groups to develop accessible, practical messages based on the conference conclusions that dentists can use in their daily practice. As a result, the findings of the Consensus Conference will reach both an academic audience (through COIR) and benefit the wider community through practical applications when treating real cases. The EAO believes this dual approach is further amplifying the value of the conclusions reached at these important, unsponsored events.
Introduction

This article describes a method for refurbishing fixed restorations composed of a metal-based substructure covered with acrylic or composite resin gingivae and teeth. These restorations have been given a variety of names in the literature, including hybrid implant prosthesis; implant-supported fixed partial denture; implant-supported fixed complete denture; fixed bone-anchored prosthesis; and fixed dental prosthesis. They have been successfully used for a number of years to provide full arch restorations on dental implants in edentulous patients. Recent systematic reviews have shown good five year implant survival rates of 87–100%. These restorations do, however, exhibit biological and technical complications, with cumulative prosthetic survival rates ranging from 82–100% in studies with ten years or more follow-up.

One of the most frequent technical complications is fracture of the metal framework, as there was no indication to replace it.

Clinical case 1

A 50-year-old woman presented to the dental hospital with two fractured maxillary teeth. Six years previously, five maxillary implants had been placed and the patient had been provided with a full arch hybrid titanium-acrylic implant fixed dental prosthesis. Examination revealed the acrylic teeth had fractured in the 12 and 11 positions (Figure 1).

The woman was happy with her implant fixed dental prosthesis: she liked its appearance, and was able to maintain oral hygiene around it easily using interdental and single-tufted brushes. She asked for it to be repaired or replaced.

The prosthesis was intact apart from the fractured teeth. The underlying abutments showed no abnormalities, and the implants were osseointegrated. Soft tissues were normal and healthy and the patient had good oral hygiene. In the lower arch, she also had a full arch hybrid titanium-acrylic implant fixed dental prosthesis which was functioning well.

The following technique was used to refurbish the fractured prosthesis. It included retaining the metal framework substructure, as there was no indication to replace it.

Appointment visit 1

The first appointment involved removing the maxillary prosthesis for a few hours. The patient was alerted to this beforehand and brought an old upper complete denture with her. Following removal of the implant prosthesis she was able to wear the denture as a temporary measure.

An alginate impression was taken of the opposing arch, as well as a silicone registration record. The fractured prosthesis was removed, and healing caps were placed on the implant abutments intraorally (Figure 2). The prosthesis was checked on the master cast and then sent to the laboratory, along with the master cast, alginate impression and registration record. It was copied in the lab within a few hours. Laboratory putty (Sheraduplica) was applied around the prosthesis, which was retained on the master cast to copy its shape (Figures 3–5).

Having been copied, the prosthesis was returned to the patient. As a temporary measure, the fractured area of acrylic was restored intraorally using acrylic teeth and composite. The acrylic surface was sandblasted beforehand, with grooves added to aid retention of the composite (Figure 6). This was purposefully kept out of occlusion to minimise the risk of further debond/fracture.

Appointment visit 2

Prior to this appointment, the laboratory technician had made an occlusal registration record block in wax and acrylic on the original master cast, using prosthetic implant cylinders on the implants and the putty copy of the fixed dental prosthesis to aid in the design and shape of the registration block. The acrylic was as similar in shape as possible to the metal substructure of the original damaged prosthesis. Wax was placed on top of the acrylic.

The purpose of this appointment was to remove the old prosthesis and, using the registration block, obtain an appropriate registration. Softened wax and a silicone registration material were used to record this at an appropriate occlusal vertical dimension. The shade for the new teeth for the prosthesis was recorded at the same time. The tooth mould was to be as similar as possible to those on the damaged prosthesis. The old prosthesis was replaced in the patient's mouth after completing the registration.

Appointment visit 3

Using the registration recorded at the previous appointment, the laboratory technician had made a wax and tooth try-in for this appointment. The old fixed prosthesis was removed and the try-in completed, with small adjustments made to the tooth position as required (Figure 7). The patient was shown the try-in using a mirror to ensure she was happy with the tooth shape and colour. The old fixed prosthesis was reinserted.
The patient was warned that her next visit would involve two appointments on the same day: one in the morning and one in the afternoon, and that for the few hours between these appointments her maxillary prosthesis would be in the laboratory and she would have healing caps placed on her implant abutments. She was advised to bring her old temporary denture to wear for these few hours if she so wished.

Appointment visit 4

Morning visit. The patient had her old maxillary prosthesis removed and healing caps placed on the implant abutments. She was asked to return to the clinic later that day. Meanwhile, the old prosthesis was taken to the laboratory. Prior to this visit the technician had flasked the copy prosthesis using abutment replicas and guide pins. The flask was prepared using the lost wax technique and the acrylic substructure (which had been part of the registration block) was removed. The technician removed all of the acrylic from the metal framework of the old prosthesis and screwed the original metal framework to the abutment replicas within the opened flask using 15mm guide pins. She then processed new acrylic teeth and gingivae superstructure on to it. This frequently takes 3–4 hours depending upon what acrylic is used, so a fast curing cycle is recommended (Figures 8–11).

Afternoon visit. The healing caps were removed, and the new full arch titanium-acrylic implant fixed dental prosthesis was fitted using new implant screws. The occlusion was checked and adjusted as necessary. The screw holes were filled with PTFE tape and tooth-coloured composite. Oral hygiene instruction was reinforced to ensure the patient could keep her new restoration clean (Figure 12).

Appointment visit 5

At review, the patient reported that she was delighted with the result. She had no concerns and her good oral hygiene had been maintained.

Clinical case 2

The same method of refurbishment was also successfully used in the case of an 80-year-old woman who presented complaining that her lower teeth were very worn. She had had four mandibular implants placed 15 years previously, and her current mandibular implant fixed dental prosthesis had been functioning well for eight years. It was of a hybrid design with a gold beam substructure and acrylic gingivae and teeth. She had noticed the teeth wearing over the years and was now unhappy with their appearance. Clinical examination revealed significant wear of the teeth on the lower prosthesis (Figures 13 and 14). It was opposing a dentate upper arch. The worn prosthesis was successfully refurbished using the same technique as for clinical case 1 (Figures 15 and 16).

Conclusion

Fracture or wear of the veneering material of full arch implant fixed dental prostheses can be a common occurrence. If this complication occurs, the prosthesis can be refurbished using the method described, without the need to remake the metal bar framework. This is a relatively quick, cost-effective and accurate method of refurbishing a prosthesis which has been performing well for the patient. When providing implant prostheses, it is imperative that patients are informed of the potential maintenance required.
References

Combining implants and new restorative materials

From aesthetic risk assessment to final reconstructions – a case report

Introduction

To ensure both predictable treatment and a successful outcome when using an implant-supported reconstruction, meticulous preoperative treatment planning and diagnostics are crucial. These must include aesthetic risk assessment and prosthetically oriented implant positioning. Well-formulated guidelines have been established to help teams achieve long-term success, including detailed aesthetic risk assessment, principles for 3D planning of the implant position, and criteria for hard and soft tissue contour amelioration, when indicated.

New developments have led to new challenges in selecting restorative materials that guarantee predictable, long-lasting oral function and aesthetics for implant-supported reconstructions. All-ceramic materials are being more widely used, and their mechanical properties have increased promisingly. Since their biological and aesthetic characteristics can naturally match teeth and surrounding soft tissues, all-ceramic materials are becoming the primary option in patients with high aesthetic demands, as opposed to the once-conventional ‘gold standard’ of metal-ceramic reconstructions. Moreover, all-ceramic materials are becoming a less expensive alternative when the increased price of precious metals is taken into account.

All-ceramic materials still risk chipping of the veneering ceramic, especially with zirconia-based restorations. However, this can be minimised with ‘anatomical framework designs’ that provide support to the veneering ceramic, by centring occlusal contact points, and with attentive long-term follow-up.

The aim of this case presentation is to show how a partially edentulous young patient with very high aesthetic demands and expectations was restored using multiple implants and a combination of all-ceramic and metal-ceramic reconstructions, achieving function and acceptable aesthetics. The patient’s main desire was to avoid metal materials in the aesthetic zone.

Case presentation

A 32-year-old female patient presented with a failing splinted metal-ceramic fixed dental prosthesis (FDP) from teeth 15 to 22. Her chief expectations were re-establishment of oral health and aesthetic rehabilitation. There were no significant medical findings. The patient presented a thin gingival biotype and a high smile line that showed a variety of colours, with inadequate fit margins and asymmetric gingival levels (Figure 3).

The radiographic and clinical examination revealed periapical pathologies, absence of multiple teeth, inadequate endodontic therapies, and failing restorations with recurrent caries (Figures 4–6). The periodontal examination revealed generalised gingivitis.

The patient insisted on a conservative treatment option, excluded orthodontic treatment or extractions, and wished to avoid multi-unit fixed dental prostheses. Based on her desire and the existing clinical situation, the treatment plan included the elimination of local inflammation and re-establishment of adequate oral hygiene, followed by implant placement, provisional phase and final restorations (Figures 7–20).

Implant placement

Taking into account the remaining bone structure in the sites for implant placement, different types of implants were prosthetically placed as follows: Straumann® Tissue-level RN (Ø 4.1mm; SLA 8mm) on position 16 and 26. Straumann® Bone-level RC (Ø 4.1mm; SLActive 10mm) in position 14, and Straumann® Bone-level NC (Ø 3.3mm; SLActive 10mm) in position 22. Straumann® Tissue-level RN Roxolid® (Ø 3.3mm; SLActive 10mm) implants were placed in positions 36 and 46.

Prosthetic phase

The patient specifically wanted to avoid restorations including metal, particularly in the aesthetic zone.

Figure 1. Initial situation. The patient presented with a splinted metal-ceramic FDP from tooth 15 to 22 (cantilever).

Figure 2. Final situation.
She didn’t present signs of wear or bruxism habits, although these were also controlled for during the provisional phase. Nonetheless, she agreed to use a nocturnal bite splint to protect the restorations, and also to attend routine follow-ups. With the consent of the patient, using all-ceramic materials that were available on the market at the time, the final restorations comprised: alumina-based restorations (NobelProcera Alumina™; VITA VM7) on teeth 15, 13, 12, 11 and 21 and two screw-retained zirconia-based single crowns (Cares® Straumann; VITA VM9) on teeth 22 and 14. Implant-supported metal-ceramic crowns were used on the first molar sites.

Discussion

This young edentulous patient presented high aesthetic demands and expectations. After a meticulous risk assessment and diagnostics, which revealing a high lip line and thin gingival biotype as the main characteristics, all-ceramic materials were chosen to restore the aesthetic zone. The restorations included tooth-borne and implant-supported restorations. The first included alumina-based (NobelProcera Alumina™; VITA VM7) single crowns. This type of restoration has shown survival rates ranged between 90.2–100% at 5 years15–17. The latter included zirconia abutments which were available on the market at that time (Cares® Straumann), veneered with VITA VM9. Especially for the lateral-maxillary narrow-diameter implant, the use of a narrow one-piece screw-retained zirconia abutment was a risky decision18. Even though the patient was informed about this drawback, she insisted on avoiding metal-ceramic. The positive points were that she did not reveal signs of bruxism and agreed to attend yearly follow-ups. Nowadays, we have the option of using a secondary metallic component that may improve the stability of zirconia abutments (i.e. Straumann® Cares® Variobase™).

For posterior implant-supported restorations, manufacturers currently provide monolithic CAD/CAM crowns made from lithium-disilicate blanks or yttrium oxide partially stabilised zirconia (Y-TZP), which can be luted on prefabricated-titanium implant abutments when all-ceramic materials are required. These should offer promising mechanical and economical advantages. Nevertheless, clinical data on this type of implant-supported reconstructions is not yet available19.

As for the alumina-based tooth-borne restorations and implant-supported crowns, an anatomical framework design was used to support the veneering ceramic20,21. This was followed by regular relief of occlusal contact points in unsupported veneer ceramic during follow-ups19.

Summary

Implant therapy depends on meticulous diagnosis and treatment planning. This case report shows how a young edentulous patient with high aesthetic demands was restored using different types of implants and restorative materials available at that time. After a rigorous aesthetic risk assessment, all-ceramic crowns were chosen for the aesthetic zone and metal-ceramic for the molar regions. Adhering to clinical recommendations such as anatomical framework designs and occlusal controls can reduce mechanical complications in cases like this.
Figure 7. Treatment plan

Figure 8. Provisional phase

Figure 9. Framework 'anatomical designs'

Figure 10. Frontal view anterior restorations

Figure 11. Final restorations

Figure 12. X-ray after screw-retained crown placement with zirconia abutment (Straumann® Bone-level NC implant 10mm)

Figure 13. Left-lateral view after final placement of restorations

Figure 14. Initial status: occlusal maxillary view

Figure 15. Final situation: occlusal maxillary view

Figure 16. Initial status: occlusal mandibular view

Figure 17. Final situation: occlusal mandibular view

Figure 18. Frontal smile 3-year follow up

Figure 19. 3-year follow-up panoramic radiograph

Figure 20. Traditional and digital pathways were performed to build final reconstruction
References

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