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A Single Implant with Tissue Training in the Aesthetic Zone

Abstract: This paper presents a case study for replacing a single maxillary central incisor with a single implant, in conjunction with grafting lost hard and soft tissue. Using staged protocols, the maturity and stability of the implant was ensured prior to finalizing the case. In this respect, it was originally planned that a minimum healing period of nine months would be observed, but in fact the patient did not return for one year.

Taking time to stage phases of the case and observe any changes provides an opportunity to evaluate each phase before the next step is carried forward. By staging the challenges faced in this case, the author was able to progress to each subsequent step with added assurance. By the time the final restorations were fitted, the graft and tissues were stable. The time involved not only placed biology on the clinician's side, but also helped the patient to spread the cost.

Clinical Relevance: In modern aesthetic dentistry harmonious results can be relatively quickly achieved when the prerequisites for aesthetic success have already been met but, as this case demonstrates, human biology often requires more time and patience for augmented hard and soft tissues to heal and mature.

Dent Update 2009; 36: 366–372

Trends in modern aesthetic dentistry are being constantly developed and revised, as clinicians strive to accelerate treatment programmes in order to attain optimal aesthetic outcomes using the minimal number of stages over the shortest possible time period. This approach may be more cost-effective for the practitioner and thus, seemingly, more beneficial to the patient. However, to achieve a clinically successful outcome consistently, human biology requires adequate time and patience for augmented hard and soft tissues to heal and mature. The cost in tooth substance should also not be undervalued, if tooth preparation is required to achieve an aesthetic result. Predictable outcomes require an understanding of the limiting factors, with biology being of paramount importance. Without accounting for biology, there may be a multitude of hard and soft tissue problems that could arise and be complex to rectify.

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The use of implants for replacing missing teeth has offered an extension to conventional treatment options in removal and fixed prosthodontics, with their principal uses in dentistry ranging from replacing single or multiple teeth with fixed prostheses to offering retention and support for over-dentures.

Demands for 'perfection' by both patients and clinicians appear to be on the rise. Osseointegration is not the only concern for the successful long-term outcome of implant therapy. The soft tissues and emergence profiles must now also mirror the adjacent teeth as closely as possible, and stability over time should be without question.

This paper presents a case study for replacing a single maxillary central incisor with an implant, in conjunction with grafting lost hard and soft tissues. Using staged protocols, the maturity and stability of the implant's environment is ensured prior to finalizing the case.

Planning treatment

Planning and meticulous execution of treatment may be considered to be fundamental for success. By visualizing the end goal prior to any treatment, a series of steps can be developed to provide a pathway to the desired result. This helps create a logical set of treatment phases that are required to complete the case. With good understanding, variations from the plan can also be accounted for, such as additional grafting and correctional appointments. This may occur in surgical cases where healing in individuals may be varied and not wholly predictable.

Parameters for success

Some cases may be treated over a short period of time with few appointments, with the end result being aesthetically harmonious. However, such cases have already met the prerequisites for aesthetic success. These include:

- Surrounding bone levels of sufficient height and thickness not only to house the implant but also to offer support to the soft tissues.
- Satisfactory soft tissue height: for instance, it is more favourable to have

a

b

Figure 1. (a) Pre-operative view, **(b)** pre-operative PA.

the soft tissues of the edentulous site in balance with the surrounding dentition at the initial presentation. However, in cases where the underlying bony ridge has become deficient in volume and height, there may be a marked difference in tissue levels between the teeth and the edentulous site. This would require some form of regeneration to correct the differences and thus add to the complexity of the case.

- Thicker soft tissue biotypes: these offer greater gingival stability and masking of underlying metal show-through of the implant and subsequent restorative counterparts, whereas thinner soft tissue biotypes are less forgiving, more difficult to manage during surgical phases and also more prone to recession over time.
- Favourable soft tissue contour: this is dependent on the tooth shape, with square or ovoid-shaped teeth presenting less of a challenge to mimic the gingival architecture prosthetically than triangular-shaped teeth.
- An absence of infection, chronic or acute: this makes the surgical phases more predictable to control, although this may not always be a contra-indication.
- Favourable occlusal factors: the restored implant should be placed into a stable occlusion, free from overloading, interferences, temporo-mandibular joint (TMJ) problems and parafunction.
- Favourable lip line: the lip line position may play an important role in the final aesthetic result, because a low lip masks any differences that may occur between gingival levels of adjacent teeth, differences in papillae heights and any colour discrepancies seen at the gingival margin. A smile with a high lip line and greater gingival display becomes a more challenging treatment scenario.
- Good general health with no underlying contra-indicating problems.

These criteria present themselves with differing variables for each individual and thus must be carefully assessed prior to any treatment.[1-3] Taking time to stage certain cases and observe any changes provides time to evaluate each phase before the next step is carried forward. This, in turn, allows the body's biology to harmonize and, with this, stability will come hand-in-hand. Whilst waiting for maturation of grafted tissues, good provisional restorations may reduce the urgency to finish the case quickly, thereby buying more time for nature to take its course.

The following case illustrates the need for staging treatment to face the challenges of aesthetic demands.

Case study

Condition at presentation

A 28-year-old female patient was referred to the author's practice with a failing maxillary right central incisor. She presented with the following:

- A skeletal Class II;
- Facial thirds in approximate proportion;
- A high lip line and 'gummy' smile with more than 3 mm gingival display;
- A Class II occlusion with anterior open bite and with an overjet of 3 mm;
- A negative smile curve;
- Occlusal guidance in posterior group function with non-working side interferences on both left and right side shifts of the mandible;
- No TMJ symptoms;
- No problems with eating;
- A maximum opening of 48 mm;
- A clear medical history.

The patient's principal complaints were the appearance of both maxillary central incisor teeth and their respective differing gum levels. The patient reported that UR1 was occasionally tender to bite on and becoming increasingly more mobile. At presentation, a labial sinus was present, associated with this tooth (Figure 1a). After the initial consultation, the patient stressed that she did not wish to receive orthodontic treatment, nor did she wish to undergo orthognathic surgery and crown lengthening to correct the skeletal and occlusal discrepancies and to reduce or eliminate an excessive gingival display.

It is good practice to present all the treatment options to each patient before embarking on a case, thereby giving a fully balanced opinion from which the patient can decide upon the differing pathways available to achieve his/her desired end result. However, in this case, the patient insisted that she would like individual teeth, with an implant to replace tooth UR1, stating that she did not want to have any fixed bridgework, regardless of design.

At a further clinical examination, the remainder of the patient's dentition was found to be clinically and periodontally sound, except for the tissues around UR1, which had a mid-labial pocket of 8 mm and large apical amalgam tattoo. Fortunately, the amalgam tattoo was hidden under the patient's upper lip, even with her excessive gingival display during a full smile. Both maxillary central incisor teeth had been restored with porcelain fused to metal crowns. UL1 was found to be vital, whereas UR1 had been root-filled and apicected (Figure 1b).

The patient was already well informed of treatment options from her referring dentist when she attended the author's practice, with a metal ceramic Rochette bridge already having been

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b

Figure 2 (a). View of rochette *in situ* six weeks after extraction of tooth UR1, **(b)** PA six weeks after extraction.

fabricated, ready to replace UR1 when it was extracted.

Treatment plan

- To extract UR1 and fit the Rochette provisional bridge.
- To wait 6–8 weeks to allow for soft tissue healing.
- To graft the area and possibly place the implant simultaneously, should it be possible to ensure its primary stability.
- To wait at least 9 months and then review the need for further grafting of soft or hard tissue or a combination of both.
- To place provisional restorations on UR1 and UL1, and evaluate aesthetics at subsequent review appointments, over a period of 3 months, in order to assess the balance of the soft tissues around the implant provisional in relation to its surrounding environment.
- Final restorations to be considered once stability has been demonstrated.

It was planned that each phase would have healing periods to evaluate success, prior to the next phase being undertaken. The patient's routine dental care was undertaken by the referring dentist.

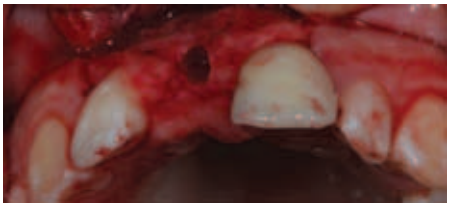

Figure 3. View of surgical site at exposure.

Figure 4. Directional indicator used as a positioning guide for implant placement.

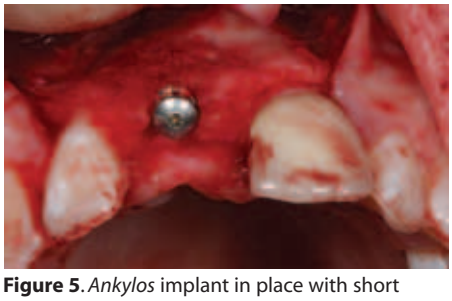

Figure 5. *Ankylos* implant in place with short healing abutment exposed threads covered with autogenous chips.

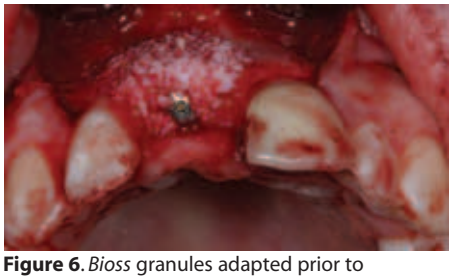

Figure 6. *Bioss* granules adapted prior to membrane coverage.

Stage 1: Extraction

Tooth UR1 was extracted using a periotome technique in order to minimize trauma, with the socket being thoroughly curetted and flushed with sterile saline. The socket was carefully examined and it was noted that most of the labial plate of bone had been lost, up to the apex of UR1. The labial bone lost from the socket was 8 mm from the gingival margin. A decision was made to place a collagen plug immediately into the socket and allow for complete tissue healing, following which, the site would be revisited after 6–8 weeks for a bone graft. The Rochette bridge was cemented to replace the missing tooth (Figure 2a and b). The benefit of waiting for this time prior to grafting the site was to ensure that the underlying structure would be free from infection and also that there would be a gain in soft tissue volume over the tooth socket.

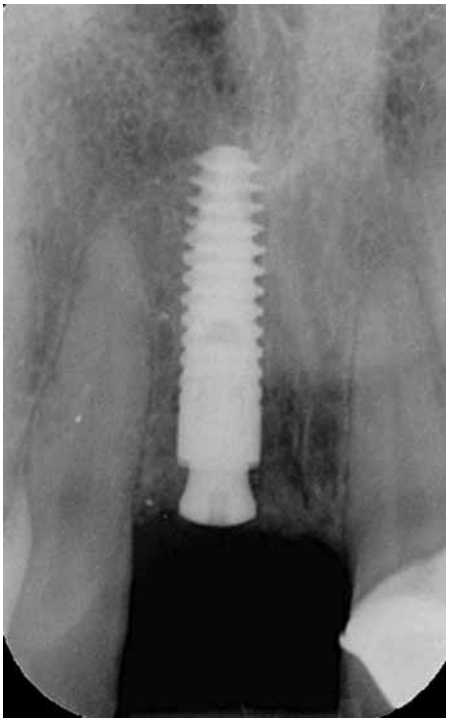

Figure 7. PA of implant in position.

Stage 2: Bone graft

A full mucoperiosteal flap was raised to expose the surgical site and the extent of the bony dehiscence fully. At the exposure, it was assessed that, owing to the fact that UR1 had a shortened root, it was possible to position an implant (*Ankylos*, Dentsply Friadent, Mannheim, Germany) and obtain excellent primary stability as a result of the presence of apical bone. The only surface of the implant that was not

Figure 8. One year after implant graft placement with rochette *in situ*.

Figure 9. Chairside cantilever bridge from UL1 adapting the pontic over the healing abutment.

Figure 10. Zirconia abutment torqued in place.

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b

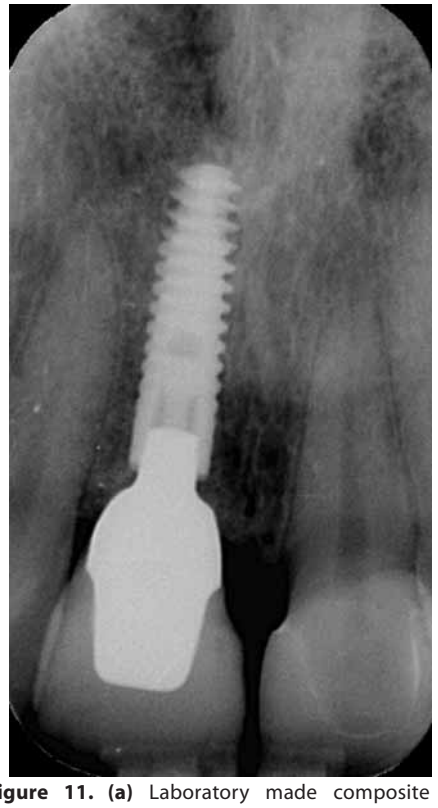

Figure 11. (a) Laboratory made composite provisionals after one year *in situ*, **(b)** PA of the fit day.

fully submerged in bone was the labial 3–4 mm. Local autogenous bone chips and scrapings were collected from the nasal spine and used to cover the exposed implant threads immediately.

The cover screw was then removed and a short narrow healing abutment placed into the implant. The healing abutment was not transmucosal at this stage, but would remain under the flap and act as a 'tent' for the slowly resorbing membrane (*Ossix*, Biomet 3i, FL 33410, USA), under which inorganic bovine bone mineral (*Bioss* granules, Geistlich Pharma AG, Biomaterials Division, Wolhusen, Switzerland) was carefully adapted.[4] The whole flap was then periosteally relieved, and a frenectomy was simultaneously performed so that the flap was passively closed to achieve primary closure (Figures 3–7). The implant and grafting procedures were performed at the same visit owing to the good primary stability of the implant.

The implant system was chosen because it would allow for 1–2 mm subcrestal placement, so that this would not affect the final tissue level. It could be considered that the absence of a microgap at the abutment interface could further promote stability in bone and gingival tissue levels coronal to the fixture head position.

Once the tissues had been sutured free of tension, the Rochette pontic was reduced apically in order to ensure a passive fit over the sutured flap. Only then could the bridge be re-cemented.

Healing period

It was originally planned that a minimum healing period of nine months would be observed. In actual fact, the patient did not return for one year. At this review appointment, the tissue level of the UR1 tooth site was more coronal than that of UL1. The grey shine through mucosal tissue was coming from the healing abutment (Figure 8).

The next phase was to uncover the implant and place a larger, modified, two-piece healing abutment, this being used to start the process of creating the correct emergence profile. This is part of the 'tissue training' stages, since the healing abutment was now transmucosally located. The Rochette bridge was then relined to fit over the healing abutment prior to being re-cemented.

After waiting six weeks for tissue maturation, UL1 was prepared for a full coverage crown and a chairside provisional cantilever bridge fabricated. This was carefully refaced with composite in order to create natural form and an increase in length for both UR1 and UL1 (Figure 9). The pontic was carefully adapted to the healing abutment and aesthetic form and emergence profiles reassessed. An addition-silicone impression was now taken in order to translate the information to the laboratory technician accurately, namely, to establish, as closely as possible, the correct form and length of the desired final restorations. The technician was also sent photographs to accompany the impressions. He was asked to select the correct prefabricated zirconia abutment for the implant. The reasoning behind selecting a zirconia abutment was to optimize soft tissue aesthetics, as well as other well documented advantages that this metal alternative displays[5] (Figure 10). The abutment was torqued to 15Ncm and the two composite provisional crowns placed using temporary cement and left *in situ* whilst waiting for further tissue maturation. The patient was, at this stage, happy to leave the current situation for a further year until she was ready to complete the case (Figure 11).

The final restorations were two zirconia-based crowns (*Lava*, 3M ESPE, Seefeld, Germany), which were definitively cemented. The final post-operative picture shows the definitive crowns at three months after fit, but it should be noted that the provisional crowns had been in place one year prior to this and the bone

Figure 12. Note gingival topography after tissue training.

Figure 13. Final close up view at three months.

Figure 14. Lateral view.

graft had been placed one year prior to the provisionals[6,7] (Figures 12–16).

Discussion

Decision-making for dental treatment is a multi-faceted process, involving the clinician, patient and often the technician. In this case, the possibility of using a fixed, three-unit bridge or a resin-retained bridge could have been quite feasible alternatives, especially if combined with soft tissue augmentation of the edentulous site. This would have provided for stable soft tissues with a natural appearing emergence profile of the pontic. However, even with the higher cost of implant treatment, the benefits are as follows:

- From the patient's psychological perspective, the direct replacement of a single tooth with an implant.
- From a biological perspective, not involving adjacent teeth as would have been the case for bridgework.
- From a hygiene perspective, it should be easier for the patient to maintain good oral hygiene around single restored teeth than around bridgework with an ovate pontic.
- From a financial perspective, the costs may be spread over an extended period of time to suit the patient, whilst not compromising on the end result.

Planning each treatment step prior to its execution should offer greater predictability for successful outcomes. This staged process also allows for any additional corrections to be performed along the treatment pathway, should they be necessary. By staging the challenges faced, the author was able to progress to each subsequent step with added assurance. Therefore, by the time the final restorations were fitted, the graft and tissues were already stable. In this case, the time involved not only placed biology on the clinician's side but also helped the patient to spread her cost, another factor that can all too often be taken for granted.

Acknowledgments

The author is indebted to his technicians and friends, Eva Forst and Richard O'Brien for their technical teamwork involved with this case. Thanks are also due to Trevor Burke for his editing of the text.

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Figure 15. Final portrait view.

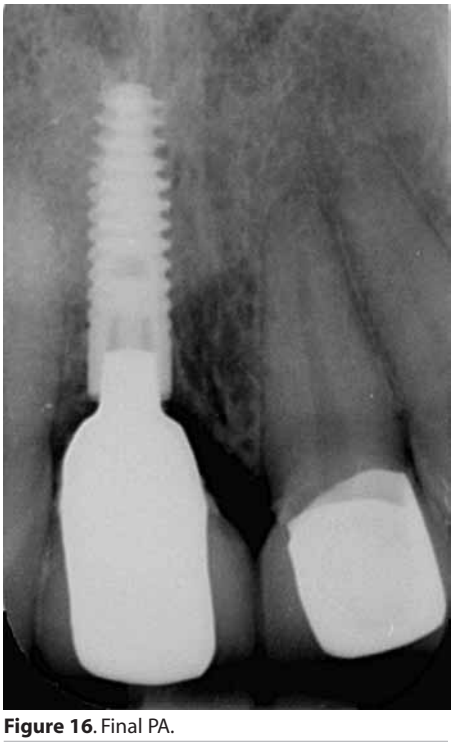

Figure 16. Final PA.