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Dear Reader,

During the last several years, we have witnessed widespread digitisation of life. I read recently that as many as 6 of the 7 people use their smartphones in the first hour after waking up, and 75 percent of smartphone owners use it for a while before falling asleep. Interestingly, the younger the owner of the smartphone, the higher the percentage is, and using the device after waking occurs within a few minutes. Is it searching for knowledge or an addiction of accessing information? I think that everyone should personally answer this question.

Our publications are also available online; we offer mobile applications, create newsletters and webinars. We provide news and information in 25 languages, 7 days a week to keep our readers updated whenever they open their smartphones.

In this issue of the CAD/CAM magazine, you will find articles on CAD/CAM-supported restorative dentistry, digital workflow, practice management as well as a cone beam supplement with very well documented articles on diagnostic imaging in clinical practice and implant treatment. Lina Craven explains how to manage expectations of the management role to turn into success, and highly experienced business consultant Chris Barrow presents his opinion on globalization in dentistry. Also informative is the interview with Dr Margareta Hultin, a senior lecturer at the Department of Dental Medicine at Karolinska Institutet in Stockholm in Sweden, about immediate CAD/CAM restoration and recent developments in implant dentistry.

I hope you will find this issue interesting and I would like to remind you that all DTI publications are available as E-Papers at www.dental-tribune.com.

Sincerely yours,

Magda Wojtkiewicz
Managing Editor
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Manager versus clinician
How to manage expectations of the management role and turn it into success

Author: Lina Craven, UK

Practitioners’ expectations of the kind of manager they want for their practice vary considerably in terms of experience and skills. How guilty are you of promoting a nurse or receptionist to a management role without determining the skills gap and providing the necessary training? It is a common scenario in our industry.

Practitioners have a responsibility to their teams and to the financial success of their practices to appoint someone who either has the necessary skills or has the capacity to learn them in the appropriate time frame. How realistic are your expectations and how can you ensure your management role results in success?

Creating and managing realistic expectations

Expectations are difficult to control and impossible to turn off. According to Brazos Consulting, “Expectations are deeper and broader than requirements. Expectation is your vision of a future state or action, usually unstated but which is critical to your success.” By learning to identify and influence what you expect, and by ensuring it is clearly communicated, understood and agreed with your manager, you can dramatically improve the quality, impact and effectiveness of your business.

Expectations are created by many different circumstances. It may be something you said or the way that you said it, something you or someone else did, or an expectation of your prospective manager based on his or her previous experience. The vital point here is that expectations, whether right or wrong, rational or otherwise, are not developed in a vacuum. You should consider instances when you were let down by your manager and ask yourself how that expectation was derived. Was it based on an agreement with your manager after a discussion or was it based on something you said or thought...
In passing? In retrospect, you may wonder how realistic that expectation was and why you thought your manager was in the strongest possible position to fulfill it.

In my experience, the following scenarios are typical of how unrealistic expectations are created:

- The practitioner is busy and needs someone to take charge. He or she chooses the "best of the bunch", hoping he or she will learn on the job.
- The new manager has his or her expectations of the job and these are often unrealistic.
- No detailed job description or objectives are ever provided. No on-the-job or any other type of training is provided; the practitioner simply assumes the manager will learn as he or she goes along.
- The manager is excited about the new position. For some, the empowerment, the title and the kudos mean a great deal; for others, the challenge and the task at hand mean more. When reality hits, so does the realisation that the original motivating factors are no longer as important.
- Both practitioner and manager are reticent to discuss what is not working and often brush the issues under the carpet until it is too late.
- Resentment grows and what is at stake—the patients, the practice and the staff—outweighs the actual issue, which is poorly managed expectations.

Of course, there are many practices managed by very capable staff members. However, for all the well-functioning practitioner–manager relationships, there are more people in these roles who prefer not to talk about the problems inherent within and who are only too glad for someone else to address the issues.

One of my aims is to facilitate management teams to assess where they are at present, to plan for appropriate change and to implement that change. The outcome is that a weight is lifted from your shoulders and focus moves to a united partnership working towards the success of the practice. In order to move forward, however, you must recognize where you are now.

An alternative approach

The first step towards achieving a successful management partnership is to honestly appraise your current situation. If anything I have said so far has touched a nerve, if frustration exists between you and the manager, or if you simply think things could be better, then acknowledge the fact and take action. Knowing what action to take for the best is probably the most difficult thing to assess.

The following are tips on getting started: Vocalize your vision, agree that your vision is realistic and share it with your team. Create a job description with and a training plan for your manager, as well as identify skills gaps and create smart objectives with and for her or him. Also agree and schedule regular one-to-one meetings and plan to assess and review with your manager. Most importantly, however, keep communicating.

Drive your success

Expectations always exist, even if we do not know what they are and despite them often being unrealistic. Managers have expectations of their roles and their employers have expectations of the person given responsibility for managing the practice. The problem is that mismatched expectations can lead to misunderstanding, frayed nerves and ruffled feathers. More seriously, they often lead to flawed systems, failed projects and a drain on resources.

There is nothing wrong with having expectations; the trick is to communicate them and to agree how they might be satisfied over time and with the right support. Managed expectations drive your success.

contact

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But it’s different here

An international perspective on the business of dentistry

Author: Chris Barrow, UK

As a business consultant, I have been providing training, coaching and mentoring services to UK and Irish dentists and their teams for the last 23 years. Additionally, I have had the opportunity to work with clients in a number of European and other countries, including Turkey, India, the US, Canada and Australia. I consider myself a bit of a rebel and love to talk about innovation in business and how it applies in dentistry and the wider health care environment.

In this article for DTI I want to take you back to the mid-1990s and my first experience of working with UK dentists, providing team training workshops all across the country. Inevitably, there would come a point in one of those early workshops at which an attendee would raise his or her hand and, instead of asking a question, make a statement that came down to something like “Chris, this is all very good and exciting, but you need to understand that here in (insert place name) things are different.”

Candidates for “insert place name” ranged from the valleys of southern Wales to the West End of London, from north to south, from crowded to thinly populated areas; references were made to cosmopolitan, suburban and rural communities. The speaker would elaborate and suggest that whatever idea I was proposing would fall on stony ground because of the idiosyncrasies of the local population or macro- and micro-economic circumstances.

As a speaker, one learns to deal with such objections and concerns with empathetic listening and...
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compassion, but I gradually realised that, in each of these locations, there were dentists who were just getting on with the job and enjoying great success, because they were either oblivious or immune to those self-limiting beliefs. Now, do not get me wrong here, if your dental practice is situated in a town where a significant proportion of the population is dependent on one major employer that then closes down, even the greatest optimist and positive thinker would have to take a reality check and respond. Thankfully, such economic disasters are relatively few in number. Most of the time, the aforementioned statements of difference are a self-fulfilling prophecy on the part of the conference questioner.

The caring speaker will try to engage the attendee in meaningful dialogue, but experience shows that, sadly, the critic rarely wants to be persuaded away from his or her unfalsifiable hypothesis. Bringing this phenomenon into the second decade of the twenty-first century, the most frequent use of the phrase “ah, but it’s different here” relates to the digital marketing landscape. Whenever I comment in writing or at a conference on the explosive growth of digital, there will inevitably be a listener who wants to tell me that people in his or her postcode are not on the Internet, do not use social media and do not have e-mail addresses. Mirroring my earlier experience, I then meet dentists in the same location who are happily generating digital sales.

A recent internal survey of my top clients (located across diverse geographical and economic locations) revealed the startling fact that almost 66 percent of their website visits were from mobile devices—smartphones and tablets—thus demonstrating that website appearance on a 27-inch iMac screen is no longer as important as how it looks on mobile.

If I now refer back to the international locations in which I have had the opportunity to work, I can think of not one of the listed countries in which I would argue that the situation is different. Perhaps the most notable of these is Pune in northern India, where I was privileged in February to deliver a two-day workshop to 50 dentists from that city and nearby Mumbai. Halfway through the morning on my second day there, an attendee rose to his feet and requested a hand mike and I knew what was coming: “Chris, we have all enjoyed your lecture so far, but you need to understand that here in India things are different,” he said.

I listened, acknowledged and then simply carried on, in the knowledge that Mumbai is now regarded as the health care tourism capital of the world, that technology is influencing society as rapidly as anywhere and that the traditional Indian business model of sole-trader dentists with no nurse, no hygienist and no associate is rapidly being replaced by dental corporates and retailers, as is the case everywhere. In my original list of countries, there is not one excluded from the information and connection revolution that is reshaping all of our lives.

“The global village contains dental patients and they have similar needs and expectations of value.”

People are people. The independent traveller of 50 years ago would have commented on diverse cultures. In 2016, the same traveller will comment on similarities, whether good or bad. The global village contains dental patients and they have similar needs and expectations of value. So if you are looking for tips on how to improve your dental business, you now gain a global perspective when observing best practise.

I have visited and worked with the best in all of the countries listed and found that no nation is behind the curve when it comes to innovation in the business of dentistry and we can all learn from each other. Except, of course, in your place—if it’s different?

contact

Chris Barrow is the founder of 7connections business coaching. An active consultant, trainer and coach to the UK dental profession, he regularly contributes to the dental press, social media and online. Chris Barrow can be contacted at coach.barrow@7connections.com.
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Exploring the fracture resistance of retentive pin-retained e.max press onlays in molars

Authors: Dr Les Kalman & Yasmin Joseph, Canada

Abstract
Retentive titanium dentinal pins have been combined with indirect restorations. Application of pins has been used with lithium disilicate, an indirect pressed ceramic restorative material, termed e.max. The objective of this study was to investigate the fracture resistance of pin-retained versus non pin-retained indirect e.max press restorations. Ten human extracted teeth were used for the control and ten for the test group. Titanium dentinal pins were placed and e.max press restorations were fabricated, by a commercial laboratory, and then cemented. Fracture resistance was assessed. Data was collected and results were obtained. Fracture resistance of both groups indicated no significant difference in values. An observation from testing illuminated that pin-reinforced e.max benefitted from a controlled fracture, which minimized tooth damage. The data suggests that pin-reinforced indirect e.max restorations offer no appreciable difference in fracture resistance. Further testing would be required to expand upon the sample size, explore other strength vectors and consider a clinical investigation.

Introduction
The loss of tooth structure, from disease or biomechanical stress, requires the replacement of tooth structure through dental restoration techniques. This may occur either directly or indirectly. Extensive tooth restorations typically require indirect restorations. Indirect dental restorations benefit from excellent form, function, esthetics, and strength; however, the retention of indirect restorations can prove problematic. This is primarily due to the variable technique-sensitive chemical bond of the restorative material with the tooth. The type of restoration used largely depends on the magnitude of tooth destruction and dictates unique preparation design characteristics.

Fig. 1: No pin onlay tooth preparation.
Fig. 2: Pin onlay tooth preparation.
With the increasing demand in esthetics, use of ceramics has become more prevalent in restorative dentistry. E.max, a ceramic and metal-free restorative material, has been demonstrated to be an extremely strong, dependable restoration with ideal esthetics. It is a highly biocompatible glass ceramic composed of lithium disilicate. E.max is also among the most durable dental materials to date. Previous studies have concluded that E.max poses no health risk to dental patients and has little potential to cause irritation or sensitizing reactions, when compared to composite or gold restorations.

Although the primary retention of an indirect restoration is based on bond strength, secondary elements can be introduced to further increase surface area and retentive strength, such as pins. Traditionally, retentive pins were employed to offer significant retention to direct restorations when minimal tooth structure remained. Effective utilization of pins required proper application of biomechanical principles in each clinical case. Adequate dentin, to support the pin, remains an important factor in the evaluation of the clinical success of retentive restorations. The type of pin used also determines the success rate of the restoration. Among the two pin types, titanium retentive pins have been found to be highly biocompatibility with minimal corrosive activity.

Due to the sensitivity of indirect restoration bonding and resultant retention, an investigation on whether the use of titanium retentive pins would offer an increase in fracture resistance seemed fitting. If there was a significant increase in fracture resistance between the restorative material and the tooth, pin reinforced E.max press restorations could justify further investigation. In addition, with advances in 3-D intra-oral imaging and CAD/CAM, a digital workflow would provide a simple and predictable clinical alternative.

**Materials and methods**

Human extracted molar teeth were used for this investigation. They were sorted and randomized. A total of 20 extracted molar teeth were used. The control group contained 10 molar teeth. Each tooth was prepared for a four surface onlay restoration which did not incorporate pins. The test group included 10 molar teeth. Each tooth was prepared for a four surface onlay restoration which did not incorporate pins. Each four surface E.max onlay restoration preparation had either the buccal or lingual wall remaining intact (Fig. 1) following standard
study fracture resistance of restorations

Titanium pins with a diameter of 0.6 mm were used (Stabilok; Fairfax Dental Inc.). Two pins were placed in each tooth at the appropriate line angles; pin 1 was placed on the mesial side whereas pin 2 was placed on the distal side of each molar tooth (Fig. 2). Pins were inserted to a 2 mm depth. The top 1 mm was sheared off and smoothed. Pin length was slightly variable among the teeth. Radiographs were taken in a buccolingual and mesiodistal fashion to verify pin placement (Fig. 3). All tooth specimens were packaged and sealed in a moisture controlled container and shipped to a dental lab (DentUSA) for restoration fabrication with e.max press (IPS e.max Press; Ivoclar Vivadent). Specimens were returned in the same manner along with the e.max onlay restorations (Figs. 4 & 5). Tooth specimens and restorations were prepared and bonded (Fig. 6) using Multilink adhesive cementation system (Multilink Automix; Ivoclar Vivadent) following manufacturing recommendations.

Cement flash was removed and the restorations were polished following standard Schulich Dentistry protocols. The prepared tooth was fixed with ortho resin (Fig. 7) (acrylic resin, DENTSPLY Caulk) in the stabilization ring (Fig. 8). A universal loading machine (Instron laboratory testing unit: ITW) was utilized to apply an axial load to the tooth until the tooth fractured (Fig. 9). The machine applied pressure at a maximum crosshead speed of 0.5 mm/min. Tooth fracture was assessed visually and measured in Newtons for all the teeth in the control and test groups (Fig. 10).

Results

The force (Newtons) required to cause fracture of either the restoration or tooth, or a combination of the two, was extremely variable (Table I). The test group suggested greater variability among the values and the highest fracture resistance value. There was no significant difference in the fracture resistance between the non pin-retained e.max press restorations and the pin-retained e.max press restorations (Fig. 11). An unpaired t-test result using P < .05 was P = .4443 in this assessment. Data were obtained by using an analysis of variance (ANOVA). Significant differences were set at a .05 level (Fig. 11).

Discussion

There was no statistical difference between the control group (non pin-retained restorations) and the test group (pin-retained restorations) in fracture resistance. The results indicated that the test group exhibited greater variability. This could be due to pin location, pin length, differences in pin angulations or variations in the width of the onlay preparation margin. The highest fracture resistance value was a pin-retained e.max onlay, which could be related to the increased surface area and subsequent bond strength. Pin-retained e.max onlays had a tendency to fracture in a very controlled manner, with much of the tooth-restoration complex remaining intact. Conversely, non pin-retained e.max onlays typically fractured in such a violent manner that the tooth-restoration complex was destroyed.

Due to the degree of variability, further laboratory testing would be warranted with a larger sample size. A clinical investigation, highlighting the pro-
Conclusions

This study explored combining retentive titanium pins with indirect e.max press onlay restorations in extracted human molar teeth. Teeth were then subjected to axial loading in a universal loading machine. There was no statistical difference in fracture resistance between the two groups. However, the highest fracture resistance was displayed from a pin-retained e.max onlay. This may be related to the increased surface area and subsequent bond strength. Observationally, pin-retained e.max onlays fractured in a manner that seemed more controlled than non-pin-retained onlays.

Digital dentistry could simplify this potential alternative by providing the clinician with the tools required to acquire the digital impression, design and fabricate the final restoration. Although pin-retained was termed for the investigative restorations, perhaps pin-reinforced would seem more logical. Further investigations are required to substantiate the research and identify whether this approach may be considered as a clinical alternative.

Conflict of Interest

Research was supported by the Schulich Dentistry Summer Research Project and by Research Driven Inc. Les Kalman is the co-owner and President of Research Driven Inc.

Acknowledgements

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Editorial note: A complete list of references is available from the publisher.

about

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Addressing bone loss and implant angulation with custom abutments and monolithic zirconia

Author: Dr Ara Nazarian, USA

Introduction

According to the Misch prosthetic classifications for completely edentulous patients, the FP3 (fixed-prosthesis-3) is an implant restoration that addresses cases with significant tissue loss by including pink gingival areas that replace the lost bone and soft-tissue contours. The FP3 prosthesis allows for the reestablishment of proper function, esthetics, lip support and phonetics while avoiding over-elongated teeth. The fixed nature of this prosthesis type affords the highest levels of stability, chewing capability and patient satisfaction, making it the premium restorative option for fully edentulous cases.

For clinicians who favor the maximum durability and high esthetics of monolithic zirconia, the versatility of dental CAD/CAM technology allows for a screw- or cement-retained restoration. While both of these prosthetic options offer a predictable, highly effective means of restoring the edentulous arch, this article will focus on the indications, treatment protocol and benefits of the cementable full-arch BruxZir restoration (Glidewell Europe GmbH; Frankfurt/Main, Germany) over custom abutments.

Because of bone loss and anatomical factors, some implants must be tilted buccal-lingually in a manner that would situate the access holes on the incisal edge or facial aspect of a screw-retained restoration. The use of custom abutments and a cementable prosthesis corrects the angulation of the implants and eliminates the need for screw access holes. This approach also allows for a prosthesis with less buccal-lingual width in these challenging situations. Using CAD software, custom abutments can be designed in the precise manner needed to support an esthetic restoration. And because the entire body of the restoration is milled from high-strength monolithic zirconia, the problems of wear, chipping and fracture that can occur with layered porcelain, which has traditionally been used in cementable full-arch bridges, are prevented.

Determining whether a cementable FP3 prosthesis is indicated largely depends on the bone characteristics of the patient and the preferences of the practitioner. The clinical workflow for the full-arch BruxZir bridge over custom abutments is relatively simple to follow and includes many techniques used in traditional crown & bridge work. The protocol includes a poly(methyl methacrylate) try-in bridge, which offers a three-dimensional preview of the proposed restoration and is a precise communication tool between the practitioner and dental lab. Any necessary alterations are made to the PMMA try-in bridge, digitally scanned by...
the lab and incorporated into the final prosthetic design.

In the following case report, a fully edentulous patient with limited vertical bone volume is provided with a cementable FP3 prosthesis, helping reestablish the hard- and soft-tissue architecture needed for a functional, esthetic restoration. A treatment plan is executed in which the latest advancements in dental implant design, CAD/CAM technology and prosthetic materials are utilized to overcome difficult anatomical circumstances and meet the immediate and long-term needs of the patient.

**Case report**

A male patient in his early sixties presented for treatment with an edentulous maxilla and grossly decayed, hyper-erupted mandibular dentition (Fig. 1). The patient was a heavy smoker, had not seen a dentist in nine years, and was not taking proper care of his remaining teeth due to pain and discomfort (Fig. 2). The patient’s upper denture had become increasingly loose-fitting since losing his teeth nearly a decade prior. His desire for a restoration that felt and functioned more like natural teeth led him to my practice, where he could undergo the surgical and prosthetic phases of treatment under one roof. Intraoral and radiographic evaluation indicated sufficient bone volume for full-arch implant therapy (Fig. 3).

Treatment options were presented to the patient for his edentulous upper arch and non-restorable mandibular dentition, including various combinations of fixed and removable implant prostheses. This involved a discussion of complete edentulism and its problems, consequences and solutions (PCS), the effect of tooth loss on oral health, and the differences in stability and function afforded by each treatment option. Dental financing programs were explained, which is an important part of treatment presentation, as it can help make implant therapy feasible for patients who cannot cover the entire cost upfront.

Figs. 5a & b: The implant osteotomies were created following a straightforward, user-friendly surgical protocol.

Figs. 6a & b: The Hahn Tapered Implants were initially threaded into position with a handpiece.

Fig. 7: With high primary stability established, 3-mm-tall healing abutments were connected to the maxillary implants.

Fig. 8: After extracting the patient’s mandibular teeth, a bone-leveling guide was placed over the arch to assist with the alveoplasty procedure.

Fig. 9: Bone-level surgical guide seated over the mandible.
The patient strongly desired fixed restorations, as he had grown quite frustrated with his removable maxillary denture over the years. In addition, the patient had a pronounced gag reflex, making the fixed option optimal as it would free up the palate.

An FP3 prosthesis was required for the patient’s upper restoration, which had undergone substantial bone resorption and gingival recession. The tissue contours would also need to be recreated in the mandible, where bone leveling was required to remove undercuts, create an ideal occlusal table, properly seat a bone-supported surgical guide, and establish adequate bone width in which to place the implants.

The anatomy of the patient’s ridges called for a cementable solution, as the labial-lingual bone volume required that several of the implants be tilted in a manner that would have required access holes too far to the facial if a screw-retained prosthesis were to be prescribed. This would have been especially problematic for this patient, as cigarette smoking tends to darken the composite used to seal the screw access holes. The patient also desired prostheses that occupied as little facial-palatal space as possible, further indicating a cementable solution. Thus, custom abutments would be utilized to correct the angulation of the implants and support a full-arch BruxZir restoration. The monolithic construction of the FP3 prosthesis, in which both the gingival areas and teeth are milled from the same block of solid zirconia, would ensure the longest-lasting restoration possible.

The patient returned for the records appointment, and upper and lower impressions were made so immediate temporary dentures could be fabricated for delivery at the surgical appointment. CBCT scanning was performed to provide the information needed for virtual treatment planning. The three-dimensional data obtained from the CBCT scans was used to determine the ideal length, width and placement of the implants in the key positions of the patient’s edentulous arches, including the first molar, first premolar, canine and central incisor regions. A total of eight implants would be placed in each arch, facilitating a prosthetic design that minimizes cantilevers and pontic spans.

From the digital treatment plan, a tissue-supported surgical guide was produced for the maxilla while a bone-level guide was created for the mandible, where a flap was required in order to evaluate the extraction sites and perform the alveoplasty.

The Hahn Tapered Implant was selected for the procedure because the pronounced thread design would help achieve optimal positioning and primary stability. The tapered shape and wide range of sizes also simplified the task of situating the implants in the key positions around the arch. Its conical internal hex connection results in a very stable seal between the implant and prosthesis, which is beneficial for crestal bone preservation and soft-tissue health.

At the surgical appointment, IV sedation was administered to the patient. The tissue-level surgical
guide was seated over the patient’s maxilla, and the fixation pins were tightened (Fig. 4). Tissue punches were used to provide access to the preplanned implant sites. The implant osteotomies were created following the simplified surgical protocol of the Hahn Tapered Implant System (Figs. 5a & b). Eight implants were placed from first molar to first molar in the maxillary arch (Figs. 6a & b). Healing abutments were connected to the implants to help prepare the soft tissue for the restorative phase (Fig. 7).

Next, the patient’s untreatable mandibular teeth were extracted, a flap was reflected, and alveo-plasty was performed (Fig. 8). A bone-supported guide was seated in order to control the location and angulation of the implant osteotomies (Fig. 9). As the Hahn Tapered Implants were threaded into place, their deep, sharp threads engaged the walls of the socket sites and helped maintain proper position toward the lingual aspect (Figs. 10a & b). Because of anticipated tissue swelling as a result of the bone-leveling procedure, 5-mm-tall healing abutments were connected to the implants in the lower arch (Fig. 11). The immediate dentures were soft-relined to seat over the Hahn Tapered Implant Healing Abutments, the hourglass shape and undercuts of which provided a degree of retention that enhanced dental function for the patient during healing.

Four months later, the healing abutments were removed and the stability of the implants was confirmed (Fig. 12). Hahn Tapered Implant Impression Copings were seated with ease due to their contoured cervical area, which matches that of the healing abutment (Figs. 13a & b). Closed-tray impressions were taken, as well as a bite registration with the patient’s immediate dentures in place. Because the immediate dentures were well-fitting and satisfactory to the patient, duplicates were provided to the lab to aid the restoration design process.

Based on the impressions, the lab poured and scanned stone models, creating a digital representation of the patient’s arches on which the designs for custom abutments and the cementable prostheses were planned. Advanced dental CAD software was used to design the custom abutments and the cementable FP3 prostheses, which included gingival areas in order to recreate the bone and soft-tissue contours. The PMMA try-in bridge and temporary restoration were milled based on the initial digital prosthetic design. Gingival stain was applied to the temporary appliance so it could function as an esthetic provisional.

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restoration were created (Figs. 14a & b). Note that although the impressions, bite registration and immediate dentures were sufficient for establishing the initial prosthetic design for this patient, the dental lab requires a wax rim and setup try-in in most cases in order to establish the correct centric relation, vertical dimension, interocclusal relationship and other details. Inclusive Titanium Custom Abutments (Glidewell Europe GmbH) were fabricated, and a try-in bridge and a BioTemps restoration (Glidewell Europe GmbH) were milled from solid blocks of PMMA (Figs. 15a & b).

The patient returned for clinical evaluation of the prosthetic design. The custom abutments were delivered using lab-provided acrylic delivery jigs, which helped ensure proper orientation during seating (Fig. 16). Due to the precision of the digital design process, the fit of the custom abutments was ideal, establishing margins that were at or a slight distance from the gingival surface (Fig. 17). This simplified the removal of excess cement from the margins and illustrates the advantages of CAD/CAM-produced abutments.

The PMMA try-in bridges were seated over the custom abutments, and slight alterations were made to fine-tune the gingival margins, length of teeth, and bite (Fig. 18). The same adjustments were then made to the BioTemps restorations. A bite registration was taken with the try-in bridges in place. The provisional prostheses were affixed to the custom abutments with temporary cement, functioned well for the patient for the duration of healing, and helped the patient confirm that the prostheses did not present any functional or esthetic issues (Fig. 19).

The PMMA try-in bridges were returned to the lab along with photos, the bite registration and instructions for minor modifications, including lowering the gingival margins of the lower prosthesis and raising the gingival margins of the upper. The lab scanned the adjusted PMMA try-in bridges, made the requested alterations to the prosthetic design, and milled the final prostheses from BruxZir Solid Zirconia.

The final restoration was delivered at the next appointment and established accurate fit, function and interocclusal relationship (Fig. 20). No adjustments were needed for the monolithic zirconia prostheses because of the PMMA try-in process, which captured the precise modifications needed for proper form and esthetics. Final radiography confirmed complete seating of the BruxZir restoration on the Inclusive Custom Abutments (Fig. 21). The patient was extremely happy with the reconstruction of his edentulous arches, which restored esthetics, dental function, comfort and confidence (Fig. 22).
CC DISK NF CoCr
Disc for CAD/CAM based on CoCr.
CTE 13.9-14.0 x 10^-6 K^-1.

CC DISK Zr Smile
Disc for CAD/CAM made of pre-sintered ZrO.
With exceptional light transmission and translucency.

CC DISK Zr Multicolour
Disc for CAD/CAM made of pre-sintered ZrO.
For natural restorations with no colouring liquids needed.

CC DISK Ti2

CC DISK Ti5

CC DISK Zr/HT

CC DISK PMMA

CC DISK WAX

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Aesthetic composite layering of implant-supported restorations in an edentulous jaw

A good option for the lifelike recreation of gingival tissue

Authors: Drs Patrice Margossian & Pierre Andrieu, France

Careful planning is indispensable in the treatment of an edentulous jaw with implant-supported restorations. The axes and positions of the implants must correspond to the given biological, mechanical and aesthetic conditions. In situations in which severe bone recession has occurred, the work of the dental team has to involve the reconstruction of the dental and the gingival tissue. The flawless reconstruction of gingival tissue requires sound teamwork, as well as excellent materials and exceptional skill. Layering with the light-curing laboratory composite SR Nexco (Ivoclar Vivadent) takes this procedure to a new level.

A 37-year-old female patient presented to our practice with her teeth and the surrounding bone structure in very poor condition (Figs. 1 & 2). Numerous teeth were missing from both the upper and lower jaws. In addition, the upper jaw showed considerable bone and gingival resorption. The patient wished to have her teeth restored to regain an attractive appearance. Owing to the extensive damage, complete restoration of both jaws with implants was indicated.

Surgical phase

Owing to the sufficient bone structure in the lower jaw, this part of the mouth could be restored at once with four immediately loadable implants. During the reconstructive phase, the upper jaw had to be treated with a provisional removable denture owing to the atrophied alveolar ridge. The tooth extractions from the upper and lower jaw were...
performed on one day. At the same time, four mandibular implants were placed and loaded. An immediate denture was seated in the upper jaw.

During the osseointegration period of the mandibular implants, the maxillary bone was reconstructed. The maxillary sinus and the alveolar ridge were augmented in one appointment. At a later appointment, ten implants were placed according to the treatment plan and exposed after six more months. As a result of well-planned soft-tissue management, adequate firm keratinised tissue had formed. The permanent restorations for the upper and lower jaws were fabricated two months later (Figs. 3 & 4).

The determination of the occlusal plane and the ideal incisal line allows the dental arches to be integrated more easily in terms of aesthetics and function. Open-tray impressions were taken with a special plaster (Snow White, Kerr Dental) and unsplinted impression posts. The considerable stiffness of the impression material completely immobilised the impression posts, thereby preventing any errors in the casting of the study models.

An articulator allows the kinematics of the jaw to be correctly simulated. The goal of this part of the treatment is of a functional nature. It is intended to ensure optimal occlusal integration of the restorations and the proper jaw movements during mastication, speaking and swallowing. In this particular case, the maxillary model was positioned with the help of a facebow. Four impression posts were screwed on to the implants in order to provide strong support and enhanced reliability.

Alternatively, this step can take place directly on the immediately loaded provisional restorations. For this purpose, however, the model has to be mounted in the articulator. In the present case, the masticatory model was positioned in correct relation to the hinge axis-orbital plane. Subsequently, we adjusted the bite patterns in order to record the vertical dimension of occlusion.

The centric relation is regarded as the reference position for adjusting the muscles to the centric and functional jaw relation. The mandibular model was mounted in the articulator with the help of an antagonist jaw relation record. If the centric relation and the vertical dimension of occlusion are correct, the immediately loaded provisional restorations can be used for this purpose. The restorations have to be immobilised when they are mounted in the

Fig. 4: Four implants were placed in the lower jaw. Bone augmentation measures were not necessary in this case.

Figs. 5a & b: Recording of the aesthetic facial axes with the Ditramax system.

Fig. 8: The denture was set up with prefabricated teeth (SR Phonares II).

Fig. 7: Try-in of the CAD/CAM-fabricated titanium framework in the upper jaw.
The Artex system (Amann Girrbach) allows the articulator of the dental practice and that of the laboratory to be synchronised. The Ditramax system was used to transfer the precise data on the aesthetic facial axes to the maxillary model (Figs. 5a & b). Two axes were marked on the plaster base of the model (vertical and horizontal). The vertical axis represents the midsagittal plane. From the front, the horizontal axis is aligned parallel to the interpupillary line and from the side to Camper’s plane. These markings, which should be very close to the working area, function as a guide for the dental technician in setting up the teeth. Therefore, the incisal line has a predictable parallel alignment with the interpupillary line. The incisal axis is aligned parallel with the midsagittal plane. The Camper’s plane markings indicate the alignment of the occlusal plane. All these elements provide a sound rationale for the tooth set-up according to aesthetic and functional principles.

We selected the tooth shade and the teeth on the basis of the SR Phonares II tooth mould chart (Ivoclar Vivadent). Holding the teeth up against the lips of the patient quickly revealed whether they were in harmony with her facial features. The set-up of the teeth according to the Ditramax markings (Fig. 6) allows the situation to be clinically validated. In this case, attention was given in particular to the aesthetic integration of the dentogingival complex when the patient was smiling. The lip dynamics were shown with video clips. The functional criteria were also checked. The vertical dimension of occlusion had to be harmonious in order to achieve a balanced lower facial third and proper phonation.

We felt that a CAD/CAM-fabricated titanium framework (NobelProcera, Nobel Biocare) would best fulfil this indication. The double-scan technique allowed the implant model to be superimposed on the tooth set-up to construct the framework. In the next step, the framework was machined and then tried on the model and in the patient’s mouth (Fig. 7). The cast impression and the high-performance processing systems significantly contributed to providing the optimal passive (tension-free) fit of the framework, which is decisive for the long-term success of the restoration.

The areas that needed to be built up with gingival materials were blasted with aluminium oxide at 200 to 300 kPa pressure. Subsequently, the SR Link bonding agent (Ivoclar Vivadent) was applied, followed by a thin layer of the light-curing SR Nexco Gingiva Opaquer to mask the metal framework. The Opaquer was polymerised and then a second coating was applied and polymerised. The resulting inhibition layer was removed.

The conventional flask technique with a heat-curing denture base material (ProBase Hot, Ivoclar Vivadent) was used to produce the denture. After the polymerisation process, the denture base was ground and space was made for building up the Gingiva composite. The surface was conditioned by blasting it with aluminium oxide (50 µm) at 200 kPa (Fig. 8). A bonding agent was then applied and left to react for three minutes before it was light cured.

In order to achieve very lifelike results in the layering of the gingival tissue, saturated (intensive) materials (SR Nexco Paste Intensive Gingiva) were used.
first (Fig. 9). Next, translucent, light-curing gingival materials (SR Nexco Paste Gingiva and SR Nexco Paste Basic Gingiva) were used to impart the gingival areas with the desired depth (Fig. 10). The colours of the Gingiva composites range from pale pink through reddish and orange to purple. A certain amount of time and effort are necessary to master the necessary mixing techniques and achieve a harmonious interplay of the intensive and the translucent materials. Practical experience is essential. With some technical skill, the gingival areas can be naturally reproduced in terms of shape, texture and shade.

All the individual layers were pre-cured (Quick curing light, Ivoclar Vivadent) in segments. A high-performance curing light was used for the final polymerization. Prior to this step, a coating of glycerine gel (SR Gel, Ivoclar Vivadent) was applied to the surfaces to prevent oxygen inhibition, which could lead to an unattractive result that is difficult to polish. The surfaces of the teeth were characterized with a vertical and horizontal macrostructure. Particular attention was paid to mechanical polishing. Once the glycerine gel had been removed, the restorations were finished with different polishing instruments (various grit sizes, pumice, leather buffing wheels and universal polishing paste; Fig. 11). In the present case, mechanical polishing was preferred to glazing with a light-curing composite in order to prevent premature ageing of the surface.

The dentures were seated manually with the help of multi-unit abutments from Nobel Biocare (Fig. 12). The screw channels were sealed with Teflon and light-curing composite resin. The position of maximum intercuspation was checked and the occlusal pathways were adjusted to the protrusive and lateral movements. In addition, the restorations were checked in terms of the ability to clean them with interdental brushes, and the patient was given special instructions regarding her oral hygiene.

Conclusion

For a long time, ceramics were considered to be the aesthetic benchmark. With the introduction of state-of-the-art industrially fabricated acrylic teeth specially designed for implant applications, the bar for aesthetics has been raised in this category of materials. The teeth used in this case exhibit a true-to-nature morphology, which allows the restoration to be functionally integrated without any problems. Using the laboratory composite SR Nexco to recreate gingival tissue is an effective restorative approach. In contrast to ceramic materials, the composite resin is easy to handle and delivers exceptionally aesthetic results (Fig. 13). The light weight of the material is an added benefit. An all-ceramic restoration (zirconium dioxide framework, layering ceramic, gingival mask) weighs almost twice as much as a titanium and composite resin denture. Another advantage of the type of restoration described here is its long service life. The success of an implant-supported denture depends on the systematic coordination of all the surgical and prosthetic requirements. A strict procedure needs to be followed from the treatment plan to the final outcome. Layering gingival portions with a laboratory composite represents a genuine improvement on previous materials and methods with regard to aesthetics, handling and hygiene (Fig. 14).
Immediate implant placement and digital workflow

Authors: Dr Brian L. Wilk, Dr Barry P. Levin & Tony Cirigliano, USA

Introduction
Immediate implant therapy is a clinically validated procedure. In the anterior dentition, success is measured not only by implant survival and stable bone levels, but by long-lasting, aesthetically-pleasing outcomes. This is accomplished by satisfying several biologic and restorative criteria.

Implant position is crucial in terms of developing proper restorative emergence profile and establishing facial and proximal soft tissue levels. Fixtures should be palatally-positioned, and not in close proximity to the facial bone. This often requires that the implant diameter selected be smaller than that of the root being replaced. This facilitates formation of a clot between the socket walls and implant, leading to modelling and remodelling of native bone. The fate of the facial bone, often consisting of 100 percent bundle bone in its marginal portion, is of great importance. Regardless of surgical approach (such as flap vs. flapless, graft vs. non-graft, membrane vs. no membrane), this aspect cannot be ignored. Being a “tooth-dependent” tissue, bundle bone loses its embryologic function of supporting periodontal tissues once extractions are performed. Often, especially in the anterior dentition, this facial bone wall is extremely thin prior to extraction. Compensation for post-extraction dimensional changes can be critical for long-term aesthetic success.

Some advocate retention of the periosteum (flapless placement) for bone preservation, but this
cannot be assumed to be a predictable technique, especially in sites of thin periodontal biotypes. Augmentation, including flap reflection and facial grafting, can sometimes be advantageous. Materials capable of supporting hard (osteogenic) and soft tissue ingrowth and regeneration should be utilized in these cases.

Valentini demonstrated aesthetic success of immediate implants in sites where bone grafting and collagen membranes were utilized at the time of extraction and implant placement.

Soft tissue augmentation in relation to implant therapy, often accomplished with subepithelial connective tissue grafts, has been recommended to enhance the cosmetic appearance. The time involved in procuring and closing the soft tissue and its donor site, along with the increased morbidity associated with this step, may preclude its implementation in therapy. Palatal anatomy may also preclude its use in certain situations. In patients with shallow palatal vaults, the proximity to neurovascular structures can prevent the procurement of soft tissue graft or minimize their dimensions. Also, the increased operating time and morbidity associated with autogenous connective tissue grafting cannot be ignored. Dermal allograft can, in appropriate situations, serve as a viable alternative. Soft tissue augmentation may still be desired, not only for esthetic reasons, but also to preserve marginal bone levels around implants. Formation of biologic width around implants is a physiological “must”. If needed, it will develop at the expense of the marginal bone. It has been demonstrated that implants with “thick” soft tissues maintain more coronal marginal bone levels compared to those with “thin” soft tissues. Der- mal allografts have been used to “thicken” soft tissues and eliminate autogenous soft tissue grafts. Consisting of collagen, these grafts may also serve as cell-occlusive membranes, serving the dual function of tissue-thickening agent and guided bone regeneration (GBR).

Provisionalizing immediate implants may enhance esthetics. Preserving soft tissue levels and developing prosthetic emergent profiles can be more efficacious with a provisional crown versus a round, non-anatomically-shaped healing abutment. The retention of provisional restorations may also play a role in the success of therapy. Stability of the restoration and avoiding early removal can be critical for successful osseo-integration as well as not disturbing the initial soft tissue remodelling around the crown(s). Screw-retention, though more technique-sensitive compared to cement-retained fabrication, allows for tightening of the temporary crowns and elimination of possible cement-associated, biologic complications.

Case report

The following case report (Figs. 1–22) demonstrates how a hopeless maxillary incisor is extracted and replaced with an immediate implant simultaneous with tissue augmentation and immediate provisionalization.

Following papilla-sparing, facial flap-reflection, tooth #9 (#21) was carefully extracted. The alveo-
The site was then reopened and the same bone graft was placed over the facial cortex and covered with a dermal allograft (Symbios PerioDerm GBR), which was adapted via a tissue punch around a HealDesign EV healing abutment. Symbios PerioDerm GBR was selected as the desired material due to its structural integrity, closely resembling that of human tissue. Viable cells and antigens are removed without damaging the remaining matrix, which serves as a framework for cellular infiltration and vascularization.

The flap was then sutured securely around the healing abutment with resorbable sutures. The patient was prescribed amoxicillin 500 mg for ten days, a six-day course of methylprednisolone (Medrol Dosepak), Etodolac 400 mg for analgesia and Chlorhexidine Gluconate rinses bid. He was instructed to avoid all mastication in the anterior dentition for at least six weeks.

Immediately after surgery, the patient reported to his restorative dentist’s office for fabrication and delivery of a screw-retained, provisional restoration. A temporary abutment (Temp Abutment EV 4.2) was modified and covered with opaque composite resin prior to addition of bis acryl and flowable composite resin. It was contoured and polished and the facial/incisal screw access channel covered with Teflon tape then flowable composite resin. This restoration was torqued to 15 Ncm and placed out of occlusal contact with the opposing mandibular teeth, and light contact with the adjacent teeth.

The patient was seen for post-operative appointments at ten days and again at eight weeks at the
surgeon’s practice. Soft tissue health was confirmed, radiographic bone levels were relatively unchanged and no mobility of the provisional restoration or implant was noted.

The patient returned to the restorative dentist for the initiation of restorative therapy at about ten weeks.

Removal of the provisional crown demonstrated physiologic development of the peri-implant soft tissues.

Rather than taking an elastomeric impression, an Atlantis IO FLO (scan body) for Astra Tech Implant System EV was placed for digital impression of the implant with an iTero intraoral scanner. Using a CAD/CAM impression system allowed for an extremely accurate impression of both the soft tissue and the implant position to be taken quickly and easily, providing the laboratory with all necessary landmarks to create a very natural emergence profile for the final restoration. Using the iTero impression system also allowed us to have an Atlantis patient-specific abutment fabricated for this case. The unique interface design of the Astra Tech Implant System EV allows for one-position-only placement of Atlantis patient-specific abutments, making the impression-taking and final delivery very easy and uncomplicated.

The Atlantis Abutment was fabricated with the unique combination of four key features called the Atlantis Abutment BioDesign Matrix, which includes Atlantis VAD (Virtual Abutment Design) software that takes into consideration the final tooth shape, the edentulous space and the adjacent teeth in the design of the abutment. The Natural Shape of Atlantis Abutments is the emergence profile based on individual patient anatomy while the Soft-tissue Adapt helps to provide optimal support for the soft tissue. Lastly, the abutment-to-implant Custom Connect provides a strong and stable fit.

The final prosthetic restoration consisted of an all-ceramic lithium disilicate crown (IPS e.max, Ivoclar Vivadent) providing an excellent aesthetic outcome. The all-ceramic crown was cemented with resin cement after tightening of the abutment screw to 25 Ncm and plugging the access with white Teflon tape. Figure 22 shows the nice aesthetic result of the final restoration.

Editorial note: A complete list of references are available from the publisher.

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Intraoral impression scanning combines digital and implant dentistry for streamlined results

Author: Dr Bart W. Silverman, USA

Case report

A 55-year-old male presented to my office with a right maxillary alveolar abscess and bone loss associated with his maxillary right second premolar. The patient had visited his dentist approximately one month prior, as his crown had fallen out. The dentist replaced the crown and the infection became apparent soon after. After consulting with the general dentist regarding tooth removal, a bone graft and implant placement with future internal lift were planned.

The fractured maxillary right second premolar was surgically removed, and a mineralized cortical bone graft as well as a cytoplast membrane was placed. Following healing, a CS 9300 (Carestream) CBCT scan was performed to take a cursory panoramic radiograph. A Thommen 4.5 mm/3.2 mm x 9.5 mm...
contact implant was placed, along with an internal sinus lift.

After healing, the patient presented to my office for a digital impression. A preliminary scan of the gingival former using the CS 3500 intraoral scanner was performed. The gingival former was removed, a scanning body was placed into the implant and the CS 3500 was used to scan the scanning body as well as the rest of the maxillary arch and the opposing arch.

The digital file was sent to Core 3-D lab and a custom titanium abutment was fabricated. The abutment was shipped to dental laboratory (Digident Dental Lab in Orangeburg, NY) and a ceramic crown was fabricated after the general dentist picked a shade. The abutment was placed, torqued to 32 cm and the crown cemented.

**Conclusion**

This case illustrates how digital dentistry can be used with implant dentistry. Frequently, a fixture level impression is taken and subsequently a model is poured up in stone; on top of which a custom abutment is made. Later the dental technician will fabricate a ceramic crown.

Using the CS 3500 (Carestream) intraoral digital impression, the workflow is streamlined. By placing a scanning body and scanning it with the CS 3500, the custom abutment and crown are produced via a digital model. The abutment and crown are planned virtually, reducing patient chair time and overall case turnaround time.

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**About**

**Dr Bart W. Silverman** is in private practice limited to Oral and Maxillofacial Surgery in New City, NY, and is an attending Physician at Westchester County Medical Center, Department of Oral and Maxillofacial Surgery and Nyack Hospital, Department of Dentistry. He is also a Clinical Associate Professor at New York Medical College. He lectures nationally on several different implant systems and is President of the Bi-State and Hudson River Implant Study Clubs. He is a past president of the Rockland County Dental Society and previously served on the Board of Governors of the Ninth District Dental Society.

Dr Silverman graduated from Fairleigh Dickinson University in 1982 Summa Cum Laude and received his doctorate in Dental Medicine in 1986 from Fairleigh Dickinson Jr. School of Dentistry, where he was a member of the Omicron Kappa Upsilon Honor Society. He completed his Oral and Maxillofacial Surgical residency at Westchester County Medical Center in 1989 and was Chief Resident during his final year. Dr Silverman is currently a Diplomate of the American Board of Oral and Maxillofacial Surgery.
Diagnostic imaging in clinical practice

Prosthetically driven implant placement planning requires images on which you can rely

Author: Dr Bart Vandenberghe, Belgium

A sequence of scientific papers has demonstrated the crucial role of cone beam computed tomography (CBCT) in the field of implant dentistry. In 2012, the American Academy of Oral and Maxillofacial Radiology recommended the application of this imaging technology as the preferred method of pre-surgical assessment of intraoral implant sites.

The ability of CBCT imaging to visualize the smallest bony details means that CBCT is superior to CT for evaluating the morphology of the residual alveolar ridge and bone quantity in most cases, while emitting very low doses of radiation. The data can then be used in dedicated CAD/CAM software. Finally, the relatively low cost of CBCT systems makes them economically viable—even more so than conventional CT—for use in everyday clinical practice.

CBCT imaging as preferred method

Until recently, radiographic modalities for diagnosis during implant treatment planning relied upon two-dimensional projections of three-dimensional anatomical structures. With the advent of computed tomography, cross-sectional imaging had evolved from simple, locally produced tomographic sections to more accurate, faster and more versatile 3-D reconstructions computed for maxillofacial diagnostic tasks. However, this came at the cost of relatively high exposure doses.

By the late 1990s, CBCT further advanced the field of dental and maxillofacial radiology by allowing 3-D visualization of anatomical structures and their spatial relationship with a significantly reduced radiation exposure to the patient. In contrast to the fan-shaped beams and multiple detectors used in multi-slice computed tomography (MSCT), CBCT uses a conical X-ray beam to acquire images. The entire volume is imaged in one single rotation using a flat two-dimensional image receptor, thus making it the widely accepted method of choice for the pre-surgical assessment of intraoral implant sites today.

High accuracy and patient satisfaction

The past decade witnessed a paradigm shift from surgically driven to prosthetically driven implant placement planning. No longer just an add-on to the process, CBCT scanning has become the cornerstone of an integrated treatment workflow helping clinicians better execute their treatment plans.

With a single scan, practitioners are able to acquire much more—and more accurate—data at low effective radiation doses that are nearly equivalent to the dose of panoramic exams. The superior radiographic visualization compared with 2-D radiography facilitates better pre-surgical assessment and a better understanding of any oral pathologies. At the same time, the data can be used to optimize virtual treatment planning in 3-D and to prepare for guided surgery, which contributes to optimized treatment tailored for each patient.

Furthermore, less invasive procedures reduce patient discomfort and result in high patient satisfaction, as shown in observational studies on guided flapless...
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Preoperative planning

Initial evaluation
Panoramic radiograph, followed by intraoral radiographs to obtain supplemental information. Use of cross-sectional imaging discouraged.

Radiographic exam of implant sites
Include cross-sectional imaging orthogonal to the site of interest. CBCT considered the imaging modality of choice.

Bone augmentation
CBCT if augmentation procedures or site development before placing dental implants are required, and if bone reconstruction and augmentation procedures have been performed prior to implant placement.

Postoperative implant assessment

Immediate post-op evaluation
Intraoral radiographs are recommended in the absence of clinical signs or symptoms. Cross-sectional imaging—particularly CBCT—should only be used immediately postoperatively if the patient presents with implant mobility or altered sensation.

Follow-up examination
CBCT to be considered if implant retrieval is anticipated. Should not be used for periodic review of clinically asymptomatic implants. Instead, intraoral and, in some cases, panoramic images are adequate for postoperative implant monitoring.

Statement on the use of CBCT for research purposes
Applicable to all scanning procedures. Adhere to the principle of keeping radiation doses As Low As Reasonably Achievable (ALARA).

A recent study to assess prospective implant sites using panoramic radiography versus panoramic scans combined with CBCT imaging revealed that CBCT increases the accuracy of treatment planning as it makes it possible to predict the actual implant dimensions required at surgery (Mello et al., Braz Oral Res. 2014). Furthermore, performing a CBCT scan during the planning phase increases accurate prediction of implant length as well. The overall outcome is a more predictable surgical and restorative result.

Superior visualization of anatomical structures

Digital imaging can offer clinicians and technicians a highly accurate diagnostic and treatment-planning tool with the potential to reformat the scan data and create virtual models of the patient’s anatomy. There is also the distinct advantage of accurate measurement in any dimension.

The generated 3-D volumetric data sets are essentially distortion-free and can provide primary reconstruction images in multiple planes. One of the main characteristics of CBCT is the ability to depict the fine details of bony structures. It is therefore particularly suited to head and neck diagnostics and dental applications in order to:

- Assess the anatomy, available bone height, width, and relative quality for implant surgery planning, and in the management of suspected implant treatment complications.

- Determine the three-dimensional topography of the alveolar ridge.

- Localize vital anatomical structures in close proximity to the planned surgery sites, i.e., the inferior alveolar nerve, mental foramen, incisive canal, maxillary sinus, sinus ostia and nasal cavity floor.

- Assess the presence of dentoalveolar pathology in the jaws and dentition or even temporomandibular joint (TMJ) pathology that could not be or was not adequately assessed using 2-D radiographic techniques.

The reliability of dimensional measurements is clinically relevant. Conventional radiological data acquisition can lead to millimetre-range deviations from anatomical reality, while CBCT has not only shown the ability to provide sub-millimetre measurements at much higher accuracy, it also provides segmentation accuracy that allows for the creation of accurate 3-D models. In addition, CBCT imaging offers potential for implant follow-up, as it produces considerably fewer metal artefacts than MSCT.

Parameters that affect radiation dose

In practice, higher resolution of bone structures can be obtained with CBCT than with MSCT. Radiation exposure from CBCT is typically considered to be lower than that incurred from common spiral and multi-slice protocols. Depending on the geometrical configuration and the exposure parameters of the system, there is significant variability in the effective radiation dose delivered by CBCT machines. Dose reduction can be achieved by adjusting operating parameters. Crucial parameters include exposure time, tube current, the size of the field of view (FOV) and the angular degree at which the gantry rotates around the patient’s head.
Augmentation and implant treatment

Two-stage surgery in the severely resorbed edentulous mandible

Author: Dr Marko Nikolic, Croatia

Introduction

An adequate bone volume at the future implant site is a prerequisite for ideal implant placement and implant success. A residual bone with a vertical dimension less than 5.0 mm indicates a cut-off point and implies the need of additional augmentation procedures in connection with implant insertion, whereas higher values of the alveolar crest ≥ 5.0 mm are considered to be sufficient for treatment with standard-diameter implants without the urgent need of any horizontal bone augmentation.

Distant donor sites like the anterior and posterior iliac crest and intraoral areas like the retromolar...
Dibular and the interforaminal region of the chin are common sources for harvesting autogenous bone-grafts. Depending from the donor site, patient and surgeon should be aware of the possible confrontation with various advantages but also disadvantages when harvesting the bone. Harvesting bone from the iliac crest requires patient hospitalisation, and surgery under general anaesthesia, whereas intraoral bone harvesting can be performed ambulatory and under local anaesthesia.\(^2,3\) The main problem with autogenous bone grafting is represented by the high risk of patient morbidity, causing pain, swelling, and healing problems at the donor site.\(^2\)

The aim of this case presentation is to demonstrate a predictable, two-stage operating protocol for the horizontal augmentation of the severely resorbed, edentulous anterior mandible with an autogenous bone graft, harvested from the crestal alveolar ridge at implant site, in order to create a sufficient bone volume for the later implant therapy, without donor morbidity for the patient.

Patient data

The 47-year-old male patient visited our dental office in order to renew his old and poor fitting prostheses in the lower and in the upper jaw. The remaining five teeth 32–43 in the front of the lower jaw had been removed three months previously due to a chronic periodontitis in our dental practice. Nearly all remaining teeth in the upper and the lower jaw showed significant signs of pregrident chronical periodontitis, insufficient root treatments and prosthetic suprastructures as well (Fig. 1). The medical history of the patient was without any significant pathological findings.

Diagnostic procedures

In cases of long-term edentulism, the dental surgeon is almost always confronted with a reduced bone volume, representing both a major challenge and a significant demand for the use of diagnostic imaging methods prior to augmentation and implant treatment. Conventional X-ray images contain only a two-dimensional information concerning the vertical height of the alveolar bone. Therefore, they represent an insufficient method for the appreciation of the horizontal bony dimensions.\(^4\) In comparison, three-dimensional (3-D) diagnostic tools like cone beam computed tomography (CBCT) offer the advantage of the visualisation of the so called ‘z-axis’, representing the bone volume in the horizontal, i.e. bucco-lingual dimension of the alveolar crest respectively. A proper treatment planning and the use of 3-D diagnosis are therefore crucial parameters for a predictable and sustainable final treatment outcome in implant therapy, especially in patient cases with severe resorption of the jawbone, like in our presented patient case.

The oral examination and the CBCT-Scan (SCANORA, SOREDEX, Schutterwald, Germany) revealed a distinct bone resorption in the lower jaw, showing a more pronounced horizontal atrophy in the anterior part of the mandible (Figs. 2 & 3). According to the clinical measurements and the values of the 3-D CBCT scan, the interforaminal vertical bone height was between 22.0–25.0 mm. The horizontal bone volume amounted to between
1.0–3.0 mm in the implantation zone. The CBCT-Scan revealed a horizontal crestal bone thickness of 1.09 mm in region 32, and 1.74 mm in region 44.

Treatment planning and augmentation procedure

After patient-consultation, we opted for a two-stage surgery with an intraorally harvested autogenous bone-graft and a delayed implant treatment after a healing period of at least four months. As the vertical dimension of the implant region appeared to be sufficient enough for placement of implants with a standard length, we decided to cut off 5.0 mm of the thin and sharp-edged alveolar ridge by osteotomy, in order to create an autogenous lateral onlay bone-graft for horizontal augmentation in the anterior alveolar ridge. This protocol comprised in our view the advantage of the avoidance of donor morbidity, because the donor site was the receptor site as well. After creation and mobilisation of the mucoperiostal flap, the very thin and sharp edge of the atrophied alveolar crest became visible (Fig. 4).

The osteotomy of the bone was performed with a saw (Bone splitting system, Helmut Zepf Medizintechnik GmbH, Seitingen-Oberflacht, Germany; Fig. 5). Subsequently, the graft was detached from the anterior mandible with chisel (Bone splitting system, Helmut Zepf, Medizintechnik GmbH, Seitingen-Oberflacht, Germany; Fig. 6) and a cortico-cancellous bone block was obtained (Fig. 7). The bone graft was fixed at the buccal side of the anterior mandible (region 34–44) with four 8.0 mm long titanium microscrews (Storz am Mark GmbH, Emmingen-Liptingen, Germany; Fig. 8). A combination of autogenous bone chips and particulated xenograft (BEGO OSS, BEGO Implant Systems, Bremen, Germany) was placed in the small remaining space between the bone block and the alveolar processus, as well as around and on the bone graft. The augmented site was covered with a platelet rich in growth factors (PRGF) membrane (BTI Biotechnology Institute, Blue Bell, USA) and additionally with a barrier membrane for guided bone regeneration (GBR, Bio-Gide, Geistlich Biomaterials Vertriebsgesellschaft mbH, Baden-Baden, Germany; Fig. 9). The healing of the graft was uneventful and without any complications, like membrane exposure, being classified as a frequent post-operative complication. The patient was provided with a removable provisional prosthesis.

Re-entry and implant surgery

The re-entry for the delayed implant placement protocol was planned after a healing period of four months. With regard to the soft aspect of the augmented area of the anterior mandible, the
dimensions of the alveolar ridge appeared sufficient enough for implant placement (Fig. 10). The CBCT data confirmed the assumption, demonstrating a significant gain of bone volume in the interforaminal region of the mandible after augmentation. The horizontal thickness of the crestal alveolar bone was 5.53 mm in region 44 and 4.43 mm in region 32. The augmentation procedure resulted in a horizontal bone gain of about 3.9 mm in region 44 and 3.3 mm in region 32 respectively, representing a mean bone gain of 3.6 mm (Fig. 11). After elevating the flap, an apparently good osseointegration and stabilisation of the autograft with the underlying pristine bone could be noticed (Fig. 12). Prior to implant placement, the fixation screws were removed. The four implants with a diameter of 3.75 mm and a length of 11.5 mm (BEGO Semados® RSX, BEGO Implant Systems) were inserted epicrestally in regions 33, 31, 41 and 43 using the freehand-method without a surgical guide (Fig. 13). The insertion torque of the implants was 35 Ncm with good primary stability.

**Pre-prosthetic surgery and prosthetic rehabilitation**

After three months of uneventful submerged healing, the panoramic X-ray showed a successful implant osseointegration without any signs of bone resorption (Fig. 14). Due to a lack of keratinised gingiva, we decided for an enlargement of the ratio between attached and free gingiva by performing mucogingival surgery with the Edlan-Mejchar method (Figs. 15, 16 & 17). After an additional healing period of one month, the final bar retained, a removable acrylic overdenture was incorporated. The bar was constructed with bar abutments (PS TiBA, BEGO Implant Systems) and a non-precious alloy (Wirobond®, BEGO Dental, Bremen) and was screw-retained on the four implants (Figs. 18, 19 & 20).

**Discussion**

In our case presentation, the patient suffered from an extremely horizontal bone resorption, resulting in a 1.0–3.0 mm thin, and knife-edged alveolar crest. Since standard diameter dental implants need a certain crestal bone volume for an adequate stabilisation and a good and predictable osseointegration, augmentation procedures had to be performed prior to implant treatment.6 A recently published meta-analysis showed that dental implant survival has probably to be seen independently of the biomaterial used in augmentation procedures.7, 8 Since this evidence is limited by the fact, that defect size, augmented volume, and regenerative capacity are scarcely well described in literature, autogenous bone is still recommended as the ‘gold standard’ for augmentation in the deficient alveolar ridge. Simultaneous grafting and augmentation is the standard procedure in ridge augmentation, resulting in an extended operating time.3 Fortunately, as the vertical dimension of the anterior mandible was high enough in our clinical case, we were able to harvest an adequate autogenous bone block from the thin alveolar crest, in order to use it as an onlay graft for the horizontal augmentation of the anterior mandible. This procedure avoided donor site morbidity, and resulted in less operating time and a reduced patient discomfort. The dimensions of the graft were ideal for lateral augmentation, so that there was no need for any additional carving of the bone block. As mean bone gain after healing of the autogenous graft was

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Fig. 14: After three months of submerged healing, a successful implant osseointegration without bone resorption was visible on the panoramic X-ray.
Fig. 15: Soft-tissue condition of the anterior alveolar crest at the time of implant-uncovering: lack of keratinised gingiva.
Fig. 16: After uncovering the implants, an Edlan-Mejchar plastic surgery was performed to deepen the vestibulum.
Fig. 17: Aspect after plastic surgery.
3.6 mm in our patient, it was slightly smaller compared to the average bone gain of 4.3 mm, as reported in a systematic review by Jensen and Terheyden in 2009, but was comparable to the findings of a recent review by Sanz-Sanchez et al., showing a mean bone gain in horizontal defects of 3.9 mm in a staged approach. Nonetheless, we gained enough bone volume for insertion of four standard diameter implants. Considering the fact that the fixation screws had to be removed, and with regard to a number of benefits of a delayed implant placement in augmented deficient alveolar ridges, we opted for a two-stage protocol. Even though delayed implant placement with flap elevation required a second surgical intervention and therefore an additional burden for the patient, it comprised the additional advantage of a visual and tactile assessment with respect to the osseointegration of the autograft in our patient case. Another crucial advantage of the staged approach comprised inter alia the possibility for an implant placement in an ideal position for the later prosthetic restoration under visual control. Another reason for open access for implant placement was the use of non-resorbable microscrews for the stabilisation of the bone graft. The decision to utilise non-resorbable titanium screws in favour to resorbable screws out of poly (D,L-lactide) acid, was supported by the findings of a systematic review of the Cochrane Collaboration. Thus, resorbable screws seem to have a high susceptibility for fracture during fixation of onlay grafts. As the combination of autogenous grafts with guided bone regeneration (GBR) is apparently associated with superior outcomes, we decided to use a barrier membrane. With the additional application of a PRGF membrane, we aimed to utilise the beneficial effects of platelet-derived rich plasma for an advanced wound therapy, and the reduced risk of post-operative infection. The vestibuloplasty with the Edel-Mejchar method was performed for two purposes. Firstly it was done in order to create a sufficient amount of keratinised mucosa. According to findings of a systematic review, published by Lin et al., a lack of keratinised mucosa around implants fosters plaque accumulation, inflammation, and soft-tissue recession. Secondly we aimed to create enough space for the final overdenture.

**Conclusion**

The staged approach with the use of an autogenous bone graft, harvested from the surgical site in the anterior mandible, resulted in a significant horizontal bone gain, and took to a good osseointegration of both, autograft and implants. Obviously, the described grafting procedure has not been previously reported in literature. Despite the lack of any experience reports, our method revealed nonetheless a successful rehabilitation with an implant-supported, screw-retained prosthetic rehabilitation, and is still in function without any biological or technical problems after a three-year follow up.

Special thanks to Dr Pantelis Petrakakis.

**Editorial note:** A list of references is available from the publisher.

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The complete implant workflow – easiness with one software

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An indirect method for provisionalisation

The team approach in a complete mouth hybrid reconstruction

Authors: Dr Robert A. Levine & Dr Harry Randel, USA

Initial situation

A periodontist and ITI colleague whose office is two hours from our practices referred this patient to our team. Initially, she was seen by the prosthodontist, Dr Harry Randel, and subsequently referred to the periodontist, Dr Robert Levine, for a team approach to solve her failing dentition. The patient presented at our office as a 65-year-old non-smoking female (ASA 3: Illnesses under treatment: anxiety/depression, osteoarthritis, fibromyalgia, hypothyroidism and history of myofacial pain dysfunction, Figs. 1–3). There was a history of TMJ issues (i.e. clicking and pain with her right side TM joint) which presently is under control and pain-free.

Her chief complaint was to improve her aesthetics and comfort with a desire for a permanent and quick solution to replace her failing dentition. She also desires a reduction of her maxillary anterior gummy smile in the final prosthesis. She arrived at our office for a third surgical consult for an immediate load maxillary and mandibular hybrid restoration using the Straumann® Pro Arch treatment concept (tilting of the distal implants to avoid anatomic structures of the maxillary sinus, mandibular mental foramina). This treatment concept reduced the need for additional surgeries and number of implants needed to provide a fixed hybrid restoration with a first molar occlusion. A medium to high lip line was noted upon a wide smile with a bi-level plane of occlusion. Also noted was supraeruption of her maxillary and mandibular anterior teeth (FDI: #12, 11, 21, 22 and #41–43, US: #7–10 and #25–27) creating a deep bite of 6 mm (Fig. 2). A Class I canine relationship was recorded with 6 mm overjet & 6 mm overbite. Due to her medication-related dry mouth issue, generalised recurrent caries were noted. Periodontal probing depths ranged generally from 4–7 mm in the maxillary jaw and from 4 to 6 mm in the mandibular jaw with moderate to severe marginal gingival bleeding upon probing in both jaws. Tooth #6 (FDI: #13) was
noted to have a vertical fracture clinically. There was
generalised heavy fremitus in her maxillary teeth
and mobilities ranging from 2–3 degrees on the fol-
lowing teeth: #3, 7 thru 13, 20–26 and 29 (FDI: #16,
12, 11, 21–25, 31–35, 41–42 and 45). Her compliance
profile was good with her previous dentists, how-
ever, she states that she has always had “issues with
my gums.”

The tentative treatment plan discussed at the ini-
tial visit with the patient and her husband included
the following diagnosis: generalised moderate to
advanced periodontitis; generalised recurrent caries
related to medication-related dry mouth; posterior
bite collapse with loss of occlusal vertical dimension
(“mutilated dentition”). Prognosis: all remaining
teeth are hopeless.

Treatment plan

1. Obtain a CBCT of both arches to evaluate bone
quality, bone quantity, and anatomical limitations
(Fig. 4).
2. Articulate study models with fabrication of diag-
nostic full upper denture (FUD), full lower denture
(FLD) and surgical guide templates.
3. Team discussions to develop the final surgical and
prosthetic treatment plan for hybrid restorations
using the Straumann® Bone Level Tapered Implant
(BLT) with a first molar occlusion. Utilisation of
an indirect technique will be used to fabricate the
converted fixed laboratory metal-reinforced pro-
visionals in one day.
4. Coordination of the surgical visit (Dr Robert
Levine) with the prosthodontist’s office (Dr Harry
Randel), dental laboratory (NewTech Dental Lab-
oratory, Landsdale, PA), and the dental implant
company representative (Straumann USA, Ando-
ver, MA). The patient is aware of the possible need
to wear one or both dentures during the healing
phase if the insertion torque values are inade-
quate for immediate loading. This may be due to
bone quality, bone quantity, or need for extensive
bone grafting requiring a membrane technique
for guided bone regeneration (GBR) and a two-
stage approach. This is very important to review
with all patients, especially when only four im-
plants are planned in the maxilla, as the distal im-
plant(s) may record poor insertion torque values
due to bone quality and quantity. The ability to use
longer, tapered (BLTs), and tilted implants—as in
the present case—with adequate buccal bone
available for the anticipated 4.1 mm implants help
to reduce this possibility significantly.
5. Delivery of the fixed provisionals in one day in the
prosthodontist’s office.
6. Post-operative visits every two to three weeks with
the periodontist’s office for deplaquing, review of
plaque control techniques and delivery of a water
irrigation device at six weeks. An occlusal adjust-
ment to be completed at each post-operative visit
with the surgical and restorative offices, because
the occlusion is very dynamic as the patient’s mus-
culature continues to accept her newly restored
occlusal vertical dimension (OVD). Time is also
needed to stabilise her TMJ symptoms.
7. Completion of final case at least three months
post-surgery. Since the patient will be spending
the winter in Florida, she will commence her final
treatment when she returns in the spring.
8. Periodontal maintenance every three months
alternating between offices.

Based on CBCT analysis it was decided to place
five implants in the upper jaw at the following sites:
#4 (FDI: #15) (tilted), #7 (FDI: #12), between #8 & #9
(FDI: #11 & #21) (midline), #10 and #12 (FDI: #22 and
#24) (tilted) after vertical bone reduction for pro-
sthetic room. Four implants were anticipated to be
placed in the lower jaw at sites #21 (FDI: #34) (tilted),
#23 (FDI: #32), #26 (FDI: #42), & #28 (FDI: #44)
(tilted). The anticipated position of each implant
is ideally palatal in the maxilla to the original teeth
and lingual to the original mandibular teeth. This is
allow for screw-access holes exiting away from
the incisal edges anteriorly, and if possible, lingually
to the central fossae in the posterior sextants. An
addition benefit of palatal and lingual placement
of each implant is that their final position will be at
least 2–3 mm from the anticipated buccal plates,
which is beneficial for long-term bone maintenance
and implant survival. If the necessary 2 mm buccal
bone to the final implant position is not available,
then contour augmentation (bone grafting) is rec-
mended to create that dimension. The goal is
to prevent buccal wall resorption over time using
slowly resorbing inorganic bovine bone and a re-
sorbable collagen membrane. This membrane allows
easy contouring and flexibility over the graft mate-
rial when wet. It is also important to evaluate tissue
thickness. It is ideal to have at least 2 mm of buccal
flap thickness over each implant as thin tissues are
associated with bone loss and recession over time.
Either connective tissue grafts from the palatal flap or tuberosity can be harvested and sutured under the buccal flap. Alternatively, an allograft connective tissue or a thick collagen material can be used to thicken the buccal flaps when necessary.

**Surgical appointment**

The patient was pre-medicated with oral sedation (triazolam 0.25 mg), amoxicillin, a steroid dose pack and chlorhexidine gluconate (CHG) rinse, all starting one hour prior to surgery. The patient’s chin and nose were marked with indelible marker, and the OVD was measured using a sterile tongue depressor with similar markings while the patient’s mouth remained closed. The patient was then given full mouth local anaesthesia.

Starting with the maxillary arch, full-thickness flaps were raised and sutured to the buccal mucosa with 4-0 silk to provide improved surgical access and vision. The teeth were removed with the goal of buccal plate preservation using the PIEZOSURGERY® (Mectron: Columbus, OH) for bone preservation (tips EX1, EX2, Micro saw: OT7S–3). The sockets were degranulated with PIEZOSURGERY® (tip: OT4) and irrigated thoroughly with sterile water.

With the anatomically correct surgical guide in position and firmly held in place by the surgical assistant, measurements were made from the mid-buccal of each tooth. Surgical cuts were made going from the anticipated cantilever of site #3 (FDI: #16) to site #14 (FDI: #26) using the PIEZOSURGERY® saw (tip: OT7). Our team goal was to create the prosthetic room necessary for a hybrid restoration i.e. 10–12 mm. The cuts were intentionally extended beyond the anticipated cantilever length to create adequate strength and thickness of the final prosthesis in these unsupported cantilever areas (Figs. 5–6). The mandibular arch was treated in a similar manner. Additionally, bilateral mandibular tori reduction was accomplished with the aid of the PIEZOSURGERY® saw (tip: OT7) after the extractions and prior to the vertical bone reduction of the mandibular ridge. Subsequently, the implants were placed.

The implant sites were prepared per the manufacturer’s protocol (except for bone tapping) for the Straumann® BLT implant. The implants were placed using the surgical guide template with the following insertion torques measured: site: FDI: #15, #12, #11, #21, #23, #25, #34, #32, #42/US: #4, #7, #8–9, #11, #13, #21, #23, #26. All torques were >35 Ncm with #28 (FDI: #44) recording 20 Ncm insertion torque values. All implants were 4.1 mm in diameter and 14 mm in length except FDI: #12, #11, #21, and #23/US: #7, #8–9, and #11, which were 12 mm in length (Fig. 7). All 17 and 30 degree-angled implants
were bone profiled prior to SRA abutment placement. This allowed the complete seating of the SRA abutment at the recommended 35 Ncm torque. Using the available Straumann® bone profilers with the appropriate Narrow Connection (NC) or Regular Connection (RC) inserts was a critical step for an abutment to fit correctly. The following SRA abutments (all were 2.5 mm gingival heights) were then chosen: straight: FDI: #32, #42; US: #23, #26; 17 degrees: FDI: #15, #12, #11, #21; US: #4, #7, #8–9; and 30 degrees: FDI: #23, #25, #34, and #44; US: #11, #13, #21, and #28. Tall protective healing caps were then placed (Fig. 8), and the dentures were checked to evaluate that there was adequate space for the pink acrylic to allow for bite registration material thickness. All sockets and buccal gaps to the immediately placed implants were bone grafted. Prior to suturing, the tissue flaps were scalloped with 15c blades to reduce overlap of the flaps over the protective caps. This not only aided in post-operative healing, but also aided in the visualisation of the abutments by the restorative dentist for the provisional insertion. The patient was sutured with resorbable 4-0 chromic gut and 5-0 Vicryl™ sutures (Ethicon: Johnson & Johnson) and was released to be seen immediately by Dr Randel for the coordinated restorative visit.

As discussed below, his responsibilities included: bite registration, impressions, and the dental lab conversion of the complete denture to a metal-reinforced fixed transitional prosthesis (indirect provisionalisation technique). Our team of restorative dentists have been treating full-arch immediately loaded cases on 5–8 implants (depending if restoration is a hybrid or C&B) since 1994. Our earlier experiences, for approximately the first two years (1994–1996), have resulted in us all presently using the indirect technique, which in our hands is easier for everyone involved (especially the patient). We handle these coordinated visits between offices, the dental lab, and our Straumann representative weeks in advance so we are all on the same page with timing. These coordinated efforts could be compared to a symphony orchestra, where each musician knows their specific part and when and where they are expected to be. Many of our patients have described this fluidity as a seamless experience that they witness first hand and greatly appreciate.

**Same-day restorative appointment**

The patient was seen in Dr Robert Levine’s office for restorative records with Dr Randel (prosthodontist) in preparation for immediate load protocol. The previously processed dentures were first checked with pressure paste to ensure the absence of contact between the intaglio surface and the tall healing caps. Bite registration material was then used to confirm there was no contact (Fig. 9), and later will be used by the lab to articulate the models. Efforts were made to confirm the OVD (with the marked tongue depressor provided by Dr Levine), incisal position, midline, plane of occlusion, and centric position with the prostheses in place. Adjustments were made as needed. Photographs were acquired to document and relay information via e-mail to the lab technician. The lab will use the registration material left in the intaglio surface of the prostheses, as healing caps will be placed on the newly fabricated models. This allows the index to transfer the OVD and centric relationships with contact just on the healing caps. The soft tissue plays no role in this relationship. A bite registration was made to confirm centric relation. Healing caps were then removed and open tray impression copings were placed. If the connection between the implant abutments and the impression copings are not visualised, then X-ray confirmation of the connection is needed. Transfer impressions were made using a custom tray and rigid impression material of choice, in this case polyether was used.
Our lab courier delivered the dentures and impressions to the lab for the conversion to metal-reinforced, screw-retained provisionals, which were delivered back to the restorative office within 24 hours. The next afternoon, the prostheses were inserted (Fig. 10) and panoramic radiographic confirmation of proper seating was obtained (Fig. 11). Any necessary occlusal adjustments were then completed. The patient was then seen every two to three weeks for deplaquing and plaque control review per our earlier discussed protocol. The occlusion was also refined as needed. The patient’s TMJ symptoms were significantly reduced within the first three weeks. A water irrigation device was given and reviewed at six weeks post-surgery. As the patient was in Florida for the winter, and unable to come in after the typical 3 month protocol, she was seen 4 1/2 months after the surgery. At that time, periapical X-rays of each implant were done to confirm bone healing. The prostheses were removed and cleaned. GC verification jigs (Fig. 12), made on the original models and fabricated prior to the appointment, were tried in. If passivity is not confirmed, then the GC jig can be cut and re-indexed.

Once the fit of the verification jigs was confirmed, custom trays were used to transfer the relationships (Fig. 13). During the following appointments, OVD and centric relations were obtained, and the wax try-ins were confirmed for aesthetics, phonetics, and occlusion prior to the milling of the framework (Fig. 14). It is important to confirm tooth location prior to milling the framework so that the framework was designed within the parameters of the acrylic/tooth borders. At the insertion appointment, the healing caps were removed and cleaned with chlorhexidine. Figure 15 demonstrates the excellent healing of the soft tissue prior to insertion of the prosthesis. Once inserted, aesthetics, phonetics, and OVD of the prosthesis were confirmed. The occlusion was adjusted as needed. Screws were tightened to 15 Ncm, screw access openings were filled with Teflon tape to within 2 mm of the surface, and a soft material such as Telio or Fermit was used to seal the
access. A maxillary acrylic nightguard was fabricated to help protect the occlusal surfaces from wear and reduce any parafunctional habits. The completed case is shown (Figs. 15–18). At subsequent appointments, the prostheses were evaluated to determine if they needed to be removed to assess the soft tissue or if any contouring of the acrylic was necessary. Eventually, the soft material used to close the access can be replaced with a hard composite material.

Conclusion

A Complex-SAC Straumann® Pro Arch Case was presented. Management of this treatment utilised the advantages of the team approach for maximising our combined knowledge to benefit the patient, consistent with ITI doctrine. The use of the BLT implants, due to excellent initial stability, gave us the confidence in our ability to not only use immediate extraction sites (Type 1 implant placement), but also to increase avoidance of anatomic structures. In this case, the structures include the maxillary sinuses, nasopalatine and mental foramina, as well as the inferior alveolar nerve canals. In addition, with the tapered design of the BLT implant, maxillary anterior areas could be utilised by the surgeon to avoid apical fenestrations where undercuts could become problematic using straight-walled bone level implants. The coordinated appointments, along with the symphony-like steps in the procedure, created a positive, “seamless” experience for the patient.

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New 3-D printer expands possibilities

Planmeca recently expanded its portfolio with an entirely new kind of product. Named Planmeca Creo, the company’s brand new 3-D printer will allow dental laboratories and large clinics to perfect their craft and grow their business.

Planmeca Creo is a powerful 3-D printer for creating models and surgical guides from medically approved materials with true precision and efficiency. In the near future, the device will also support the creation of other dental objects of intricate detail, such as dental splints, temporary fillings, and orthodontic models.

“3-D printing is the way of the future, as it permits labs and larger clinics to expand their production capabilities and increase efficiency”, comments Jukka Kanerva, Vice President of Planmeca’s Dental care units and CAD/CAM division.

Planmeca Creo uses Digital Light Processing (DLP) technology to create objects out of UV curable resin. The 3-D printer has its own dedicated software, which is included as part of all deliveries.

“We feel that 3-D printing is set to take on a much more substantial role in dentistry—we can’t wait for our customers to see what Planmeca Creo is capable of”, Kanerva states.

The new Planmeca Creo 3-D printer is already available for orders, with deliveries expected to begin soon.

chairside milling unit

Planmeca PlanMill 40 S—power meets precision

The latest addition to Planmeca’s product line is the Planmeca PlanMill 40 S milling unit for dental clinics. It is the most powerful unit for chairside milling the dental market has seen.

The Planmeca PlanMill 40 S milling unit has been designed for the chairside fabrication of metal-free dental restorations and appliances. It combines superior usability with accurate high-speed milling.

“Planmeca PlanMill 40 S will introduce a level of quality, precision and performance that has not yet been seen in the industry”, states Jukka Kanerva, Vice President of Planmeca’s Dental care units and CAD/CAM division.

With its state-of-the-art design, smart tool paths, expanded range of applications, automated tool changer for 10 tools, and intelligent maintenance features, Planmeca PlanMill 40 S is set to offer the most complete milling experience available today.

“The S in the product’s name stands for Smart – which is exactly what the unit brings to the table”, Kanerva illuminates.

The Planmeca PlanMill 40 S unit will replace its predecessor Planmeca PlanMill 40 in the company’s product line.

The new milling unit will also combine with the Planmeca PlanScan intraoral scanner and the Planmeca PlanCAD Easy design software in forming the Planmeca FIT chairside CAD/CAM system from now on.

Planmeca PlanMill 40 S is immediately available for orders everywhere except the North American Market. Deliveries are expected to begin in the final quarter of 2016.
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Today, zirconia material is the preferred choice in dentistry due to its superior aesthetics and hardness. This is why INTERDENT d.o.o. produces CC Zr SMILE 98 mm diameter discs made of biocompatible pre-sintered ZrO₂. Its exceptional translucency and low hardness value enables highly aesthetic constructions in the anterior region. You can prepare fully anatomical single crowns and bridges up to 3 units or frameworks designed with the cut-back technique, which, together with layered ceramic, give the appearance of a natural tooth. A wide selection of colours A1, A2, A3, A3.5, B2, B3, C2 and D2 in sizes 14 and 18 mm with a diameter of 98 mm, enables you to produce prosthetic restorations that fulfill high aesthetic demands. CC Zr SMILE is compatible with all ceramic veneering materials for zirconium and can be coloured by dipping or brush techniques.

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Possibilities and risks of digital techniques in implant dentistry

An interview with Dr Margareta Hultin, a senior lecturer at the Department of Dental Medicine at Karolinska Institutet in Stockholm in Sweden

Author: Anne Faulmann, DTI

Implant dentistry is constantly advancing. New research results, the rapid development of digital technologies and increasing experience in clinical practice change the way implantologists work. This may lead to a rethinking of already established treatment approaches. In the “Things we stopped in our practice due to failures” session, the 2016 congress of the European Association for Osseointegration (EAO) will address this topic, evaluating the possibilities and risks of certain treatment protocols. DTI had the opportunity to talk to one of the session speakers, Dr Margareta Hultin, about her topic of immediate CAD/CAM restoration and recent developments in implant dentistry.

Dental Tribune International: Dr Hultin, how has implant dentistry developed in recent years, and what new insights have changed the way implantologists work?

Dr Margareta Hultin: Implant dentistry has developed in several areas in recent years, such as grafting and augmentation procedures, as well as treatments for optimising and predicting the aesthetic result after rehabilitation. On the one hand, improvements in implant treatment can be attributed to a better understanding of how both the hard- and soft-tissue anatomy—for example, the role of thickness, width and positioning of keratinised tissue—influence the long-term outcome and aesthetic result. On the other hand, 3-D radiographic imaging techniques have greatly improved individual assessment of hard tissue with regard to jaw anatomy and bone volume in treatment planning.

Digital dentistry is increasingly relevant in dental practice nowadays. How has digital technology changed implant dentistry, and what are its main advantages?
Digital technology can support dentists in several steps of restorative treatment, from cone beam computed tomography and the virtual planning of implant positions through to prosthesis manufacture for immediate function. Also, virtual planning can be transferred to the actual clinical setting by fabricating surgical guides for flapless implant placement.

The main advantage of digital techniques is the ability to plan and optimise the positioning of implants in a prosthetically driven manner. Moreover, computer-guided techniques can help decrease postoperative discomfort and allow immediate function, as they enable implant placement with minimal surgical trauma. In addition, these techniques can offer a useful alternative to bone augmentation in severely resorbed jawbone, as they facilitate optimal positioning of implants in the available bone.

In your lecture at this year’s EAO congress in the “Things we stopped in our practice due to failures” session, you discussed immediate CAD/CAM restoration. What are potential complications of immediate CAD/CAM restoration, and why is this treatment approach prone to failure?

Although computer-guided techniques for implant placement can offer advantages for both the dentist and the patient, guided implant surgery is technically demanding and not free of specific procedure-related complications. For example, the drilling template may fracture or there may be complications related to limited access and visibility when using a flapless approach. This can lead to deviations in implant positioning and ultimately a poorly fitting prosthesis. Moreover, high aesthetic demands may be difficult to completely foresee, since computer-guided implant positioning carries the risk of overlooking the ideal location of an implant with regard to the soft tissue. Therefore, the skills and experience of a clinician who wants to use these techniques need to go far beyond those necessary for regular implant surgery.

What alternative treatment protocol do you recommend for less experienced clinicians?

A good option is to use digital techniques for implant placement in combination with traditional protocols for prosthesis manufacture. For example, a template-guided flapless surgery for implant placement can be combined with a traditional protocol for unloaded healing and the fabrication of a permanent prosthesis.

Dr Margareta Hultin is a senior lecturer at the Department of Dental Medicine at Karolinska Institutet in Stockholm in Sweden and has more than 15 years of experience in research and education in implantology.
Since the 1990s, when the first non-precious metal bases were produced using 3-D printing methods, the 3-D printing technology has established itself as a modern production process. Today various plastics are also available as high-performance materials. Many users are already considering supplemental extensions and thinking about investing in this technology—the International Dental Show (IDS) in Cologne from 21 to 25 March 2017 will provide an overview.

3-D printing is an additive production process—contrary to subtractive methods, for example computer-controlled milling or grinding ceramics or the machining of non-precious metals or titanium. However, many analogies can be discovered and used as advice when one is considering implementing 3-D printing.

Familiar and established in the dental technology field

First of all, one has to be aware that additive manufacturing is a trusted method. Ordering dental technology items that have been industrially produced using the 3-D printing technique has been common for many years. Among others, one is familiar with selective laser melting, selective laser sintering (SLS), direct metal laser sintering (DMLS) or laser using: Here crowns, bridges and denture bases (“digital model casting bases”) are made out of non-precious metal dental alloys. Non-precious metal powder layers are applied and are briefly melted onto the defined places with a laser beam in using a high amount energy. In this way following a construction plan, which was created on the monitor for example using the CAD process, high-precision dental technology items are produced.

Stereolithography is a further, very familiar 3-D printing method. Models, splints and drilling templates can be produced using this method. The principle is similar to laser sintering, however whereas in the latter the applied material is melted on layer by layer, in the case of stereolithography the light polymerisation of plastic is implemented.

In order to be able to assess the 3-D printing method more efficiently in future, it is worth taking a look at the early zirconium oxide technology. Initially large industry machines produced dental technology items and the laboratories were able to order them from external service providers. Later, in-house production also became attractive. In this way, a combination between central manufacturers, cooperative laboratories that carried out contract manufacturing for other
laboratories in order to exploit their own systems to the full and laboratories that offered round-the-clock own production, who also additionally outsourced parts of the production, established itself.

Currently, some laboratories are asking themselves about the optimal implementation of 3-D printing: Drilling templates, different splints, dental technology models, individual impression trays and plastic base casts for the metal cast depict the most frequent indications. Whether they are ordered from an external service provider or produced in one’s own firm, is determined by the amount of the orders to be expected and the speed required by the customer, where own manufacturing principally allows immediate production. IDS 2017 shows which technologies are available and how to invest in them—and thus facilitates an individual economical calculation.

**The extended range of printing methods**

In addition to the methods already mentioned, among others the so-called multi-jet technology (detailed work up to precisely 16 micron), the fused layer techniques (fused deposition modelling, FDM; fused filament fabrication, FFF) and the mask exposure method prove to be interesting. The multi-jet technology works following the principle of the “ink-jet printer”. For example, (almost) two-dimensional layers of powder are rolled out and then imprinted with bonding agents—exactly on the places where the dental technology item belongs according to the construction plan (= virtual model), the non-bonded power can be simply removed. The material used is either glass or metal powder, whereby with today’s current state of technology only the metal powder is suitable for the production of solid objects, because to this end after the printing process, a sintering and an infiltrating step to fill up existing cavities have to subsequently be carried out. Alternatively, one prints (once again almost) two-dimensional photopolymers according to the construction plan and lets them harden so that the item is formed layer by layer.

Using the layer melting technique one extrudes for example waxes or plastics out of a nozzle or applies the material drop by drop, once it cools down it solidifies—then the next layer can be applied. Finally, the mask exposure method works similar to the well-known stereolithographical technique. The decisive difference: Instead of using a laser, the plastic is hardened with the aid of a UV LED lamp.
Printing of tooth-coloured table tops and temporaries

One of the big hopes for dental 3-D printing is the optimised colouration of materials, for example of high-performance plastics. The experiences of the subtracting methods have proven that zirconium oxide has initially only been implemented with a veneer covering. More recent versions with a higher translucency are on the other hand used monolithically.

When today complete dentures are produced digitally in a working step in the laboratory and the time-consuming procedure is limited down to two dentist appointment for the patient: why not printed table tops and temporaries soon too? Case studies are already showing now: An implant-supported top jaw complete denture can indeed be made out of PEEK (polyether ether ketone) using the 3-D printing technique and plastic veneers lend it an attractive appearance. PEKK (polyether ether ketone) could also become one of the base materials of the future, especially since in combination with a veneer composite it displays similar characteristics to veneered zirconium oxide.

Digital workflows make 3-D printing additionally attractive

In addition to new materials, the possibility of integration in the digital worlds also provides a boost. For example, the 3-D printing of dental technology models could develop into a frequently used option as a result of the further distribution of intraoral scanners.

"3-D printing offers extraordinary potential," said Dr Martin Rickert, Chairman of the Association of the German Dental Manufacturers e.V. (VDDI) convinced. "This also applies to the closer collaboration between the dentists and the dental technologists, which will be promoted through the joint work in the digital workflows. The backward planning in implantology is an example of this, where 3-D printing creates a concrete additional option in the form of the production of detailed drilling templates at the laboratory. At the International Dental Show in Cologne, the opportunities of this modern production technology can be experienced close-up with tangible innovations and in direct contact to the respective manufacturers."

The International Dental Show takes place in Cologne every two years and is organised by the GFDI Gesellschaft zur Förderung der Dental-Industrie mbH, the commercial enterprise of the Association of German Dental Manufacturers (VDDI). It is staged by the Koelnmesse GmbH, Cologne.

*Images courtesy of Koelnmesse.*
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IMAGINA Dental—Digital technologies & Aesthetic dentistry congress

The 6th IMAGINA Dental edition, Digital technologies & Aesthetic dentistry congress will be held from 13 to 15 April 2017 at the Grimaldi Forum in Monaco. IMAGINA Dental is the industry’s leading event for new digital technologies, 3-D and CAD/CAM in dentistry.

IMAGINA organizers invite dentists to a new generation of congress designed to help them better understand, learn and share experiences and clinical cases about how digital technologies could change their daily practice. From 3-D imagery and 3-D diagnostic tools to guided surgery, treatment planning, implantology, CAD/CAM, aesthetic restoration and Digital Smile Design, IMAGINA Dental brings a unique educational experience in an intimate setting, to discover and find out more how enjoyable innovative dentistry can be.

After this year’s edition (7–9 April 2016) it was apparent that IMAGINA has maintained its reputation as the leading congress for digital technology. In particular, participants emphasised the quality of the presentations and remarked that IMAGINA is more personal, giving the opportunity to engage with the presenters. More than 600 visitors from 26 countries attended the event, which received positive feedback from both the presenters and attendees.

Highlights of 2016 meeting

IMAGINA 2016 focused on CAD/CAM dentistry and microscopy, innovations in implantology and digital smile design.

The guest of honour at the opening session was Dr Marcus Abboud, Founding Chair of the Department of Prosthodontics and Digital Technology and Director of Continuing Education at Stony Brook University’s School of Dental Medicine in New York in the US. The title of his lecture was “Innovations in CAD/CAM and digital workflow for the daily practice”. Abboud pointed out that digital dentistry and 3-D printing have rendered possible what could only be dreamed of just a few years ago, including individualised bone grafts and trachea replacements for cancer patients. However, it is important to realise that these technologies do not replace knowledge or conventional treatments; rather, they open up new treatment avenues, he said.

“Innovations in implantology” was the theme of the second day and started with a presentation by Drs Luc Manhès and Guillaume Fougerais titled “At the dawn of artificial intelligence, how to leverage technologies to keep hold of our dental treatments?”. The speakers demonstrated that using CBCT technology, it is possible to obtain perfect treatment planning in 3-D. They pointed out that very few dentists use the technology and emphasised the value of using CBCT. Only 3 per cent of dentists use surgical guides to place implants, but Manhès and Fougerais encouraged the use of a surgical guide even for a simple case “to see the technology through”.

Dr Joseph Choukroun was the guest of honour of the second day. In his presentation, titled “A-PRF and i-PRF: the latest innovations with the use of mesenchymal stem cells in the dental office”, he explained how it is possible today to treat patients who have lost bone, cartilage and collagen by regenerating the lost tissue with stem cells. In the past, harvesting stem cells and treating them were very difficult to achieve. However, today, stem cells can be extracted directly with a blood sample, and Choukroun presented the technique for quickly extracting stem cells and injecting them where needed.

The theme of the last day of the congress was “Digital smile design”. The room was full for Prof. Angelo Putignano’s presentation, titled “Simplexity in dentistry: The StyleItaliano approach”. He began by explaining the guiding foundation for his work—colour and details—and went on to demonstrate this, taking the attendees on a magical trip to see what can be achieved in aesthetics.

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