Screw-retained implant crowns
Technical solutions for challenging situations

“Paris is always a good idea”
Countdown to the EAO Congress

Effective teamwork for optimal outcomes

Evaluating the role of soft tissue substitutes

When and how to use d-PTFE membranes
Providing dental care in war-torn Syria

Anna Farina reports on Syria Relief’s new oral healthcare project: the Mobile Dental Clinic

My work in Syria began three years ago. Being a mother of two little girls, I have been deeply affected by TV images of Syrian children living in awful conditions. In 2013, I decided to do something concrete to help them. For a couple of years I spent a few days every two months doing voluntary work in refugee camps at the Turkish-Syrian border, helping to distribute food and survival items and supporting children in schools. This year, after a 17-year career in banking, I decided to move full-time to the humanitarian sector and I joined Syria Relief to develop their operations in London.

Syria Relief has existed since the uprising began in 2011. It was founded by seven Syrian trustees, most of whom are doctors. The charity’s current focus and objective is to provide support and care to the eight million people who are internally displaced by the conflict. As well as offering emergency help, education and food security, Syria Relief has begun developing livelihood programmes which enable communities to become self-sustainable and self-sufficient again.

In addition to our headquarters in Manchester, we have two offices in Turkey and five across Syria, where we employ more than 100 staff. Through our schools and hospitals we also provide jobs to more than one thousand people, from teachers to doctors.

Our new Mobile Dental Clinic is an important example of our work. In the past, we have supported a number of important medical projects including Bab Alawa Hospital (near the Turkish Border), maternity units in Aleppo and Idlib, two stationery prosthetic limb clinics, a mobile prosthetic limb clinic, and a mental health clinic in Turkey for children with post-traumatic disorders. However, last year we realised that we did not cover oral or craniofacial healthcare.

In the light of the mobile prosthetic limb clinic’s success, we conceived the Mobile Dental Clinic. The clinic is a large van containing a full dental surgery and space for equipment and instruments. The van was funded by English dentists, built and fitted out in the UK and then shipped to Turkey in a container. It entered Syria in October 2015.

A van is a viable option for providing medical care in a war zone for several reasons. For stranded survivors, who cannot travel due to their dangerous environment or mobility challenges, it is one of the only types of service which can reach them. It is also far smaller than a hospital, which is more visible, busier, and stationary: potentially making it a target during war time. Because dental and craniofacial treatments can all be provided from one room – using one chair – a spacious van is also an ideal context for providing such therapy.

Since the project launched in October 2015, our mobile dental clinic has reached over 500 patients. It mainly travels between Aleppo and Idlib, in the more densely populated north-western regions of Syria. The van is staffed by two dentists, a nurse and a driver, who live and travel with it. When off-duty, they stay in nearby hospitals for shelter. The staff provide dental check-ups for local citizens, but also more substantial reconstructive surgery for those who have been injured. Services are offered to anybody who needs them, regardless of their background. On average, the staff treat more men than women, and a third of the clinic’s patients have been younger than 12.

Supporting a van like this is costly. The project’s outgoings, which include dental materials and supplies; fuel and maintenance; salaries for dentists and staff; and administration and management fees, amount to a total of approximately £30,000 per year.

Dental Aid Week for Syria

Inspired editor Isabella Rocchieta is working with Anna Farina, Dr Sabena Bhuiyan and Dr Cleopatra Darwish, to organise ‘Dental Aid Week for Syria’ between 10 and 17 July 2016. As part of this initiative, dentists will be asked to donate three hours’ worth of their profits to support the mobile clinic. If you would like to help Syria Relief and the Mobile Dental Clinic to continue its journey inside Syria, join Isabella, Anna, Cleopatra and Sabena in their efforts and visit mydonate.bt.com/fundraisers/dentalaidsyria to donate to the cause. Even the smallest contribution can make a big different inside Syria.

If you would like to support Syria Relief’s work, please visit their website and donate: www.syriarelief.org.uk/get-involved
It’s now less than four months until the EAO’s 25th Annual Scientific Meeting takes place in Paris, and plans are being finalised for what promises to be the most exciting and interactive EAO congress yet.

We’re proud to be closely associated with the meeting, which is being chaired by David Nisand, and will include an Arena session chaired by me, Isabella Rocchietta. Many other members of the Inspyred editorial committee will be taking part too, along with several of the authors whose articles appear in this edition.

The EAO’s Annual Scientific Meeting is the biggest event in the European calendar for anyone with an interest in implant dentistry. It provides a mix of top-quality scientific and clinical presentations, along with practical tips for daily practice aimed at practitioners at all levels. And of course it’s a great opportunity to meet old friends and make new ones, as well as discovering the latest equipment and software. We do hope you will be able to attend and help make this the most successful EAO meeting ever. Early bird discounts are available until 20 June 2016, with generous extra discounts for EAO members.

This edition of Inspyred is as varied as you have come to expect, and includes thought-provoking articles on a wide range of subjects. Anna Farina’s piece on the vital dental care being provided for people affected by the war in Syria is a reminder of the fundamental importance of dentistry to basic health. The work we carry out as specialists is only possible because our patients live in societies where basic healthcare is widely available and often free to access. Anna’s article shines a light on the humanitarian challenges that are faced by communities affected by war.

The clinical articles in this edition cover a wide variety of topics. They include a paper describing options for using screw-retained restorations in challenging situations where implants haven’t been placed optimally. Two other articles explore the theme of achieving optimal results through taking a multidisciplinary approach, including using one or more orthodontic procedures. There are also detailed case studies describing when and how soft tissue substitutes can be used, along with a paper on a technique for ridge preservation/restoration using d-PTFE membranes.

**Could you submit a paper to Inspyred?**

Inspyred is ‘the alternative EAO voice’, and provides a platform for both EAO members and the wider professional community to discuss different treatment options. All readers are warmly invited to submit papers of their own by emailing the editorial board at inspyred@eao.org. You’ll find further guidance on submitting an article by visiting the Inspyred home page: [http://eao.org/inspyred](http://eao.org/inspyred). Once we receive your paper, we will review it against the submission criteria, then provide feedback with a view to publishing it in a forthcoming edition, wherever possible. Contributions from readers make an invaluable contribution to the diversity of subjects that Inspyred explores, and the board would be delighted to receive your paper for consideration.

Isabella Rocchietta and David Nisand
Screw-retained implant crowns
Technical solutions for challenging situations

Two options are available for retaining implant-supported crowns: cement or screws. For decades, dentists have filed and shaped teeth to enable them to act as abutments before restoration with fixed partial dentures, retained with dental cements. Because of their familiarity with this process, most dentists originally preferred to cement crowns on to implant abutments. However, this approach has several shortcomings.

Numerous scientific papers have been published showing key benefits of the screw-retained option, backed up by long-term clinical experience. In response, manufacturers have developed advanced tools to compensate for screw access holes in non-ideal locations. Some of the reasons screw-retained implant crowns are preferable are:

- There is no possibility of applying excess cement, which can cause peri-implant infections.
- Screws provide an easy, safe and non-invasive method for removing the crown if necessary.
- They enable convenient try-ins. By contrast, pressure from the mucosa may make it hard to leave the crown in a fully seated position if it is not screw-retained.
- Improved implant connections and abutment screws have made screw loosening a relatively rare phenomenon, providing screws are used according to the manufacturer’s recommendations. Screw-retained crowns also show fewer complications compared with cement-retained alternatives.
- Smart implant connection designs have allowed abutment screws to become smaller, meaning screw access holes can also be smaller. This reduces the potential weakening effect of the occlusal access hole on the final reconstruction and also helps avoid aesthetic problems. Some manufacturers offer special screwdrivers with screw head geometries that allow major tilting of the screwdriver. Regular screwdrivers may also need to be carefully modified to allow tilting (although to a lesser extent).

One major disadvantage inherent in the screw-retained system is the need for an access hole. In cases where the implant can be placed in an ideal prosthetically-driven way, access holes are positioned in the middle of the occlusal surface in the posterior areas, and in the palatal concavity in the front tooth region. Screw heads are first protected with Teflon tape, then the access hole is filled with a composite.

A technical point of view, good stability can be achieved, and since the composite filling is located at an aesthetically uncritical region, patient acceptance is very high. If a re-intervention is required, quick and non-destructive access to the screw is easy to achieve.

Implant surgeons often face situations where there is a bone defect around the implant. Even though GBR procedures allow many of these defects to be addressed effectively, it is not always possible to place the implant in such a way that the screw access holes will be located in an ideal position. One approach to this is the use of angulated abutments. These can compensate for the technical problems associated with implants which are not placed in an axially ideal way. However, they have several disadvantages. Apart from their greater technical complexity and cost, the risk of recession is increased because of the greater pressure they place on the submergence profile of the soft tissues. Aesthetically, this often leads to exposed abutment surfaces. In addition, when using screw-retained crowns, secondary screws must be used with lower preloads, increasing the risk of screw loosening. Therefore, angulated abutments are currently the option of last resort and are only recommended when all other options have been ruled out. Where possible, one-piece implants (also known as soft tissue level implants) are used in the posterior region to avoid the need for a separate abutment. For anterior teeth, there are situations where both a one-piece and a two-piece implant will offer specific advantages. Both types are suitable for use with one-piece crowns which can be directly fixed to the implant body with abutment screws, avoiding the need for secondary screws.

The following cases illustrate reconstructive concepts which enable screw-retained implant crowns to be used in less favourable situations.

Case 1

This case demonstrates the intentional and carefully planned tilting of lower posterior implants towards the lingual side.

Even though a panoramic CT scan showed more than sufficient vertical bone, the cone beam CT, as well as the intraoperative view, demonstrated a major lingual concavity and inclination of the alveolar bone in the rear mandible. Upright installation of the implants would have required a vertical bone augmentation. The combination of difficult access and an unfavourable soft tissue situation were key reasons to avoid this approach, therefore minimising the risk of surgical complications. By tilting the last two implants lingually, the need for GBR was avoided. Additionally, the screw access holes could be located close to the middle of the lingual surface. A PFM reconstruction was made with the framework directly connected to the soft-tissue-level implant system (Thommen Medical, Switzerland).

As one regular diameter and two small diameter...
implants were used, the restorations were splinted for optimal mechanical resistance. In general, angulated abutments should be avoided in a case like this because of their unfavourable submergence profile, which increases the likelihood of recessions, along with the potential risk of imprecision when used with multiple splinted crowns. However, in this case the location of the screw access holes and their small diameter due to the small abutment screw offered by this system outweighed these risks. In addition, the framework provided excellent support for the associated occlusal loads. To achieve the high precision necessary, the impression copings were first bonded together with a low-shrinkage resin (GC Pattern Resin, GC, Japan), then separated and rebonded, and a pick-up impression technique was used.

To fill the access holes, the screw head was first covered with a Teflon strip, then filling composite was added. The veneering ceramic was etched in the lab to provide an excellent bond between the crown and the composite.
Case 2

This case illustrates the technical and aesthetic compensations that were used to address the unfavourably long axis of an upper anterior implant that had been placed alio loco.

The implant (Straumann Bone Level, Switzerland) had been placed in the aesthetic area in an alio loco position, with the result that the screw access was located in the middle of the buccal aspect of the crown. A veneered zirconia crown was chosen as the reconstruction, which allowed the placement of an aesthetically perfect composite filling using the porcelain etching technique. The following layering technique was used: a Teflon strip to cover the screw; etching and silanization of the veneering ceramic; an opaque dentine layer; and an enamel composite portion.

Fig. 2-1: Impression coping in place.
Fig. 2-2: Incisal view of crown.
Fig. 2-3: Buccal view of crown.
Fig. 2-4: Final clinical situation.

Case 3

The previous cases were characterised by access holes in the buccal or oral aspect of the crowns. The non-optimal location of the access holes meant that the restoration could be designed in a mechanically and technically optimal way. By contrast, this case demonstrates the advantage of using monolithic ceramics bonded to a prefabricated titanium substructure in order to provide more options for the placement of the screw access channel.

In this case, two implants (Thommen Medical, Switzerland) were placed so that they were tilted slightly outwards. This was necessary because of a deep vestibular concavity. The access holes were at the incisal tip of these first bicuspids. In traditional crowns with a high-strength core made out of gold alloy or zirconia covered with weaker veneering ceramics, the veneering material would not be stable enough to incorporate an access hole in a pointy situation like this. Therefore another approach was indicated, and a prefabricated and modified titanium base was used. The crown was made out of high-strength lithium disilicate glass ceramics and was adhesively bonded to the substructure outside the mouth (Panavia 21 OP, Kuraray, Japan). Due to the small abutment screws, a reasonably narrow screw channel could be incorporated (this approach is only feasible with traditional large abutment screws if the crown is very large). Since the major part of the crown consisted of glass ceramics which have quite similar optical characteristics to composites, a composite coverage of the access hole was easily achieved. This was invisible to the patient and stable enough to withstand the forces applied to it. Again, the screw head was covered with a Teflon strip and the glass ceramic was etched to provide an excellent bond between crown and composite.

Fig. 3-1: Location of screw access hole.
Fig. 3-2: Glass ceramic crown bonded to Ti base with screwdriver in place.
Fig. 3-3: Implant crown in place.
Fig. 3-4: Final radiograph.
Case 4

This case describes a technique for converting a fixed partial denture which was originally cemented into a screw-retained version.

The implants had been placed several years previously and a significant peri-implant infection had since developed. The bridge had been made elsewhere so it was not clear whether it would be possible to remove it. The practitioner succeeded in breaking the cement by applying strong impacts at the interdental area transmitted by a crown removal tool (Coronaflex, KaVo, Germany). The abutments were then removed and an impression was taken. Next, the dental technician drilled access holes into the buccal side of the bridge and cemented the abutments extraorally into the removable partial denture. It was thus converted into a screw-retained and therefore predictably removable RPD. The most anterior implant needed to be removed, and the two distal ones underwent a flap surgery and implantoplasty. Since the bridge could now be easily removed for this step, surgical access was optimal, which is crucial for the success of such procedures.
Case 5

This case describes the use of a modified screwdriver to allow the screw access channel to be tilted.

This implant had been in function for many years with a cemented crown. However, pus on pressure was present, and the crown, which had always been too short, required an intervention. The removal of the cemented crown proved to be very difficult. During the process it needed to be cut into several parts, resulting in total destruction. Unfortunately the dentist who had placed it had bonded all the parts together, including the abutment screw. The lack of preload obviously caused the suppuration. When taking the impression it became clear that the access hole would need be situated exactly at the incisal edge, so a simple screw-retained reconstruction was not going to be possible. Due to the small dimensions of this lateral incisor, the best option was to design an angled access hole in combination with a specially modified square-cut screwdriver, enabling up to 25 degrees of angulation. Although this worked very well, it must be pointed out that a measure like this can sometimes lead to technical difficulties if the crown needs to be removed again. Also, the head of the screw requires more space to enable the tip of the screwdriver to be positioned properly.

Conclusion

An implant-supported crown should always be screw-retained rather than cemented. This can, however, lead to challenges where implants have been placed non-ideally. Nonetheless, a variety of approaches are available which provide technical solutions to using screw-retained reconstructions in these non-ideal settings, as illustrated in this article. Careful 3D planning must always be conducted before placing any implant in order to allow the simplest and thereby most effective technical design and avoid unplanned technical challenges. Such an approach will minimise complications and maximise efficiency in the long run.

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Audrey Hepburn famously said that “Paris is always a good idea” and what better reason to visit Paris than to participate in the EAO’s 25th Annual Scientific Meeting? Established as the leading European event for anyone with an interest in implant therapy, the EAO’s annual congress continues to innovate, attracting world-leading speakers and hosting a huge range of interactive presentations.

New highlights for 2016 include 7 Minutes to convince, along with two arena sessions that will see international teams debate clinical cases with interaction from the audience. The first arena session will focus on the hot topic of ‘Decision making on the basis of the level of disease: conservation versus extraction’.

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**Arena Session 2: Treatment planning session: a clinical case with a “complex” problem or involving extensive rehabilitation**

**Chair:** M. Cohen (USA), **Presenter:** A. Ricci (Italy), **Coordinator:** S. Gracis (Italy)

Each team will receive details of the case they are discussing before the congress. During the session they will explain the treatment they propose and its rationale. Afterwards the presenter will reveal the therapy that was actually performed.

**Team America:**
Sonia Leziy (Canada)
Brahm Miller (Canada)
Ward Smalley (USA)

**Team Europe:**
Rino Burkhardt (Switzerland)
Joerg Strub (Germany)
Marc Schätzle (Switzerland)

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**Arena Session 3: Please give me back my smile! Decision making in the aesthetic zone: Challenge your speakers**

**Chair:** I. Rocchietta (United Kingdom), **Co-Chair:** M. Brient (France)

For this session, the participants won’t see the clinical problems beforehand so will react to them in real time along with the audience. After the case has been discussed, the presenter will reveal the treatment that was carried out.

**Team 1:**
Markus Hurzeler (Germany),
Otto Zuhr (Germany)

**Team 2:**
Tidu Mankoo (United Kingdom),
Laura Frost (United Kingdom)

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**7 Minutes to convince.**

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The EAO Junior Committee will host a new session at this year’s congress giving YOU the opportunity to spend seven minutes on stage presenting on any research topic of your choice. At the end of the session, the Junior Committee and the audience will vote on the best presentation. To apply send us a one-minute video summarising what you will present, and explaining why it is groundbreaking and why you deserve to be one of the seven selected presenters. Don’t miss this unique opportunity to present your research to an audience of your peers from around the world. Visit www.eao-congress.com/submission today to apply to take part!

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**EAO Certification Programme workshop**

During the scientific meeting, you can attend a workshop enabling you to learn how to obtain the EAO’s prestigious Certificate in Implant-based therapy. The free workshop will take place on Friday 30 September and you don’t need to pre-book. This is the ideal opportunity to learn more about the Certification Programme.

Certification from the EAO demonstrates to your patients and colleagues that you are committed to providing high-quality implant treatments. Guidance from the experts during the workshop will ensure you are equipped with the knowledge to submit a successful application. You can read more about the programme at eao.org/certification-programme.
Killing two birds with one stone
Achieving optimal results by combining minimally invasive procedures

As dentists we should always be looking for opportunities to reduce discomfort for our patients, while improving treatment outcomes. Minimally invasive procedures can provide ways of meeting these goals. In addition, when presented with challenging cases and other obstacles, a creative approach can provide opportunities to ‘kill two birds with one stone’. The following case illustrates these principles.

The patient was a 33-year-old male in good general health. His chief complaint was a dissatisfaction with the aesthetics of his smile. An assessment revealed that tooth 11 had been extracted as a result of past trauma, while tooth 12 was noted as being deformed (Figure 1). It appeared that another dentist had tried to anchor a bridge to it.

Based on evidence presented in the scientific literature, the case featured a series of problems, over and above the obvious aesthetic challenges. These included:

- a low gingival margin
- low distal papillae height
- a thin scalloped gingival biotype
- the triangular shape of the adjacent tooth

Tooth 21 was an intact tooth, so the gingival margin and tooth shape could not be changed. In the occlusal view, a knife-edge was visible, as well as scar tissue from the trauma (Figure 2).

Before placing an implant, the patient would require a bone graft. However, at that time, the Japanese Health Agency did not allow the use of any bone substitutes in the dental field, so autogenous bone from the patient had to be used. This is usually harvested from the areas marked in red on Figure 3. However, harvesting bone from these sites can lead to significant swelling and pain. On further consideration, a better location for harvesting the required autogenous bone was identified. This was in the neighbourhood of the patient’s wisdom teeth, and was deemed appropriate because these teeth needed to be removed as well (Figure 4). Using this approach it was possible to kill two birds with one stone.

The left wisdom tooth was removed and bone blocks were harvested from around it (Figures 5 and 6). One of these was screwed into the ridge, and the other was crushed, with the particles used to fill the space around the main block. The site was then covered with a collagen membrane (Figures 7 and 8).

After an eight-month healing period, the implant was placed and a second wisdom tooth removal and bone graft and was carried out (Figure 9). There was then a delay of a year before the implant was exposed and a connective tissue graft was carried out. (This was due to the patient’s personal circumstances, and not related to any clinical factors.)

Figure 10 shows post-operative healing three months after the implant had been provisionally restored. However, at this stage the aesthetic outcome was not satisfactory. To address this, a papillae reconstruction technique was carried out (Figure 11), after which the soft tissue was allowed to heal for two months. After that, limited orthodontic treatment was carried out to adjust the gum line and papillae height (Figure 12). A zirconia abutment was made and final preparation of tooth 12 carried out (Figure 13). Figure 14 shows the post-operative outcome, with ceramic restorations on both the implant and tooth 12 and bleaching of the patient’s natural teeth completed.

This case illustrates that there are sometimes more options for harvesting autogenous bone than may at first be apparent. In this case, the patient’s wisdom teeth needed to be removed, making it possible to kill two birds with one stone. The resulting procedure was less invasive and uncomfortable for the patient, and offered a more straightforward surgical route.
To submit a paper to Inspyred, email the editors at inspyred@eao.org.

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Soft tissue substitutes in dental implantology

Evaluating the role of collagen matrices and porcine dermal matrices

The predictability of osseointegration is no longer a challenge in dental implantology. Today, the challenge for clinicians and researchers has shifted to the harmonious integration of the implant fixture into the neighbouring soft and hard tissue architecture. In the aesthetic critical zone, soft and hard tissue defects are often encountered due to pre-existing tissue defects or shrinkage of the ridge following tooth extraction.

The field of bone augmentation has evolved dramatically over recent decades and today xenogenous or allogeneic bone substitutes are widely used, either as a scientifically accepted alternative to autologous bone, or in combination with autologous bone.

In the field of soft tissue augmentation, soft tissue matrices are still fighting for their spot in the treatment armoury of experienced clinicians. Using autologous soft tissue grafts to correct deficiencies either at the time of implant placement, or at the second stage, is still regarded as the gold standard (Thoma et al., 2009). However, autologous grafts, routinely harvested from the palate, have certain disadvantages, such as second site morbidity; limited donor site availability; and risks of complications. These disadvantages have led to the development of soft tissue matrices to increase tissue volume or augment attached keratinised mucosa.

Different soft tissue matrices are now available, including acellular dermal matrices derived from human or porcine skin, and bilayer collagen matrices of porcine origin. Both can be used to improve tissue quantity and quality at different time points in dental implantology. Recent review articles point out that for recession coverage, scientific evidence for the efficacy of these materials is still low (Cairo et al., 2014). On the other hand, preclinical and clinical studies have clearly shown that these materials can be used successfully when strict case selection is performed (Jepsen et al., 2013, Thoma et al., 2011, Thoma et al., 2010).

The group working alongside the author has investigated the clinical efficacy of xenogenous matrices for soft tissue surgery and compared subepithelial connective tissue grafts and a porcine acellular dermal matrix for the treatment of dehiscence defects in a pre-clinical setting. They found no statistically significant difference either in soft tissue height or thickness, and thereby concluded that porcine acellular dermal matrix might be an alternative to an autologous graft for soft tissue augmentation (Fickl et al., 2015). The purpose of this article is to illustrate the use of different soft tissue matrices as an alternative to autologous soft tissue grafts.

**Case 1: Ridge preservation with a bilayer collagen matrix**

Scientific evidence from the last decade has clearly shown that ridge preservation techniques are able to limit tissue atrophy following tooth extraction (Ten Heggeler et al., 2011). Studies illustrate that the combination of a xenogenous bone substitute with an autologous soft tissue punch can be regarded as the best technique for limiting post-extraction shrinkage (Fickl et al., 2008, Thalmair et al., 2013). However, tissue harvesting from the palate can be associated with disadvantages – in particular when punch grafts are removed – so porcine xenogenous matrices should be considered as an alternative. The amount of volume preservation achieved using a xenogenous bone substitute and a porcine matrix seems to be comparable with the use of an autologous punch and a xenogenous bone substitute (Jung et al., 2013). Therefore, in cases where a thick soft tissue complex is present, porcine collagen matrices can be used as an alternative to punch grafts. Figures 1–5 illustrate a clinical case where ridge preservation was performed using a xenogenous bone substitute (BioOss Collagen*) and a porcine collagen matrix (Mucograft Seal*).

**Case 2: Soft tissue matrices for volume augmentation at the time of implantation**

Review articles clearly demonstrate that immediate implants are a viable treatment option – particularly in the aesthetic zone – providing a proper case selection is performed (Lin et al., 2014). Nevertheless, tissue shrinkage of approximately 1mm has to be expected following immediate implant placement (Clementini et al., 2015). Therefore, various studies and case series have advocated the use of subepithelial connective tissue grafts to compensate for these minor shrinkages (Lin et al., 2014). In this context, acellular dermal matrices could also help in increasing tissue volume at the time of implant placement. The scientific evidence for using dermal matrices at the time of immediate implant placement is still low; nevertheless, these materials seem to be useful for these indications. Fischer et al presented case reports and an ultrastructural
analysis of this material and concluded that its distinctive composition is ideal for submerged use (Fischer et al., 2014). Figures 6–10 show a case where an immediate implant placement was performed and an acellular dermal matrix (OsteoBiol® Derma) was used to increase tissue height and tissue volume.

**Case 3: Soft tissue matrices for volume augmentation at the second stage**

In many clinical situations, tissue defects are still visible at the second stage. Formerly, if these defects needed to be corrected, subepithelial connective tissue grafts were traditionally harvested to compensate for the volume defects. Dermal matrices could be an option to improve tissue quantity at this time in a more atraumatic way. Research data has shown that dermal matrices are replaced by connective tissue over a period of four months and integrate into the soft tissue without any foreign body reactions (Fickl et al., 2015). In particular, acellular dermal matrices seem to be indicated for these clinical situations as the post-operative shrinkage is rather low and they have to be used in a submerged environment. Figures 11–14 show a case where soft tissue augmentation was performed using a acellular dermal matrix (OsteoBiol® Derma) at the second stage.

**Summary**

Subepithelial connective tissue grafts and autologous punch grafts are still the gold standard for soft tissue augmentation, particularly when dealing with thin periodontal biotypes or large soft tissue defects. Nevertheless, soft tissue matrices can be a helpful way for the experienced clinician to reduce patient morbidity. Depending on the material and its composition, these products can be used for different indications. Collagen matrices are useful for ridge preservation procedures as they can be used in a non-submerged fashion. By contrast, porcine dermal matrices should be used for volume augmentation and submerged under the flap. If used properly, these materials can be a useful addition for every clinician. One important aspect of soft tissue xenografts is that their composition is consistent. This is not always the case with autologous grafts, which can include fatty and glandular components. In conclusion, early scientific evidence is encouraging, but long-term data still needs to be obtained before these materials should be used on a general basis.
References


Having attended several EAO congresses over the last 10 years, we noticed that very few to none of the presentations discussed the use of d-PTFE membranes immediately after an extraction. The role of this type of membrane in bone augmentations was only discussed during a couple of short oral presentations and in some posters. The goal of this article is to inform EAO members and other readers about the interesting indications for placing a d-PTFE membrane directly after extraction.

A variety of alveolar ridge preservation and augmentation techniques have been described in the scientific literature. Autologous bone or bone substitutes can be used to fill the alveolar process/dental alveolus. A resorbable membrane or collagen plug can be used as a cover. In addition, non-resorbable membranes have a role to play in the ridge preservation/restoration process.

The non-resorbable e-PTFE (Gore-Tex) membranes which were previously available were not suitable for this purpose. Instead, a d-PTFE (Teflon) membrane (Cytoplast) is required because unlike e-PTFE this remains in function if exposed to the oral cavity. This is because d-PTFE membranes are non-permeable to bacteria. A study by Hoffmann et al. (2008) reported minimal changes in the alveolar process when a d-PTFE membrane was placed following an extraction. An additional advantage is the increase in the width of the zone of keratinised gingiva when using this type of membrane (Barboza et al. 2014).

**Application of d-PTFE membranes in practice**

We have been applying d-PTFE membranes directly following extractions for a considerable period of time within our practice, and with good results. Their use means that after a healing period we can place implants surrounded by hard bone and keratinised tissues with sufficient dimensions in around 95% of all cases. The following case illustrates one example of the technique.

The case concerns a 50-year-old woman who had been referred for treatment of periodontitis. She underwent treatment in accordance with the Dutch periodontology protocol, resulting in a predominantly stable and healthy reduced periodontium. Endodontic retreatments were performed on teeth 36 and 37 (tooth 36 had had an apex resection in the past). However, in the 36 an endo-periodontal problem developed with a primary endodontic cause, indicating an extraction (Figures 1–2). The 36 was removed with some difficulty, as much as possible by applying a titanium reinforced d-PTFE membrane with allogeneic bone graft material as filler. The edges of the tissue were deliberately not primarily closed. The reasons for this were as follows:

- to preserve the position of the mucogingival junction
- because exposure of the d-PTFE membrane does not have a negative impact on regeneration, as long as the edges are not openly exposed
- because following removal of the membrane, the upper part of the osteoid matrix will reform into keratinised gingiva over time, with a fine, wide zone of keratinised tissue as a final result

The membrane was removed five weeks after it had been put into place (Figures 4–5). This can be fairly easily done by elevating it slightly and cutting off the connection between the outside of the membrane and the inside edges of the tissue, e.g. by means of a pocket probe without anaesthesia. After this the membrane can be removed with the help of a pair of tweezers (sometimes local anaesthesia is necessary). It is important to leave the tissue (bone matrix) untouched, because it is now no longer protected by the membrane. If required, a stitch can be put in to stabilise the edge of the tissue. Three months after the removal of the membrane, the tissues had healed nicely and there was a wide zone of keratinised tissue present (Figure 6).

After elevating a flap to enable the placement of the implant, the alveolar process could be seen to have visibly recovered and the preservation and augmentation of the shape had been realised (Figure 7). As a result, the placing of an implant in position 36 was straightforward (Figure 8). During drilling to create the implant bed, a very good degree of hardness of regenerative tissue was observed, comparable to the feeling of drilling into hard, natural bone. Some months later the crown was placed by the referring dentist (Figure 9).

**Potential complication**

A potential complication can occur when using this technique if the edge of the membrane is not fully covered by the soft tissues during the healing period. This will create a portal of entry for bacteria, which has a negative impact on the process of bone augmentation. In such a case, early removal of the membrane is required. The amount of regeneration will then depend on the length of time the membrane has remained in position, well covered by soft tissues.
Conclusion

Using a d-PTFE membrane directly following an extraction is a valuable technique because it has been clinically demonstrated to lead to good results. The placement of implants becomes easier and more predictable when this technique is used. It also considerably increases the likelihood that at the time of implant placement no additional bone augmentation procedure will be needed (including sinus lifts). The d-PTFE membrane will preserve/restore the shape of the alveolar ridge and increase the amount of keratinised gingiva, even in compromised situations. Likewise, the presence of a wide zone of keratinised tissue will increase the chance of stable peri-implant tissues. However, this technique requires further studies to investigate its limitations. Furthermore, its success is linked to the skill and knowledge of the practitioner and it should only be undertaken by well trained and suitably experienced surgeons.
Question and answer with the authors

1. Do you have any experience of using this technique without any bone substitutes? No, we use bone substitutes because we want to provide as much support as possible to rebuild the alveolar process and to speed up the formation of the osteoid matrix. As the case shows, our aim is to regenerate bone horizontally and vertically outside the affected/reduced bony walls. Studies which report on vertical augmentations with e-PTFE membranes show an advantage when a bone substitute is used as a filler (Simion et al. 1998, Tinti et al. 1998), so we combine membrane placement after extraction with a bone substitute. Interestingly, the study by Hoffmann et al. (2008) describes the same technique as illustrated in our case using d-PTFE membranes but without titanium reinforcement and without bone fillers. The study excluded clinical situations where the lingual bony wall was affected and/or more than 50 % of the vestibular bony wall was missing. Hoffmann reported very small reductions in the shape of the alveolar process after 12 months. The largest changes of 2mm were found in the centre of the extraction site where the d-PTFE membrane had the least support. Histology 12 months after extraction showed newly formed tissues consisting mainly of new alveolar bone following the existing outline of the bone walls present at the time of extraction. So to improve the results and technique reported by Hoffmann, we use bone substitutes in combination with titanium reinforced membranes to regenerate as much bone as possible. The goal is to obtain the original size of the alveolar process.

2. Do you have any experience of using this technique with other bone substitutes? No we do not. However, in a review of animal studies by Nakajima et al. (2007) and Fiorellini et al. (2007) which investigated the regeneration and osseointegration of mandibular defects using e-PTFE membranes and various bone fillers, some indications can be found. It is important to stress that in these studies bone augmentation was carried out in a conservative way, so not directly after extraction and with wound closure. After a healing period of 8 months, the authors reported no significant differences between different bone fillers including autogenous bone, DFDBA, anorganic bovine bone, TCP granules, collagen sponge and no filler (control). We think this gives an indication that alternative bone fillers will also perform well with a d-PTFE membrane placed directly after extraction.

3. Could you describe in detail the surgical procedures (in particular the placement of the membrane and the suturing of the flap)? Following anaesthesia, the tooth or molar is extracted asatraumatically as possible using instruments including periotomes, a Piezon and a root extraction system, separating roots if applicable. After the extraction, the alveolus is carefully cleaned and all granulation is removed. The tissue is then manually cut from the underlying bone all around the extraction site. We then place a titanium reinforced d-PTFE membrane underneath the tissue, without a flap if possible (if the amount of bone destruction is large, or the augmentation area is broadened to an adjacent edentulous area, a limited flap can be raised). In the case illustrated here a small flap on the vestibular side was raised as the vestibular bone wall was largely missing. The membrane is placed between the bone and the tissue on one side after which an allogeneic bone graft material is put into the alveolus as a filler. Care must be taken to place the membrane with the textured surface (with small dimples) outwards, i.e. facing the oral cavity. The remaining edge of the membrane is then also placed between the bone and the tissue. Some bending of the titanium reinforced part of the membrane is required to make this possible. By doing this, the desired shape of the membrane can be achieved. A substantial part of the membrane will not be covered with tissue, thus creating a deliberate exposure. However, the edges of the membrane must be covered with tissue. The wound margins are sutured using a horizontal mattress suture, single or cross suture.

4. Do you recommend particular post-operative procedures to the patient? No, not really. We believe that post-operative procedures like chlorhexidine rinsing twice a day, antibiotics (Amoxicillin 500 mg 1 week, 3 x a day), and avoiding chewing or applying forces on the affected area are pretty standard after all augmentation procedures.

References

As Michael Cohen states, designing and implementing an interdisciplinary treatment plan is always a challenging process. This is because there is no formula for ideal treatment planning that clinicians can easily follow. Moreover, innovations in all areas of dentistry tend to lead to more complex treatment, involving a greater number of clinicians in the therapeutic team. Despite these challenges, this article will demonstrate how efficient teamwork can lead to a satisfying clinical and aesthetic outcome using two clinical case reports.

Case 1

The patient in this case study was 25 years old. She was conscious of the misalignment in her anterior upper region and was also concerned about the discoloration of teeth 11, 21 & 22. She had experienced a facial trauma at the age of 16 and tooth 21 had been replanted after avulsion. The clinical examination revealed a dystrophic calcific metamorphosis for teeth 11 and 22 and an external resorption with partial ankylosis for tooth 21, which is hopeless. These problems were analysed one by one:

1: Tooth 21 would have to be removed. The paradoxical integrity but questionable prognosis of teeth 11 and 22 excluded a bonded-bridge option. In a challenging situation like this, with a high smile line and a thin biotype, the use of an early or delayed implant placement approach may be indicated, but immediate implant placement would probably be ruled out. Regardless of the timing of the implant placement, the key factor for success would be the 3D positioning of the implant, especially considering the proximity of the adjacent teeth.

2: From an aesthetic point of view, the patient’s dento-facial composition could be improved at a low biological cost using an orthodontic step, involving only the upper arch, and mainly the position of the lateral incisors and canines. The patient’s age and the fact that all teeth except 21 were intact militated against a more invasive approach.

3: The intrinsic dental dyschromia of teeth 11 and 22 could be treated using vital tooth-bleaching techniques. The probability of improved colour unity would be good and the risk was low. In any case, this clinical situation would require rigorous endodontic follow-up.

This clinical situation required a combination of these three therapeutic options, with good synchronisation between them. None of the steps were independent from the others. This interdependence would normally be seen as a limiting factor, but could also be viewed a positive one.

Limiting factors:

- it was apparent that the implant placement had to be performed after the orthodontic step. The orthodontist expected treatment to last 10 to 12 months, ruling out the early implant placement approach. Thus, the treatment planning incorporated a socket preservation procedure following the extraction of tooth 21 to maintain the alveolar ridge until implant placement
- the orthodontic step required post-orthodontic splinting from one canine to the other at least. Using an implant-supported crown to replace tooth 21 would exclude the possibility of long-term splinting gathering the 6 anterior teeth. Moreover, the number and frequency of surgical
and prosthetic post-orthodontic steps would benefit from a removable splinting device

- Tooth-bleaching techniques using 10% carbamide peroxide take on average 3 to 4 weeks, followed by an additional week to achieve remineralisation using casein phosphopeptide-amorphous calcium phosphate (CPP-ACP). Bonding an orthodontic device or splint to bleached enamel would require a two-week extension of this timetable

**Facilitating factors:**

- The delayed implant placement meant the aesthetics of the temporisation would be challenging due to its longevity and the necessity to remove the temporary restoration and put it back frequently. However, a lingual orthodontic device could be used successfully as an aesthetic provisional prosthesis without preventing differential movements of the abutment teeth

**Decision and treatment planning design**

A shared decision-making process involving the patient and the therapeutic team led to the following treatment plan, which avoided any period when the tooth was missing. The team was made up of Christine Muller (orthodontist), François Bronnec (endodontist), David Nisand (periodontist-implantologist) and Martin Brient (general practitioner-prosthodontist).

- **t0**
  - Orthodontic appliance bonding/no archwire
  - Extraction of tooth 21/socket preservation procedure
  - Archwire with aesthetic pontic for tooth 21

- **t0 to t+10 months**
  - Orthodontic movements
  - Endodontic follow up at t+6 months

- **t+10 months**
  - 3D CT scan

- **t+10 months to t+16 months**
  - Implant placement with GBR
  - Impression to prepare a screw-retained temporary crown

- **t+16 months**
  - Orthodontic appliance kept as a splint and an aesthetic temporary prosthesis

- **t+16 months to t+22 months**
  - Development of pink aesthetics and soft tissue maturation
  - Vital tooth bleaching treatment
  - Removable splinting device

- **t+22 months**
  - Prosthetic finalisation
  - Permanent splint: bonded wire on teeth 13–12–11 and 22–23

**Treatment implementation**

The treatment occurred as planned between March 2012 and December 2013. A composite resin provisional tooth was prepared by the lab technician (Laboratoire Ceralor, Mr Jean-Marc Etienne) and integrated into the orthodontic set-up used to design the orthodontic appliance. The socket preservation procedure at t0 was performed using anorganic bovine bone (Bio-Oss collagen, Geistlich). The orthodontic step was performed with an individual appliance (WIN, DW Lingual Systems GmbH). Due to the reduced available bone volume and in keeping with the design of the screw-retained prosthesis, the implant used was 3mm in diameter and 13mm long (Nobel Active 3.0), enjoining the connection of a PFM screw-retained crown (Laboratoire Ceralor, Mr Jean-Marc Etienne). The patient has been seen at six-month intervals since treatment and has not experienced any complications.
Case 2

The patient was a 17 year old girl who had had a car accident at the age of thirteen. Teeth 12 and 11 had been expelled and lost, and tooth 21 was impacted in the bone. She didn’t undergo any dental treatment at the time. Clinical and radiographic examinations taken during her first consultation showed severe resorption on 21 and dental migrations such as mesialisation of 13 and egression of the lower incisors. However, no decay or any other infectious problems were reported.

Treatment of a trauma patient is always complicated because of missing teeth, which are often associated with alveolar bone loss. In this case, significant teeth migrations made the treatment harder. However, from an aesthetic point of view, the low level of the smile line had the potential to be a facilitating factor, even though the psychological impact of the patient’s appearance didn’t allow her to have a natural smile with normal muscular relaxation.

A global analysis of the case was undertaken involving all the members of the therapeutic team. All the data necessary to help inform decision-making was gathered before any kind of invasive treatment commenced.

Analysis of clinical situation:

1: 21 would have to be extracted.
2: The available space for replacing the three anterior missing teeth was too small, so orthodontic treatment would be essential to create an adequate space to replace those teeth and to correct the migrations, especially the position of 13 and the lower incisors. Moreover, replacing 12, 11 and 21 would lead to important dental movement and complex orthodontic treatment. It would also inevitably induce the extraction of one maxillary tooth (such as a left premolar), which was an option that the therapeutic team really wanted to avoid in view of the patient’s history. Thus replacing only 11 and 21, with modification of the right canine’s shape, was considered. Using the dimensions of the visible part of 21 would allow the building of an aesthetic draft, in accordance with the team’s requirement for minimally invasive treatment. The inter-incisor axis shift that would remain as a consequence was discussed. Studies suggest this shift is not considered to be an aesthetic problem providing it is not more than 4mm from the vertical facial axis, and above all as long as it stays vertical. The draft was validated by all the team-members and the patient. It would allow the team to make smaller and more predictable orthodontic movements and would also enable the third molars to be kept and avoid any extractions.
3: The need to modify the shape of 13 initially led to consideration of a 4 unit-FPD option. But, based on the age of the patient and the requirement of minimal invasive treatment, the implant option was adopted with the placement of two implants in positions 11 and 21. The role of provisional crowns in achieving a satisfying pink aesthetic outcome was explained to the patient.
4: The need for bone augmentation indicated an alveolar ridge augmentation technique in three dimensions performed prior to implant placement.
5: The intrinsic colour of tooth 13 could be treated using vital tooth bleaching technique. This is associated with limited buccal and occlusal enameloplasty undertaken prior to a direct bonded restoration technique. As a result, the probability of an improved aesthetic outcome was good and the risk was low.

Decision and treatment planning design:

Decision-making must be a standardised protocol involving all team-members. In addition, it must be discussed with the patient to reach a shared medical decision. Afterwards, treatment planning should also be decided collectively and the schedule for the different steps finalised.

A shared decision-making process involving the patient and the therapeutic team, made up of Christine Muller (orthodontist), David Nisand (implantologist) and Florent Trévelo (general practitioner-prosthodontist) led to the following treatment plan:
t0:
- orthodontic appliance bonding
- extraction of tooth 21/socket preservation procedure

t0 to t+12 months:
- orthodontic movements

t+12 months:
- GBR using autogenous fragmented bone samples
- bonding of two resin prosthetic central incisors on to the orthodontic archwire

t+12 months to t+20 months:
- orthodontic movements, with appliance also used as an aesthetic temporary prosthesis

t+20 months:
- 3D CT scan
- implants placed using GBR
- impressions taken to prepare two screw-retained temporary crowns

t+20 months to t+26 months:
- finalisation of orthodontic movements
- orthodontic appliance kept as a splint and an aesthetic temporary prosthesis

t+26 months:
- second stage surgery with connective tissue graft
- insertion of screw-retained temporary crowns
- orthodontic device removal
- mandibular permanent splint: bonded wire from teeth 33 to 43

t+26 to t+32 months:
- development and maturation of pink aesthetics by remodelling the provisional crown's cervical shape
- vital tooth bleaching treatment on 13
- transformation of the shape of canine 13 into that of a lateral incisor

t+32 months:
- prosthetic finalisation: placement of two screw-retained all-ceramic crowns

Treatment implementation:

The treatment occurred as planned between September 2006 and June 2009. The socket preservation procedure at t0 was performed using anorganic bovine bone (Bio-Oss collagen – Geistlich) and a connective tissue graft. The orthodontic step was performed with an individual appliance (Incognito). The three-dimensional GBR procedure was performed using autogenous fragmented bone samples taken from the chin, combined with anorganic bovine bone (Bio-Oss collagen – Geistlich). The implants used were both 3.5mm diameter and 10mm long (Nobel Active 3.5). The vital bleaching of tooth 13 was performed using 10% carbamide peroxide, and ended four weeks before enameloplasty and direct resin bonding restoration. The final prosthetic treatment was performed using two screw-retained all-ceramic crowns (Laboratoire Ceralor, Mr Jean-Marc Etienne). The decision was taken to leave the fibrotic scar formation on the buccal mucosa to avoid jeopardising the stability of the soft tissue. Additionally, the patient did not perceive the scarring as an aesthetic problem. She was followed up after six months and has been seen annually since. She has not experienced any complications.

Conclusion

Treating complex cases requires a wide range of skills and experience because of the necessity to manage multiple clinical or technical aspects. The increasing range of techniques and procedures now available can lead to the involvement of more practitioners. Thus efficient teamwork is required when it comes to solving a multi-faceted problem. As a result, a discussion between the team-members and the patient which leads to a shared medical decision is the key factor for success. By taking this approach, the treatment provided can be truly tailor-made. To achieve this, effective communication and collaboration between all the therapeutic team-members is mandatory from the very beginning (initial clinical analysis) and throughout the treatment.