event review
The Clinical Innovations Conference 2012

user report
Impression techniques for Implant dentistry

case study
Implant therapy of edentulous patients
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Dear Reader,

Welcome to the second edition of Implants where we will be looking at some of the latest ideas, technology and pitfalls within the world of implant dentistry.

We all know that when done well, implant dentistry can be a tremendously successful treatment. But how do we judge success? If I buy a pen and it lasts for a year I’m not too worried but with a car it’s a whole different story. So with dental implants how long should we wait before we can say it is successful? One website I read recently claimed a 100 per cent success rate on their dental implants based on 300 implants placed within the last year. Whilst this may prove to be the result of excellent surgical and prosthetic treatment, are we as a profession at risk of promising more than we can actually deliver?

In this addition of implants we will be looking at some of the excellent presentations at this year’s Clinical Innovations Conference, which was fortunate to have some of the most sought after speakers in the dental industry as well as various case reports which we hope you will find informative and interesting, but ultimately help make you a better dentist!

I hope you enjoy this edition and always I welcome your feedback.

Until next time,

Neel Kothari
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Cover story: This month’s image can be found in the article 44 Roots - 44 Implants by Drs Topete
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High-risk patients benefit from new techniques for computer-guided implant dentistry

Journal of Oral Implantology – The added precision of computer guidance to oral implant surgery provides another leap forward in restorative dentistry. Innovative modifications of software and instrumentation are further advancing dental implant success in patients lacking adequate bone. New techniques reduce surgery time and expedite postoperative healing.

A case study in the current issue of the Journal of Oral Implantology reports on the use of computer-guided implantation in a 54-year-old patient. The patient had a very narrow ridge of bone, making drilling for implant placement difficult.

Dental implants, as introduced in the 1980s, required two surgeries and the use of a temporary denture for at least six months. In the 1990s, this restorative procedure was reduced to a single, albeit daylong, surgical process known as immediate loading. The procedure was further enhanced by the use of computer-guided techniques. The first clinical use of computer-guided techniques combined with immediate loading occurred in 2002. Dental implants can now be precisely placed in an hour or less. Dentists can use virtual planning to create a surgical template and fabricate a prosthesis for immediate placement. The patient experiences minimal postoperative pain and swelling with this less invasive procedure.

However, this technology can be limited due to local anatomical factors. To place the implant in the best position, the patient must have suitable bone at the desired implant site. Proper seating of computer-guided titanium drilling sleeves can be difficult to achieve if the patient’s crestal bone is too high or narrow. Previously, this clinical situation required opening a flap and reducing bone before placing the dental implants. The current case study, however, achieved implantation without cutting a flap or reducing the bone height, while still permitting immediate placement of the already fabricated prosthesis.

For the presented case, deeper implant site preparation was necessary for implant seating and placement of the traditional computer generated surgical guide was difficult and therefore had to be eliminated. In the virtual planning phase, a different implant length was used to reposition the guide sleeves. Drilling sequences were changed, using a starting drill that would allow deeper penetration. Osteotomes, instruments to prepare the bone, were incorporated, as was the use of an alternative implant seating mount. Despite the patient’s high risk factors for implant failure, a successful computer-guided implant was accomplished.


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Experience the freedom of unlimited possibilities. Experience Atlantis™.
Belgian researchers have developed and produced the first patient-specific, 3-D printed titanium implant. For the first time in the history of implantology, a customised implant has replaced a complete mandible. It restored form, function and aesthetic aspects of a natural mandible in a significantly shorter period compared with classical treatments.

The Functional Morphology research group at the University of Hasselt’s BIOMED research institute recently presented the first customised 3-D printed mandible, which was implanted in a patient in June 2011. The procedure was conducted on an 83-year-old woman who suffered from serious osteomyelitis, which had affected almost the entire mandible.

Given the severe and rapidly progressive infection in this senior patient’s lower jaw-bone, treatment options were rather limited. The classical treatment, namely removing the damaged bone, would have resulted in a small mandible without any support and function. Researchers faced the challenge of restoring vital functions, such as breathing, speech, chewing and sensation. The decision to reconstruct the entire mandible with a customised 3-D printed implant was made to spare the senior patient a long surgery and shorten the subsequent stay in hospital. It was the first time that a complete mandible was replaced.

The artificial jaw weighs approximately 107 grams, which is almost as heavy as a natural mandible. The implant is designed to allow the direct insertion of dental bars or bridge implants at a later stage and therefore provides the perfect foundation for dental restoration. Owing to perfect fit, the surgery was completed in four hours, which is only a quarter of the time needed with the classical method. This spared the patient additional adjustment surgeries and speeded up recovery.

Planned and designed by doctors and engineers from various institutions in Belgium and the Netherlands, the implant was produced by Layer-Wise, a company experienced in metal Additive Manufacturing (AM) technology, which is a specific form of 3-D printing used to create implants layer by layer. A high-precision laser selectively heats metal powder particles to quickly melt and attach them to the previous layer. The titanium model was coated with bioceramic afterwards. AM is used to print functional implant shapes that would otherwise require multiple metal working steps or that cannot be produced any other way.

The revolutionary jaw implant was granted the 2012 AM Award by the Additive Manufacturing Network in Belgium.
From strength to strength - Clinical Innovations Conference 2012

Author: Lisa Townshend

The Clinical Innovations Conference 2012, organised by Smile-on and the AOG and in association with The Dental Directory, was a fantastic success, boasting world-class speakers, cutting edge topics and practical advice for the many dental professionals in attendance.

Held at the Millennium Gloucester Hotel in London, the event saw more than 400 visitors from across the country come together for the two-day event.

The event began on the Friday, with world-renowned Dr Nasser Barghi speaking on 'All-Ceramic and CAD/CAM Restorations in 2012: Clinical Steps', to a highly attentive audience. Always a popular speaker, Dr Barghi's look at restorative materials and the best indication for each was both practical and entertaining.

After the coffee break the conference split into two streams; Dr Wyman Chan and Dr Anthony Roberts. Dr Chan gave a lecture on 'Modern Bleaching Techniques'. As a dedicated tooth-whitening dentist, Dr Chan focussed on bleaching techniques and the science behind the products he uses, as well as running a live demonstration alongside his lecture, with his dental nurse.

Simultaneously, Anthony Roberts spoke about 'The Periodontal Jigsaw: Putting it all Together'. Looking at what a measure of success in periodontal treatment might mean for both clinicians and patients, Dr Roberts discussed BPE charting and the journey of diagnosis. He also explained the clinician's role as motivator, communicator and educator in addition to their clinical capacity for the best treatment for patients.

The afternoon continued the high standard of speakers, with Richard Kahan giving an enthusiastic talk on 'New Horizons in Endodontic Diagnosis and Treatment Planning'. Comparing the dental and medical industries, Richard highlighted the issue that dentistry has a far smaller range of tests to use when diagnosing a patient's complaint.

Nasser Barghi, Mhari Coxon and Fraser McCord then separated the conference into three streams, speaking on 'Bonded All Ceramic Restorations in 2012', 'Effective Biofilm Management' and 'Diagnosis of Complete Denture Problems' respectively. Fraser McCord took over the lectures to discuss the best techniques for diagnosing problems with complete dentures.

Mhari Coxon followed on from Dr Roberts' presentation of the morning with a look at biofilm management. Giving an update on recent research into biofilm, Ms Coxon illustrated the four stages of biofilm development.

The first day concluded with Professor Gianluca Gambarini lecturing on '3D Endodontics: Concepts and Techniques'.

implants 2, 2012 | 09
Discussing the benefits of cone beam technology, he illustrated the importance of working with 3D images to diagnose patients’ complaints.

In the evening, the event hosted its third annual Charity Ball, where hundreds of delegates dressed to impress. Attendees were greeted by a champagne reception, and were able to relax and enjoy a sumptuous three-course meal, live entertainment in the form of dentist-turned magician Dr Raj Rattan and fantastic company.

The morning after the night before is always a tough start, but with speakers such as Basil Mizrahi and Ajay Kakar to look forward to, delegates were fired up for the Saturday programme.

Dr Mizrahi discussed ‘Clinical Tips and Techniques to improve the aesthetic and biochemical precision of your dentistry’.

As the Conference split into three sessions again, Professor Gambarini returned to speak about ‘Improving Root Canal Preparation and Obturation’. Simultaneously, Ajay Kakar lectured on ‘Non-Surgical Management of Periodontal Disease’, Sandeep Senghera discussed ‘Treating Your Patients and Business to the Latest in Technology’ and Dr Nasser Barghi spoke about ‘CAD/CAM Zirconia’ to MSc students.

Dr Senghera’s presentation was a practical look at marketing your practice to new and existing patients using the technology that many use daily in their personal lives – smartphones, social media etc. Likening the patient base to a bath with water running in and draining out, he emphasised the need to ensure patients are retained with smart recall processes and timesaving strategies for patients such as online appointment booking.

John Moore then took over the speaking to explore ‘Digital Dentistry and the Advantages for Cosmetic Treatments’. Primarily discussing how his practice is using the CEREC system to their advantage, Dr Moore showed how clinicians can use CAD/CAM in their practices to fulfil patients’ requirements.

Dr Barghi returned again in the afternoon to repeat his popular lecture on Bonding from the previous day, while Dr McCord’s lecture was ‘An Update on Impression Techniques for Complete Dentures’. Dr Nilesh Parmar looked at ‘Dentistry in the 3rd Dimension’. Discussing the clinical applications for CBCT in various branches of dentistry, Dr Parmar used many case examples using the technology to illustrate how, in his words, it ‘changed my working life’.

The Clinical Innovations Conference 2012 came to a close on the Saturday afternoon, with Dr Amit Patel speaking on ‘Peri-implantitis – a Future Timebomb’. With the growing trend of placing dental implants, cases of peri-implantitis and perimucositis will inevitably increase. Dr Patel discussed the process of the inflammation and the reasons for it, looking at prosthetic design. He discussed his preferences for screw-retained restorations and looked at therapies for managing the inflammation. One of the many strengths of the Clinical Innovations Conference is that it combines lectures with live workshops, demonstrations and a trade exhibition, to cater to practitioners’ every need. Between lectures, delegates were able to browse the exhibition stands, accessing some of the latest technologies in the world of aesthetic and restorative dentistry, and put their questions directly to the experts at each company.

Feedback from the event has been fantastic, with many delegates already penning the 2013 date in their diary. Next year’s event, the tenth anniversary of the Clinical Innovations Conference, will be held 17-18th May 2013.
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Leading Regeneration
A whitening system to suit all of your patients

Author: Dr Hadia Decharriere

So it’s a great idea to have whitening in your dental armoury. A healthy, attractive smile is pretty essential in today’s image-driven society and consumers are happy to pay to achieve and maintain this look.

Dr Hadia Decharriere practices general dentistry in Paris. She takes a global approach to the smile and offers a choice of cosmetic procedures within her practice. Her degree in psychology allows her to understand how important aesthetic dentistry issues are to patients’ self esteem and wellbeing. She has been trialling MeToo, a brand new whitening system from Acteon. Here she describes what makes the system up, how it differs to others on the market and patients’ reactions to the great results you can achieve with it.

MeToo includes chairside whitening treatment, as well as take-home and several accessories. The chairside strategy includes:

- MeToo Light: a complete one-patient kit, using a 30 per cent hydrogen peroxide gel to be activated by light-emitting diodes (LEDs)
- MeToo DeLuxe: a new whitening lamp that is dedicated to enhance the results obtained with MeToo Light kits (but can also be used with any other chairside whitening gels)
- MeToo Perfect: a small take-home kit, to stabilise the results of the chairside procedure thanks to three pre-charged trays (8 per cent hydrogen peroxide) to be used for 30 minutes, over three days.

The difference between other lamps and the MeToo Deluxe lamp lies in those light-emitting diodes, where current lamps use UV. Whereas the UV combines light and heat, MeToo Deluxe has separated those two functions by having blue LEDs and infra red light, which poses no risk to skin and soft tissues, unlike UV.

The lamp LCD control panel allows the practitioner to choose the balance between the blue LEDs and infra red light.
The aim is to be able to control peroperative sensitivity by possibly reducing the heat without reducing the blue light exposure. The MeToo Light procedure consists of three 15 minutes sessions.

Operative Protocol

The MeToo Deluxe procedure kit is made up of:

- One single use retractor that includes a saliva pump
- Two cotton rolls for the lip guard
- One 3mL syringe of NeoDam light-curing dental dam whose color changes when polymerised
- A desensitiser (MeToo Calm) with a brush that can be used during or after treatment
- Three 2.5mL syringes of MeToo 30 per cent hydrogen peroxide gel

Before each treatment, all teeth are checked and, if needed, cavities and/or any periodontal disease is treated. A dental cleaning is performed as well. The chairside whitening session begins with the shade evaluation. Then, the most important part begins: isolation of the soft tissues. MeToo retractor is a single use product. Its shape, and the use of the provided saliva rolls, allows good lip spacing. The integrated saliva pump offers a lot of comfort to the patient. The gums are isolated with NeoDam whose polymerisation will be controlled by its color change. This patented technology avoids over curing and burns. The patient’s eyes are protected with the provided orange glasses. The soft tissue isolation is reliable and reproducible.

After drying the teeth, the 30 per cent hydrogen peroxide gel is applied. For better efficiency, I take the peroxide gel out of the fridge a few hours before the session. Each of the three sessions has its own whitening gel syringe, which ensures the practitioner never runs out of gel. Each session lasts 15 minutes. During the ses-
If sensitivity is observed, it is possible to reduce the power. The lamp is totally silent, which allows the patient full relaxation, listening to music for example.

Once the three sessions are completed, the teeth are rinsed, and the whole isolation system taken off. The new shade is appreciated. Patients are then given their take-home kit, MeToo Perfect, to start the day after the chairside procedure, for three days, in order to stabilise the results.

A short maintenance procedure, say three-six day take-home whitening every year, along with a good oral hygiene regime and regular scaling procedures, should enable patients to maintain the level of whiteness they desire.

Clinical observations – Clinical cases

All of the patients pictured received all three 15-minute sessions. None of them suffered peroperative sensitivity, which allowed me to do all sessions on ‘full power’. The dental shades were evaluated with Vita Classical and Vita Bleachedguide 3D-Master when bleached shades were reached.

Conclusions

Patients consulting for teeth whitening have a cosmetic aim; this implicates that practitioners should offer a painless whitening technique that provides good results and comfort during the procedure. The MeToo Deluxe whitening system has given us so far very encouraging results. Patients were very satisfied with their new shades, and found the chairside procedure relaxing. The fact that the lamp is completely silent and the absence of peroperative sensitivity seem to be essential.
Smile-on and Tempdent understand the need for flexible learning to fit around the busy lifestyles of dental nurses and practices.

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When a patient is also looking to have implant treatment, whitening should be carried out first to ensure a superb shade matching result. On fully integrated implants, obviously whitening will have no effect.

Whitening is a totally safe procedure for both natural teeth and those replaced with implants.

**Technology making the difference**

MeToo is the gentlest, yet most complete approach to whitening on the market today. A system created to give you the flexibility to mix and match elements from its portfolio for a superb bespoke result for each and every one of your patients.

Not every patient wants to take the chairside route, so Acteon have given them that choice within this system. There is a pure take home kit – MeToo Start – which puts patients totally in control of how they want their treatment to work. The first treatment is applied in the practice waiting room to increase motivation and ensure each patient knows exactly what to do. And then they have the choice of three formulations; 11 per cent night, 17 per cent night or 21 per cent day.

Whitening simulation software has just been launched to work alongside MeToo. You simply download it from the MeToo website – www.metoo-teeth-whitening.com - to your PC or Mac and show your patient how he or she would look with whiter teeth. It is a tool that is sure to encourage many patients to undergo whitening and it also validates the results they can expect thanks to the before and after images.

To see for yourself how this flexible, easy-to-use system can make your work simple, your patients happy and your profits soar, call 01480 477307 or email: info@acteongroup.co.uk to arrange an on-site demo.

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Dr Hadia DECHARRIERE, Paris, France
Dr Hadia Decharriere practices general dentistry in Paris, France, and has a global approach of the smile. Her exercise includes several cosmetic procedures such as teeth whitening, hyaluronic acid injections, all ceramic prosthesis… Her degree in psychology allows her to understand how important aesthetic dentistry issues are on her patients’ self-esteem and wellbeing.
Imprint technique for implant dentistry

Author: Dr Ken Mun Wong

Making final impressions for dental implants can be one of the most challenging procedures in restorative dentistry. Traditionally, final impressions for implants require restorative dentists to use a very rigid impression material to capture the accurate position of the implant fixtures. Unfortunately, this technique of using rigid impression materials has one major disadvantage. The gingival tissues around the implant fixtures, fine details of the surrounding gingival tissues and occlusal details of the neighbouring teeth are missing or inaccurately captured in the final impression.

There are two objectives during the implant impression procedure. The final impression has to capture the position of the implant fixtures accurately as well as to register the fine details of surrounding teeth and gingival tissue.

This article will point out how we manage to address this problem and highlight the impression technique using Honigum-Heavy and Honigum-Light that we are currently using within our dental centre.

Case report

The patient presented with a missing right first molar three months ago. An implant restoration was indicated to replace the missing tooth. Subsequently, an implant with regular platform was inserted using a one-stage approach. The implant was left undisturbed for a period of two
months for transmucosal healing.

The implant had successfully osseo-integrated and was ready for the final impression to be taken. The healing abutment was removed (Fig 1). A regular size impression coping was connected and hand-tightened onto the implant fixture. From the labial view of the impression coping there are three concave areas on the surface of the impression coping (Fig 2) and they are the indexing features of this implant system. This is a common characteristic feature of impression copings for any implant system. They need to be registered during the final impression. In order to capture these fine details low viscosity Honigum-Light was used (Fig 3). The impression material was syringed around the implant/soft tissue interface as well as the gingival margins of the neighbouring teeth (Fig 4).

The tray material was Honigum-Heavy, a heavy-body impression material. This material achieves a very high end hard-
Honigum.
Overcoming opposites.

Often times, compromises have to be made when developing impression materials. Because normally the rheological properties of stability and good flow characteristics would stand in each other’s way. DMG’s Honigum overcomes these contradictions. Thanks to its unique rheological active matrix, Honigum yields highest ratings in both disciplines. We are very pleased to see that even the noted test institute »The Dental Advisor« values that fact: Among 50 VPS Honigum received the best »clinical ratings«.*

*The Dental Advisor, Vol. 23, No. 3, p. 2-5

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ness and thus a high fixation capability. It was loaded properly into a rigid impression tray to avoid air entrapment (Fig 5) using a MixStar automatic mixing unit (Fig 6). With the cheek retracted, the loaded impression tray was carefully manoeuvred into position and seated without causing any form of discomfort to the patient. The tray was carefully removed after complete setting of the impression material (3:15 minutes). The fine details were all recorded and the implant fixture position was also captured (Fig 7). It was then sent to the laboratory for fabrication of the final prosthesis. With an accurate impression, the dental technician was able to fabricate the abutment and the implant crown precisely, consequently expensive and gratuitous remakes can be avoided. At the fitting stage, the customised zirconia abutment was torqued to 35Ncm (Fig 8). Finally, the zirconia implant crown was cemented and the occlusion verified and checked. One week review showed a stable and excellent result (Fig 9 and 10).

**Conclusion**

This method of capturing final impressions using a dual viscosity impression technique for implant fixtures has allowed the author to complete all my implant restorations effectively and with great efficiency. The high final hardness of Honigum-Heavy allows exact positioning of the implant abutment, whilst fine details are precisely captured by the low viscous Honigum-Light. The choice of viscosity of impression materials used in this article makes challenging clinical situations easier to tackle and helps to make the restorative procedure enjoyable and impression taking predictable.

The complete Honigum impression material range is distributed in the UK and Ireland by DMG Dental Products (UK) Ltd. For further information contact your local dealer or DMG Dental Products (UK) Ltd on 01656 789401, fax 01656 360100, email info@dmg-dental.co.uk or visit www.dmg-dental.com.

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New concepts in computer guided implantology

Part I: Thread timing and implant phase

Author_Dr Gian Telara

Accuracy in guided implantology is an issue. The ability to perform implant placement both safely and correctly, in order to load a pre-surgical CAD/CAM bar or cementable metal final framework prosthesis and to digitise the entire procedure, is widely researched. Accuracy is a value also in a classical II-stage protocol and respecting hard and soft tissues for long-term implant site stability. There is an ongoing debate amongst clinicians regarding which is the best available system. Vercruyssen summarises this debate.1 The article reviews only some of the published articles on this topic. All of these articles emphasise the error margins and that they can be considered clinically more or less acceptable, and determine accuracy in implant placement by means of superimposition. In mathematical terms, “precision” means the repeatability of a measurement, and “accuracy” refers to the correspondence of this measurement to the truth. In our field, accuracy has been considered the correspondence of the placed implant to the planning. Fortin defines “accuracy” as an ideal, at present somewhat impractical, when considering a definitive prosthesis for immediate loading, with the present systems only offering predictable results (and as such only long-term reinforced provisional will be available), but does not quantify a threshold.2 According to Di Giacomo, at present a post-operative impression appears to be always necessary for immediate loading with a definitive prosthesis.3 Guided implantology is far better than a free-hand approach, however. A guard-rail...
like guide is certainly better than nothing. Many systems are available today, and from a theoretical perspective they have been categorised into semi-active and passive systems. The systems in the first category, whatever the technique used to make the surgical guide (STL or stone surgery), have metal smooth guiding sleeves, which the implant and the implant-driver must pass through, and the second systems, also called navigation systems, do not have any metal sleeves and the surgeon is guided by the monitor. In this category, the surgical handpiece is indexed to spatial markers inside a surgical guide that is inserted into the patient's mouth, but not in the surgical area. These spatial coordinates are viewed by an infra-red system, which transfers data to the computer, allowing the clinician to follow the surgical steps on the monitor. Alarm lights and sounds will warn the clinician of deviations from the desired position. I propose a new definition of a passive system: a passive system must allow any operators (ie it must be operator independent) to achieve the same, repeatable results at an acceptable inaccuracy threshold. The accepted inaccuracy must allow clinicians to obtain a good metal-to-metal fit without placing tension on the implants. This “to what extent” predictability can determine the reliability of treatment. In fact, in fixed prostheses on natural teeth, passivity (at an acceptable gap) is about 40 to 50μ in the arch; the same values could be considered acceptable for prostheses on implants. According to this definition, none of the systems on the market has replicable results, and have metal or virtual smooth sleeves. They must thus be considered metal or virtual smooth semiactive systems. I have developed a new device according to the mathematical concepts of thread timing and implant phase, which can be applied to the implant movement while being screwed, thus allowing clinicians passivity during implant placement. In the future, owing to the predictability of implant placement, the proposed device could be fundamental to achieving the desired goals in computer-guided implantology.

**Materials and methods**

The implants were placed using the bottlenecklike device, which begins implant rotation before it can touch the bone, thereby avoiding bone interference with implant movement owing to bone density gradients (“bone guidance”). The prototype of the device consists of: an internally threaded sleeve (“embedded sleeve”, with a “helical gear” feature at its top that is useful during implant placement; an externally threaded sleeve
The only control system offering the pre-programmed clinical sequences of the main implant brands is now available with a dedicated application for touchscreen tablets.

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* Compatible with iPad and Pad 2
"osteotomy sleeve"), which has to be inserted into the embedded sleeve and serves as a regular sleeve for the osteotomy drills (because it is internally smooth); a modified extender for drills; an externally threaded sleeve, longer than the osteotomy sleeve, that acts as a "bottle-neck".

For the osteotomy, I used a regular surgical kit, not a dedicated one to precision, just modifying a plain extender to fit any osteotomy surgical kits (general and not guided surgical kits). The extender should match up with the sleeve before the drill touches the bone. The prototype was realised with no endo-stop features in the extender; only lines indicate depth. The bottom end of the bottleplug is provided with a helical gear (to match up with the corresponding embedded sleeve’s helical gear; the bottle-plug in the prototype device consists of two components, the cylindrical screwed part and the lid, and they are fastened together with a joint. The lid is integrated into the implant mounting component; thus, while the bottle-plug is being screwed onto the neck, the implant mount is entering inside the bottle-neck, forcing the implant downwards. The implant mount has a hollow to allow for an implant fastening screw (the same as used to fix implants and abutments, just longer, to allow for minimal screwdriver length, when it is necessary to unfasten the components at the end). The mount also has a gauge for a wrench at its top (but it can work for a handpiece driver as well). Once implant placement has been carried out, the mount can be unscrewed from the implant and vertically unfastened from the bottle-plug. At this point, the surgical guide can be removed easily, with no risk of hex undercuts. The device must resist the vertical dislodging torque created when screwing the implant into the bone. A screwed bottle-neck performs well for this purpose and the lid must be fastened to the vertical part of the bottle-plug.

SimPlant Pro Crystal (Materialise Dental) was used only to plan the implant position, but instead of using a surgical guide, a STL digital cast with analogue implant holes for placing analogues was used in the first case reported. A plain stone model with a (presumably) correct analogue position was used for the second case reported. In both cases, the analogues were, screwed to the device, and then the device was secured to a bite-like thing (using plain relining resin for the provisional) to obtain a surgical guide (no surgical guide fixation to the bone was considered; No guided tapping drill was used. This is something that should be considered, especially in high density bone. It could imitate the implant, with sharp threads and narrow body, to be screwed to the bottle-plug, or a bottle-plug dedicated to the tapping step, with the tapping part integral to the bottle-plug itself. In both clinical cases, the device was
assembled chairside to allow for minimal vertical clearance. A base-plate resin was then used to create jigs to check accuracy between the models and the mouth.

The case results were satisfactory. The device was easy to use and jig correspondence between the abutments screwed on the analogue models and the clinical implant positions was obtained. For the STL case, four abutments were modelled on the STL model, the resin jig was created directly in the mouth, and then its correspondence to the same abutments was checked on the STL model. For the stone case, a transfer was screwed onto the analogue, the resin jig was created, and then its correspondence was clinically checked.

Discussion

The present systems do not offer sufficient and reliable accuracy because they do not consider the concepts of thread timing and implant phase. Their weak point is the smooth sleeve (whether metal or virtual), which does not have any control over the mechanics of a screw, which an implant is. Shooting a bullet makes sense, but shooting a screw does NOT. Smooth sleeve-dependent inaccuracy. The first element to be considered is the gap between the implant mount and the sleeve. A twisting implant apex is the natural effect. When the implant is guided by a smooth sleeve, the position in the arch will be correct only if the implant mount does not ever touch the sleeve during the process, but when the dentist is working there will always be contact, which will result in an error in B-L and M-V position. This is what I call the "position paradox effect" of a guiding smooth sleeve (similar to a guard-rail). Since the sleeve has a top and a bottom plane, this paradox effect is reproduced in both these two planes, and an axis deviation is a natural consequence (what I call the "axis paradox effect of a smooth sleeve"). The gap affects position and axis: these parameters go hand in hand. Depending on the gap entity, it is possible to calculate the implant apex twisting entity, using simple proportionality. At a 20mm depth from the top of the sleeve (approximately 13mm below the ridge), the linear deviation will be 0.8mm (1.6mm on the diameter that is the possible implant apex twisting entity). Trigonometry is an easy way to calculate the deviation angle of the implant axis (sine/cosine and tan/cot rules). If the gap is 0.1mm (0.2 on the diameter), the axis deviation will be a deviation of 2° 20' (Figs. 11b–d). Tapered implants can engage bone at an even greater angle, particularly if the driver is conical at its first part. Consequently, it will work only at the end of the implant placement phase. According to the previous considerations, I suggest that it does not work efficiently. This cone-shaped driver limits too large an insertion torque because it may be damag-
ing; however, the larger the axis deviation, the greater the torque perceived by the operator, who will be given an inaccurate sense of implant stability. The good results reported in publications could have been affected by right-handed operators in isotropic D2 and D3 bone or by working in sites in which cortical plates can directionally address implant placement. Excellent results reported could have been affected by working in low-density bone, where the marketed system allows for a good axis and depth, but the drills created a truncated cone volume devitalised area (depending on the drill blades’ cutting power and operator’s hand force), because the low-density trabeculae would be drilled 360° around. The hex would be missed anyway. The second matter to be considered is bone guidance. Depth and anti-rotational feature orientation depend on bone morphology and density.

When the implant has started its rotation inside the bone, it is not possible to change the threading pattern: while screwing the implant, the platform will move increasingly deeper downwards to the bone. Since it is possible to index a hex to a peripheral point along the circumference and a point along the same circumference can be indexed to the implant thread, the need to change the platform depth and hex orientation and control the threading pattern (implant phase) will be indicated. Any painted notch to index the hex and the sleeve is misleading information and naïve, as it is approximate, that is, no implant phase, and dependent on notch size, point of view (parallax) and operator’s visual acuity. Once the implant has started its rotation, it is not possible to correct the position by redirecting the implant, as the apex is inserted into the bone and will act as a fulcrum. Even if the operator redirects the implant axis, the implant body will remain displaced in position (B-L and M-D). Moreover, the redirection would be done by sight, which is dependent on the operator’s visual acuity and a parallax error is a possibility. The axis deviation introduces another concept: bone response in terms of bone density and bone anisotropy. As a matter of fact, on the other side of the surgical guide, when the implant touches the bone, with a smooth sleeve it is impossible to predict when it starts being screwed. The moment the implant starts rotating depends on the bone friction, depending on the density (HU), and the progression of the osteotomy and the implant insertion will be dependent on the HU gradient (anisotropy), which describes how rapidly the density changes per unit of length along the three spatial coordinates inside the bone. Unless we use a device able to force implants in a precise position (referred to as the surgical guide) along a path engineered according to a particular mechanics, the bone will determine
the implant threading pattern (bone density for initial screwing, whether or not a crestal bone drill has been used) and bone density gradient, or anisotropy for the subsequent axis. Accepting inaccuracy, manufacturers and researchers have created depth-control systems in the hope of offering certainty about this parameter at least, but the gap will be responsible for not only position and axis deviations, but also depth errors. In fact, the implant mount endo-stop will match up with the sleeve at an angle. The first contact will be beyond the desired depth, and keeping on screwing the implant will create a great torque with surgical guide deformation and tension on the bone. The complete contact will correspond to a deeper implant position than desired. The correct depth may be halfway (maybe operator dependent and determined using the naked eye). Depth error, axis deviation and translation in crestal position in the axial deviation direction will be the results. The likelihood of ideally positioning two implants is one out of seven billion and 500 million possibilities (just a few million less, if it is any comfort to us). And this evaluation comes from a 0.1mm mean deviation and 1° deviation, which implies insufficient inaccuracy. Fancy what the chances would be of achieving acceptable accuracy.

**Thread timing and implant phase**

From a mathematical perspective, it is possible to describe all implant spatial coordinates concentrated on the platform, where we can summarise everything, and calculate its trajectory to create kind of a spiral path, through which it is possible to start and stop an implant platform along all the parameters, thus being able to truly speak of implant-guided prosthodontics.

The idea is based on the following: when screwing a coca-cola plug onto the bottle-neck, the final position will always be the same. Once two final positions have been found, two threads will be inside the plug; once three final positions have been found, three threads will be present on the plug. The label written on the plug can be considered to be a hex (or a trilobe). So the hex, that is the platform, can easily be reproduced in its position because the thread pattern and hex are indexed to each other. This means that if we can control the threading pattern, we can consequently control the platform position too. According to this consideration, all the parameters that define the platform position can be controlled. The parameters are the position in the arch (B-L and M-D), the
axis, the depth and the antirotational feature (classically, a hex) orientation. The mechanical engineering of a screw is quite different from that of a bullet (smooth sleeve) and was defined by Archimedes (applications of an endless screw are still in use today, like the meat mincer) and by Euler (Swiss mathematician, who died in St Petersburg more than two centuries ago). In particular, Euler pointed out that the movement of a circle (in our field, the implant platform) can be described with mathematical formulas: a point along the circumference (in our field the perimetric projection of a part of the hex) can be projected along a plane orthogonal to the direction of the circle movement itself (in our field, the progression of the platform while the implant is being screwed in multiplanar reconstructions). The projection will in applied mathematics, describe a sine wave (in our field, the sine wave period can be identified with the implant thread pitch). With this in mind, I developed the device discussed in this article, which controls the threading pattern. In mechanical engineering, this is called thread timing, and the hex position can be defined as hex timing. For both of them we can speak of phase control (ie we can speak of the phase of the implant, both for the thread and the hex). Along this spiral track, the implant can be theoretically and actually screwed and unscrewed as many times as we desire (back and forth), and it will always be possible to know the hex position at the end of the spiral path (final analogue and implant position).

As a spiral circular motion is transformed into a pure translation, a threaded device will respect also position and axis. The information needed to correctly (position and axis, anti-rotational feature and depth) place an implant is in its platform and inside its threads. By creating in the surgical guide a track along which the implant is screwed before its contact with the bone, it is logically possible to start and stop the implant with a final seating with all the parameters always reproduced. We can thus decide when to stop the implant during its fall along this spiral track. The final position will always be the same, that is repeatable, and operator independent. The device meets my earlier definition of a passive system. The maximum precision possible will be what manufacturers can effectively offer (a 1/100mm is expected to be realistic), which corresponds to the actual implant placement. With a threaded system, there is no axial deviation. Therefore, there will only be a 1/100mm position deviation (in the arch this will signify a possible 2/100mm deviation), no axial deviation, depth and anti-rotational feature correspondence. This discrepancy is within the limits that allow the clinician to make a premade final prosthesis and allows for presumably optimal long-term tissue stability.

Some of the systems available also consider hex orientation position, but in order to seat the implant correctly with regard to the anti-rotational feature, an extra rotation may be needed. Speaking of "correctly", at which angle resolution? If the feature described is in the shape of two points (painted or alike) to be vertically aligned, what is the point dimension? What is the eye resolution? Is it possibly a parallax error? Extra-rotation is an implicit admission of inaccuracy: the depth will not be respected as well, and the implant platform depth may be a little above or below the desired position (it depends on the degree to which the operator is out of phase, more or less than 180°). It is easy to realise that, unless all this has been calculated, all attempts to find the anti-rotational feature position and depth are only guesswork—a waste of time! Thread timing and implant phase have not been respected. Forget any notches on the implant mount and smooth sleeves, if anti-rotational feature orientation is the goal. Notches are history in digital guided implantology. Once we have set a threading pattern, it is possible to set the stop point simply making a helical gear (a helical gear is realised by contouring the thread along its 360° run; a vertical step will be present once we have
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gone 360° all round) both in the bottle-neck plug and in the embedded sleeve (the coordinating feature inside the surgical guide), so that a vertical stop is realised in the device. When the two vertical parts match up, we can be certain that the hex is just where we have engineered it to be. The device pitch must have the same implant pitch because differences will lead to bone stripping. In fact, a difference in implant and mount insertion speed (ie the distance covered in depth every 360°) and a different wave period (ie thread pitch), will lead to something different from an out of phase working device; it will lead to bone stripping. In particular, a longer mounting period will force the implant downwards into the bone, with consequent vertical bone stripping, whereas a shorter mounting period will force the implant to rotate horizontally, with consequent horizontal bone stripping. Self-tapping implants should show better torque control.

Components and undercuts

In the prototype device, a driver for a ratchet was used. It was completely redundant because the ratchet can cooperate directly with a plug-top feature for a ratchet at its top; thus, the driver is something that can be eliminated. Once the assembly has been fixed to the embedded sleeve, the plug can be screwed with the fingers, at least until sufficient torque is found, when a ratchet can be used. When multiple implants have been planned, in case of divergent implants, hex undercuts could prevent the surgical guide from releasing itself from the bone, once the implants have been placed. In order to resolve this, the device, at least the mounting part, must be removed from the surgical guide. The device is thus divided in two components and the lid, which is integral to the driver, can be unscrewed, leaving the surgical guide along with all the other components still fastened to it, but disengaged from the implants, freely and easily removable. For single implant placement, the lid is not necessary, because there are no hex undercuts. In this case, a bottle-plug with one component will be sufficient.

Crest module

The implant crest module morphology does not affect this guiding device because the bottle-neck's internal diameter is just a little wider than the implant diameter at any point (platform or below the platform). By the way, additional threads in the crest module are not important either because, mathematically speaking, they are harmonic waves of the implant period (thread pitch).

Vertical clearance

To make the correct surgical guide, the helical gear must be engineered in the planning at a multiple pitch distance from the bone, just equalling the implant length (the implant must start rotating before it touches the bone to avoid bone guidance). For instance, the distance will be 9 or 10 mm for 9 or 10 mm long implants with a 1 mm pitch, and the distance will be a multiple of 0.75 for a 0.75 mm pitch (9 mm will correspond to 12 implant revolutions and 10.5 mm to 14 revolutions). The average mouth opening values should be considered. In case of tapered implants, a short distance can be considered because the implant apex can enter the osteotomy hole without being engaged. To reduce vertical clearance, the device can be pre-assembled, thus obtaining a working length even shorter than that of the present systems. A shorter vertical clearance is possible also with transmucosal implants because the platform results are more superficial.

<table>
<thead>
<tr>
<th>contact</th>
<th>implants</th>
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<tbody>
<tr>
<td>Dr Gian Luigi Telara</td>
<td><a href="mailto:lippitelara@gmail.com">lippitelara@gmail.com</a></td>
</tr>
<tr>
<td>Tel.: +39 0583 947568</td>
<td>contact CAD/CAM</td>
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Reconstruction of an **Atrophic maxilla** using six dental implants

**Author:** Dr Avik Dandapat

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**Case History:**

**Presenting complaint**
Mrs X attended our clinic in 2011. She was a lady in her 70’s whom had recently lost the upper retainer teeth on her partial chrome denture. She was extremely distressed with her new full upper denture and wanted a more long term solution.

**History of complaint**
Over the last five years she had worn a partial chrome denture retained by three teeth - these teeth had progressively deteriorated and were recently extracted by her GDP and they had added to the existing chrome denture making a very bulky and heavy upper full denture.

**Medical history**
Apart from suffering from Bells palsy and having a distinct lack of facial muscular function related to the left side the medical history was unremarkable.

**On examination**
Extra Oral: TMJ appeared sound and no pathology detected on examination.

---

Fig 1. **Ct Scan showing pre operative situation**.
Fig 2. **Planned implant positions on scanning software**.
Fig 3. **Sectional view of sinus cavity showing complete lack of bone inferior to sinus**.
Lymph nodes: Clear

**Muscles of mastication:** Appeared normal and with functional limits

**Facial muscles:** Exhibited atrophy on the left side and the reduced function of the following muscles:

- **Depressor Anguli Oris**
- **Mentalis**
- **Zygomaticus Major and Minor**

The most distinct element we observed was when the patient smiles only the right side of the muscles used in smiling were functional. However the patient was aware of this and understood that we would work in harmony with the current Neuromuscular function.

There also was a obvious loss of maxillary bone and support to the soft tissues. And an decreased OVD was also present. All however of these issues were corrected by the use of a well-constructed full denture replacing these areas and supporting the soft tissue.

**Intra-Oral examination**

Soft tissues were clear and free from any pathological signs

**Dental Examination:** Lower dentition was stable, Oral hygiene was good and BPE no more than one. Heavily restored molars and another eight remaining teeth present.

**On discussion**

After the examination we discussed with the patient the various forms of treatment available and also potential levels of investment required for these options listed below:

1. A complete upper denture
2. An upper denture retained by four implants and splinted with a bar
3. A screw retained hybrid bridge on six dental implants replacing facial support and utilising prosthetic replacement of tissue support but with no grafting or sinus work
4. A full hard and soft tissue reconstruction with hip grafting and up to eight dental implants and a cement retained bridge

After discussion the patient opted for the screw-retained prosthesis based on six dental implants and de-
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decided against extensive and invasive reconstructive surgery. From this point the treatment plan now started.

**Initial special tests carried out**

1. Impressions
2. Face bow record
3. Photographs
4. Study models and new temporary denture made to correct OVD, bite and to evaluate tissue support required
5. CT Scans of upper jaw with correct prosthesis in position to study hard tissue relationship to correct tooth position. And to ascertain degree of bone volume/density present. (Fig 1)

**Surgical considerations**

In such cases my approach is firstly to ascertain the corridor of bone that lies between the medial wall of the maxillary sinus and its position. In order to gain this information one must be familiar with the manipulation of the CT scan image. Often RAW data is needed to draw the correct cross sectional curve along the desired axis of implant placement. Pre-formatted scans on some software platforms may not allow the operator to manipulate this curve. The corridor of bone exists in most patients and can accommodate a longer implant fixture whereby the cervical implant head can lie distal to the apex of the implant hence negating the need of a sinus graft hence the implant is placed more distal in the arch. For inexperienced implant dentists a surgical guide to triangulate this position exactly is an absolute requirement. In practice this area can be marked out as the zygoma has a...
distinct curvature on exposure of the maxillary jaw. Where the curvature or bulbosity starts is usually the position of the medial wall of the maxillary sinus, then by use of osseotomes, drills and re confirming this position can be achieved in two ways. Perforation into the sinus via the lateral wall and palpation of the medial wall and mark points at 3,6,11mm - or by intra oral X-rays and check the osteotomy site for perforations during surgery. I recognise these are not ever as accurate as a CT guided stent and the author would always recommend a bone supported stent in these cases as opposed to a soft tissue supported guide.

The other consideration is the space along the horizontal plane to place four or up to six implants. Although there is a lot of literature relating to “all on four” technique the author prefers where possible to place six implants simply as if a failure occurs (current accepted two in every 100 or two per cent will fail) there is a backup of still making a final prosthesis on 5 or 4 implants if equally spread along the arch. One must also consider the A-P(Anterior - Posterior) spread of the implants.

In such cases there must be adequate AP spread to allow for favourable loading of the prosthesis as using this technique cantilevering will be required in most cases. The picture shows a favourable arch form (rounded) for a better AP spread when compared to a squared arch form.

After placement of the six dental implants a post-operative OPG was taken and the denture relined with soft reline material over the healing abut-
ments placed. In this case I opted for transmucosal healing as we achieved high levels of primary stability on all the implants. In this case the distal implant on the right side entered the sinus space and we performed a summers lift. The patient was allowed to heal for a period of five months with the temporary relined denture.

_Prosthetic protocol_

After the healing period all implants were checked using a periotest to measure osseointegration. The readings were as follows:

- UR3 Implant = -7.0
- UR2 Implant = -6.9
- UR1 Implant = -5.0
- UL1 Implant = -8.0
- UL2 Implant = -5.0
- UL3 Implant = -6.0

All implants had osseointegrated well and showed no pain, mobility, infection, loss of bone or exposed titanium intra orally.

We then carried out the following sequence for restoration:

1. Fixture head impressions linked in a special tray. Using floss and GC pattern resin to link impression screws
2. Try-In of the multi-Angled screw retained abutments with lab made positional Jig to parallel the abutments

3. New impression of the multi-Angled abutments and X-ray verification of correct seating. Again these are linked using GC pattern resin and also a verification jig made by the lab to verify accuracy of model prior to metal framework construction

4. The denture was relined again over the new abutments

5. Metal framework try-in - screw retained and checked for passive fit using the Sheffield test. Re-verification of the midline, re-bite registration, a new face-bow record, intra-oral and extra oral photography to give the technician sufficient data to make the teeth and an idea of degree of soft tissue support required

6. A Hybrid Acrylic-Composite prosthesis was then placed and checked intra-orally for aesthetics, lip support and bite. I had decided to provide a balanced articulation type of occlusal scheme

7. Final fixation of the prosthesis and detailed written and oral instruction given to the patient. One must consider cleanable spaces and your lab must understand this and allow for the patient to be able to clean the spaces underneath the area around the implant heads. We provide a waterpik and review the hygiene habits at three, six and 12 months post placement

8. The screw holes then filled with cotton wool followed by flowable composite

9. Post-operative follow ups at three, six and 12 months with regular dental checks on lower dentition and follow-up x-rays yearly to determine bone levels after baseline OPG taken

Dr Avik Dandapat qualified from Birmingham University then went on to complete his MFDS(UK), the Diploma and Advanced certificate in dental Implantology from The Royal College of Surgeons of England in 2006 in Cohort three of the course. Avik has been an ADI mentor for the past eight years and a mentor for both Ankylos and DIO Implant systems. Avik actively lectures at the the FGDS(UK), ADI members forum, Ankylos Implant members forum and is active ADI study club lecturer in dental implantology. At present Avik runs two practices in Reading, Berkshire and 121 Harley Street, London and his focus is solely on implant and reconstructive dentistry. Currently Avik is studying toward his MSc in Implant dentistry from Manchester University. Thanks to my Lab - Medimatch UK - www.Medimatch.co.uk and the Dental Implant Manufacturer: DIO Implants UK - www.Dentala.co.uk
Deep periodontal defects with advanced bone loss of the buccal cortical plate represent a challenge for periodontal treatment in the upper front region. Literature data suggest that one and two-wall periodontal defects do not have tendency for complete periodontal regeneration and bone fill (Eickholz et al. 1996, 1998, 2000). Remaining residual pockets can also jeopardise the long term result of periodontal treatment (Matuliene et al. 2008). Tooth extraction in the upper front region even without any periodontal defect will result in certain amount of oro-vestibular and eventually vertical shrinkage of the original soft tissue contour (Schropp et al. 2003). Due to bone remodelling appropriate implant placement cannot be achieved in most of the cases. Socket preservation and different alveolar site developments are used to offset this unfavourable feature (Camargo & Lekovic, 2004; Lekovic & Kenney, 1997). It is obvious that the application of one of these techniques can be of great importance when tooth extraction is being considered at periodontally compromised teeth with advanced buccal plate involvement. It is not clear that ridge preservation procedures are effective in limiting horizontal and vertical ridge alterations in postextraction sites. Comparing the clinical and histological results obtained by different preservation techniques there is no literature data to support the superiority of one.
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Implant therapy

Nevertheless each preservation technique provided better results than natural socket wound healing (Barone et al. 2008). The effect of extraction site development on the changes of attachment level of neighbouring teeth has not been clarified yet. While supraalveolar periodontal regeneration is still unpredictable (Sculean et al., 2004) vertical ridge augmentation has been successfully demonstrated in several publications (Barboza EP., 1999; Urban & Jovanovic, 2009; Merli & Lombardini, 2010; Beitlitum et al., 2010). Treatment of vertical ridge deficiencies has been performed in edentulous areas without neighbouring teeth demonstrating advanced periodontitis. It was suggested that natural teeth with advanced periodontitis, may impose a risk for an infection of the augmented site and of membrane exposure originating from the neighbouring periodontally compromised teeth (Karoussis et al., 2003; Hoffmann et al., 2007). Nevertheless in certain clinical situations, teeth presenting deep intrabony defects are located in close vicinity of the compromised alveolar ridge.

In these particular cases, it is of clinical interest to simultaneously reconstruct both the intrabony periodontal defect and the resorbed alveolar ridge, thus allowing proper insertion of dental implants. For those implant patients having a history of chronic periodontitis it is inevitably important to reduce periodontal pockets at natural teeth to 3mm and even below to facilitate proper individual plaque control and to reduce the chance of periodontal reinfection (Carnevale et al., 2007).

The importance of proper implant positioning and adequate amount and quality of perimplant hard and soft tissues have to be considered to maintain long term stability around implants. Therefore, the aim of the present cases was to evaluate the effect of a new step-by-step surgical technique designed to simultaneously reconstruct resorbed alveolar ridge and the adjacentally located intrabony defect to achieve a predictable clinical outcome and adequate peri-implant tissue stability.

Three patients exhibiting chronic periodontitis with localised advanced periodontal bone loss were referred to the Department of Periodontology,
Semmelweis University, Budapest, for comprehensive periodontal therapy. All three patients were middle aged Caucasian males (51, 50 and 49 years-old), systemically healthy and had never been smokers. Each patient presented at least one deep advanced periodontal bony defect in the upper front region. After initial therapy teeth were considered to be hopeless because of their disadvantageous pathomorphology. Before tooth extraction each patient had completed basic cause related periodontal therapy including full mouth scaling and root planing and oral hygiene training. Before surgery all exhibited high standards of oral hygiene. Treatment plan consisted of tooth removal followed by extraction site development (Surgery 1), and soft tissue augmentation (Surgery 2), and implant placement with simultaneous ridge augmentation (Surgery 3) and abutment connection with non resorbable membrane removal (Surgery 4). The following parameters were measured at baseline, immediately before augmentation procedure and 11–20 months after implant placement: plaque index (PI), gingival index (GI), bleeding on probing (BOP), probing depths (PD) around the neighbouring teeth at six sites, gingival recession (GR), clinical attachment level (CAL) with a millimetre calibrated periodontal probe (PCPUNC 15, Hu-Friedy, Chicago, IL, USA) and also intrasurgical direct measurements: the level of periodontal bone of neighbouring teeth, the width and height of the alveolar ridge. Standardised radiographs were taken with the long cone parallel technique preoperatively, between surgeries and postoperatively; for qualitative assessment of bone height.

**Surgery 1 – Tooth extraction with extraction site development**

Following tooth removal a full thickness flap was raised up to the mucogingival line and beyond a partial thickness flap was mobilised with a horizontal extension thus allowing a tension free soft tissue management and wound closure. This flap design let the operator to evaluate and treat the periodontal defects around the neighbouring teeth. A combined alveolar site preservation technique was used with a slow resorbable membrane (Resolut Adapt LT 2530, Gore-Tex®, Newark, DE, USA) fixed with titanium pins (Tipins; DENTSPLY Friadent, Mannheim, Germany) to cover the missing part of the buccal plate and to maintain the original form of the earlier arch. Following an appropriately sized connective tissue graft was removed from the palatal mucosa by using the Hürzeler technique (Hürzeler & Weng, 1999). The harvested tissue was trimmed and sutured (5.0 non-absorbable polyamide monofilament, Braun AG, Tuttingen, Germany) to the inner surface of the partial thickness.

**Surgery 2 – Soft tissue augmentation**

Following the above mentioned procedures if the width of the keratinised soft tissue allowed proper coverage after augmentation procedure simultaneously...
Implant therapy

Ossous augmentation and implant placement was performed. If the thickness and the width of the alveolar mucosa were not sufficient to provide predictable primary wound healing during hard tissue augmentation procedure, soft tissue augmentation was performed prior to implant placement. A free autogenous soft tissue graft or a xenograft (Alloderm®, BioHorizons, Birmingham, AL, USA) was used in order to gain enough keratinised gingiva and deepen the vestibule at the implant area using a modified tunnel technique (Azzi et al. 2009). The tissue harvesting technique has already been described before.

Surgery 3 – Implant placement with simultaneous hard tissue augmentation

One implant (Straumann Bone Level, Straumann AG, Waldenburg, Switzerland, and Nobel Replace Tapered Effect, Nobel Biocare, Gothenburg, Sweden) was inserted with simultaneous 3-D hard tissue augmentation using BDX and a non-resorbable membrane (Titanium membrane—FRIOS® Boneshield; DENTSPLY Friadent®, Mannheim, Germany) or a slow resorbable membrane (Resolut Adapt LT 2530, Gore-Tex®, Newark, DE, USA) was fixed over it. A tension free wound closure was achieved in all cases resulting in primary wound healing.

Surgery 4 – Abutment connection with non resorbable membrane removal

The same split thickness flap design was applied for non-resorbable membrane removal and abutment connection. After surgery patients were instructed to take antibiotics (Augmentin, 3x625 mg/day for one week). Post surgically mechanical plaque control was not performed in the surgical and adjacent area and chemical plaque control was maintained with a 0.2 per cent chlorhexidine solution twice daily (Corsodyl, GlaxoSmithKline). Sutures were removed at 14 days after surgery. Additional recall appointments including supragingival professional tooth clean-
ing were scheduled biweekly for the first six postoperative weeks. Prior to tooth extraction each patient received a resin bond prefabricated bridge to provide immediate provisional prosthodontics reconstruction after tooth extraction. Finally all patients received fixed prosthodontic restoration ie PFM crowns on each implant.

**Case 1 (Figs. 1–14)**

A 51-years-old male patient was referred with generalised periodontitis for a comprehensive periodontal treatment. At the upper right lateral incisor an advanced periodontal defect was registered with tooth mobility III. Deep periodontal pocket depths were assessed on the adjacent teeth. After flap elevation a two-wall crater-like defect was found on the mesial aspect of the tooth with a missing buccal bony plate. After tooth extraction the previously described step-by-step technique was carried out. As a result of surgery 1, completed with a soft tissue augmentation, the alveolar ridge configuration allowed the implant placement with simultaneous further augmentation. During abutment connection the 3-D reconstruction of alveolar ridge was observed around the previously supracrestally placed implant. This surgical approach allowed a re-entry procedure of adjacent periodontal defects, they presented bone fill and complete regeneration of earlier one-wall defects. After soft tissue healing a screw retained temporary crown was placed in situ to form an ideal emergence profile for further three months. This situation was then transferred to the cast to make the permanent PFM crown.

**Case 2 (Figs. 15–17)**

A 54-year-old male patient presented an advanced vertical bony defect on the mesial aspect of the right upper central incisor with excessive tooth mobility. After tooth extraction an alveolar site development was performed in the same way like described before without any bone substitute material. The second surgical phase was the previously described soft tissue augmentation. During surgery 3 implant placement with simultaneous hard tissue augmentation was proceeded by. As an augmentation material BDX was used covered by a slow resorbable membrane. The width and height of the alveolar ridge became sufficient to promote long term stability for the implant borne restoration.

**Case 3 (Figs. 18–20)**

The third case is a 49-year-old male patient who presented the left upper lateral incisor with an advanced horizonto-vertical bony defect on its mesial aspect. Following tooth extraction an
alveolar ridge preservation was performed and implant placement with simultaneous augmentation as described before. The augmentation material was BDX covered by a titanium membrane. The final soft tissue augmentation was followed by the prosthodontic rehabilitation, a PFM crown was established.

After the cause related periodontal therapy the patients developed proper individual oral hygiene measures. Each patients’ gingival and plaque index was under 20 per cent, the mean of PI was 7.7 per cent, and 12.7 per cent of GI, respectively. At baseline the mean periodontal PD of the neighbouring teeth was 3.97mm, GR 0.88mm and CAL 4.78 mm. After the healing of the third stage the neighbouring teeth’s PD was 2.55, GR 2.13 and CAL 4.58. The clinical parameters showed slight improvement although the number of cases does not offer any statistical analysis. The intrabony component of the adjacent teeth is being eliminated clinically and radiologically and during re-entry. Optimal hard and soft tissue conditions were found around implants.

Discussion

The long term success of implant therapy depends on the adequate volume of bone around the implant site. The lack of mineralised tissue is an unfavourable condition for a predictable implant therapy (Lekholm et al., 1986). Another key factor for maintaining the alveolar crest level around implant is the quantity and morphology of the covering soft tissues. Implant therapy in the aesthetic zone needs a comprehensive consideration of several contributing factors. In periodontal patients implant placement is even more challenging. Periodontally compromised teeth often show disadvantageous bone loss, especially if the buccal bony plate is missing. For achieving predictable healthy periodontal conditions tooth extraction cannot be avoided. Several techniques and materials have recently been developed for the purpose of extraction socket preservation. There are controversial data in the literature concerning the possible role of bone fillers in alveolar socket preservation. Several different techniques have been described to achieve this goal. There is a substantial ambiguity in the literature regarding the predictability of these kind of techniques. Several authors report positive findings on the effect of bone substitutes (Froum et al., 2002). Different animal studies (Araújo & Lindhe, 2009; Fickl et al., 2009) suggest that bone filler materials can to a certain extent retard
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or modify the resorption of the buccal bone. It is also the matter of discussion whether these grafting materials in the alveoli have an active role in the modulation of alveolar bone formation or they only slow down the vestibular bone resorption (Araújo & Lindhe, 2009). Other studies suggest the utilisation of membranes. The biodegradable membranes have recently been increasingly applied because of its incorporation in the host tissues and providing better soft tissue healing. If it is exposed to the oral cavity the healing is less compromised and the risk of infection is low (Lekovic et al., 1997, 1998). Tooth extraction always presents conditions where a complete wound closure is questionable. If the membrane is not able to maintain enough space for regeneration it should be supported with some grafting material (Case 3). Similar ridge configuration was achieved when using bone fillers (see our Case 1) or without any bone substitute (see our Case 2) (Chiapasasco et al., 2006). The use of non-resorbable membrane became the gold standard for GBR with a need of 3-D reconstruction of the edentulous ridge (Simion et al., 2007). One of the disadvantages of this technique that the gingival flaps should be sutured over the membrane in a way that a primary wound healing without any flap dehiscence could be achieved. Membrane exposure may severely compromise wound healing and also the consecutive regeneration and final treatment outcomes (Hämmerle et al., 1998). The soft tissue coverage is a prerequisite for the management of hard tissue augmentation and for the final aesthetics of the implant borne restoration. The three demonstrated clinical cases showed favourable hard and soft tissue alteration during the third surgery. During this step-wise surgical approach we managed to develop an ideal implant position in all the three dimensions covered by the required amount of hard and soft tissues (Buser et al., 2004). Literature data suggest that survival and success rate of implants partially or fully placed into augmented bone is comparable to implants placed into non regenerated alveolar ridges (Mayfield et al., 1998; Zitzmann et al., 2001b). The biological mechanism of the alveolar regeneration is not fully investigated and understood and the role of this issue in the healing of neighbouring teeth’s periodontal intrabony defects even needs further examination.
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24th September 2012
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AAID Meeting
3–6 October
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EAO Congress
11–13 October
Copenhagen

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1st November 2012
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<tr>
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<td>£140</td>
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<td>Lab Crown and charges:</td>
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