Advanced Esthetic Management of Dental Implants: Surgical and Restorative Considerations to Improve Outcomes

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ABSTRACT

Objective: Successful dental implant therapy in the maxillary anterior dentition requires meticulous attention to surgical and prosthodontic measures.

Clinical Considerations: Proper diagnosis, extraction technique, implant selection, and placement significantly impact outcomes. Respect of hard and soft tissue physiology following tooth loss and implant placement requires specific steps be taken. Management tissue contours properly, via regenerative therapy, results in successful framing of the restoration. Provisionalization and definitive restorative therapy also impacts the level of esthetic success. The contours of the temporary abutment and crown develop soft tissue contours for the final restoration. Overcontouring can lead to soft tissue recession and mucosal asymmetry. Design of the definitive crown(s) is crucial for long-term maintenance of esthetically acceptable results.

Conclusion: Visualizing the outcome of treatment prior to its inception, following specific surgical and restorative guidelines, increases the likelihood of success.

CLINICAL SIGNIFICANCE

This article demonstrates the importance of proper surgical and prosthetic principles in achieving esthetic implant results.

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INTRODUCTION

The success of implant therapy, particularly in esthetically critical regions of the dentition, is measured by biologic and restorative and functional parameters. The framing of an inconspicuously placed restoration by tissues in harmony with the adjacent periodontium should be the goal of esthetic implant treatment.

Understanding the behavior of hard and soft tissues following tooth removal and the contours of restorations coronal and apical to mucosal margins plays a crucial role in accomplishing success. This often requires delicate extraction(s), hard and soft tissue preservation and augmentation as well as meticulous temporization to guide the healing process followed by masterful abutment fabrication and ceramics.

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PURPOSE

The objective of this article is to demonstrate key surgical and restorative techniques that clinicians can use to improve esthetic outcomes of implant therapy through surgical and restorative principles. Understanding the physiologic tissue modeling and remodeling following tooth loss, how regenerative procedures can counter, to a degree, hard and soft tissue changes, and the influence of provisionalizaton on the development of healthy peri-implant soft tissues prior to final restoration.

When a tooth is extracted, negative changes in the alveolar process begin, resulting in narrower and shorter width and height of the ridge.[1,2] Though osseointegration predictably occurs, the esthetic compromise caused by this normal, physiologic process can be catastrophic. Roe[3] and Kan[4] demonstrated that simply provisionalizing immediate implants may not predictably preserve tissue dimensions and that the process of post-extraction resorption is progressive long after surgery and restoration. Funato and colleagues[5] provide a classification system demonstrating when immediate tooth replacement can be considered and when additional regenerative modalities are recommended. It is critical that extractions are performed with meticulous care not to damage surrounding tissues. Following debridement of the alveolus, implant selection and positioning is the next step with a substantial bearing on long-term success (Figure 1). Immediate implants positioned in a buccal position have shown to be significantly associated with more facial recession compared with those positioned palatally.[6]

After implant placement, consideration of how to manage the residual void between the implant and walls of the socket, in particular, the facial cortex, is important. The fact that the space fills with a coagulum, sequentially replaced with provisional matrix, woven bone and finally lamellar bone is indisputable.[7] Tarnow and Chu[8] demonstrated the efficacy of this coagulum supporting osseointegration, even without primary soft tissue coverage. Grafting the space to encourage osseous fill is inaccurate. Botticelli and colleagues[9,10] demonstrated resolution of this gap in humans; however, a substantial portion of the alveolar ridge

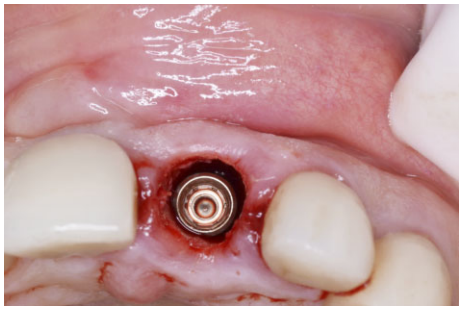

FIGURE 1. The diameter of the implant must not be too wide, approximating the thin facial bone, leaving a gap between the implant and facial wall. Also, the implant should not encroach upon the adjacent teeth and their periodontium. The implant position should also be palatal to the facial emergence contours of the adjacent teeth. Understanding if the final restoration will be cemented or screw retained will have an impact during implant placement to determine the best implant location angulation.

resorbed in a palatal direction. Augmentation is done to maintain the three-dimensional volume of the localized alveolar ridge, responsible for supporting facial soft tissues in the long term.[11] This is best accomplished with a particulate graft with a slow rate of substitution. Because the objective of implant therapy since its inception is "osseointegration," the author utilizes a composite graft of mineralized bone allograft freeze-dried, mineralized bone allograft (FDBA) that will slowly but predictably become replaced with vital bone, and bone xenograft deproteinized, bovine bone mineral (DBBM) which will not be replaced, but support apposition of vital bone. This combination allows for both osseointegration and space maintenance (Figure 2).

Regardless of whether a healing abutment or a provisional restoration is placed, the soft tissues often require augmentation for long-term maintenance of soft tissue horizontal and vertical dimensions. The augmentation of soft tissue can significantly prevent loss of peri-implant horizontal and vertical tissue dimensions.[12,13] The importance of soft tissue thickness can also play a crucial role in the maintenance of crestal bone.[14,15] This is accomplished with autogenous or allogeneic grafts (Figure 3A and B).

Frequently in esthetically demanding areas, provisional restorations are placed at the time of immediate

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implant placement. This has been demonstrated in the literature as an efficacious method of providing esthetic implant therapy.[16,17] The submucosal portions of these restorations can either negatively or positively affect the outcome of treatment. What is often overlooked is the impact the three-dimensional implant position has on the potential of the temporary restoration to provide optimal esthetics.[18] A facially positioned implant, or one less than 3–4 mm apical to the mucosal zenith of the restoration, can compromise the restorative clinician's ability to develop proper submucosal contours, often resulting in recession. With a properly placed implant, the emergence of the restoration can often enhance healing and outcomes. The facial contours are often concave or flat (Figure 4), to avoid pressure on facial tissue, which may cause contraction and recession. Schoenbaum and colleagues[19] demonstrated the modification of "stock" abutments to increase the space between the provisional crown and surrounding tissues, encouraging a soft tissue "fill" and increasing soft tissue volume.

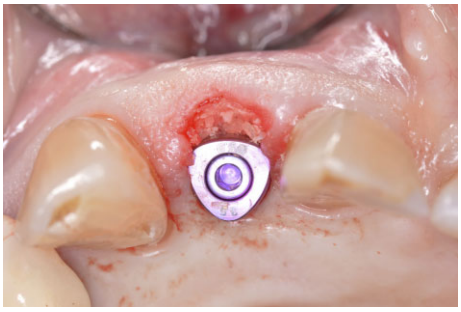

FIGURE 2. After immediate implant placement, the defect between the implant and internal, bony walls are obturated with a composite graft of FDBA and DBBM in a ratio of at least 2:1 with a higher percentage of allograft. It is important that the particulate is not "packed" or compressed in a manner that would minimize space critical for revascularization of the grafted space and cellular migration. Both of these processes are responsible for graft substitution with vital bone and osseointegration. The height of the graft placement should not exceed the height of the mucosal margin, resulting in graft sequestration and preventing placement of soft tissue autografts or allografts prior to closure.

When the basic tenets previously mentioned are followed, the framing of final restorations with healthy and stable tissues can be anticipated (Figure 5).

If implant placement is not optimal, and the contours of the provisional restorations are not favorable, such as overcontouring, esthetic compromises often result (Figure 6).

Once the temporary restoration is removed and a new, physiologically contoured and properly adapted restoration is inserted, coronal migration of the peri-implant mucosa may occur (Figure 7A and B).

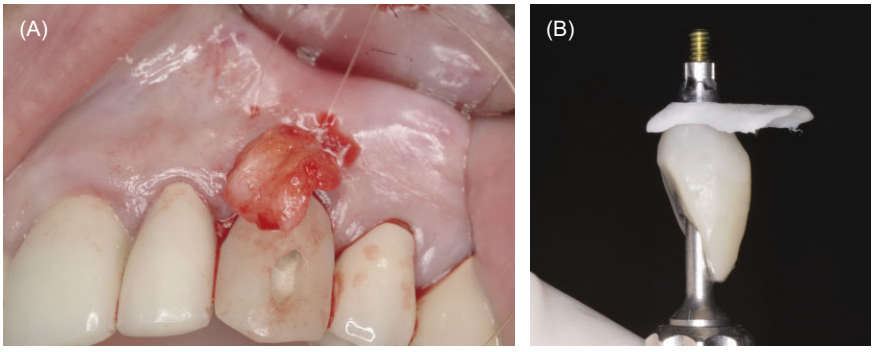

FIGURE 3. A, a subepithelial, connective tissue graft is obtained from palatal mucosa. The epithelial collar is removed via sharp dissection in vitro. It is then adapted on the facial aspect of the implant, between the free soft tissue margin and crestal facial bone. The graft is gently "tucked" and sutured to place below the height of the healing abutment. B, a dermal allograft can be used for particulate graft containment and as a soft tissue-thickening agent. In cases where a provisional crown is placed, a tissue punch can be used to allow the submucosal and intra-implant portion of the abutment/crown to protrude through the dermis. After the placement of the temporary restoration, the soft tissue graft can be adapted in the same manner as a subepithelial connective tissue graft, between the hard and soft tissues and the restoration. Suturing the graft to place further stabilizes the graft materials and wound margins.

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FIGURE 4. The contours of the provisional restoration are flat or mildly concave on the facial aspect. This facilitates soft tissue adaption against this surface. The author frequently strives for a slightly coronally positioned facial soft tissue margin immediately post-operatively. This compensates for a degree of post-operative recession. If the mucosal margin remains in a coronal position after 10–12 weeks of healing, it can usually be "repositioned" non-surgically by the meticulous addition of composite resin or acrylic to the provisional to gently displace soft tissues. It is critical to mention that the sub- and supramarginal portions of the temporary restoration are highly polished to prevent inflammation which could lead to recession, bone loss and infection.

FIGURE 6. A facially positioned implant and overcontoured restoration resulted in asymmetric mucosal margins and esthetic compromise. The question is if a surgical procedure will be required in addition to the creation of a newly properly contoured and adapted provisional.

After successful modification of the peri-implant mucosal margin via the second provisional restoration, a final, screw-retained crown is placed (Figure 8).

A screw-retained restoration has several advantages over cement-retained crowns in the esthetic region of the dentition. First, the elimination of cement negates the risk of inflammation caused by retention of submucosal cement. This can result in either peri-implant mucositis or even peri-implantitis, resulting in marginal to catastrophic bone loss. The

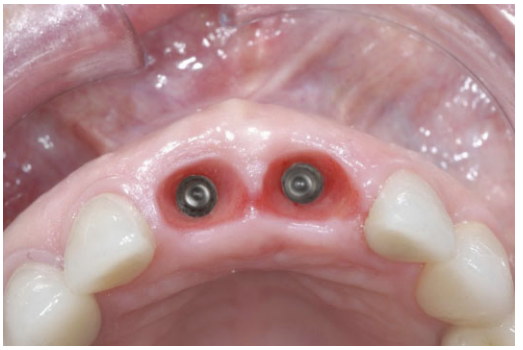

FIGURE 5. The provisional restorations, placed at time of extraction and implant placement physiologically contours the peri-implant mucosa. Proximal papillae and facial-palatal contours are developed prior to initiation of definitive restorative therapy. This case was performed with a facial, papilla-sparing flap, particulate bone grafting and adapting a soft tissue allograft around the provisional restoration.

resolution of these conditions often results in significant hard and soft tissue recession and esthetic compromises. The retrievability of this type of crown also facilitates easier repair of ceramic fracture compared with cement-retained restorations. Furthermore, when interproximal contours and tissue support are in question, they can be more easily managed or modified if the restoration has predictable ease of retrievability.

In some instances when the implant position has a buccal angulation, but the desired restoration is one to be retained by a screw, there are two main concerns: esthetics and proper support for the porcelain restoration. In this instance, instead of having a traditional screw retained crown engaging the abutment/implant in a vertical direction, a custom crown that copies the screw access on the abutment is design. In this manner, a lingual screw can engage the crown through the lingual surface of the crown, the lingual wall of the abutment and the inner aspect of the crown that duplicated the screw chamber of the abutment, thus providing excellent aesthetics and stability (Figures 8–10). Proper contouring of the proximal abutment and crown surfaces encourage papillae reformation, as appreciated radiographically (Figure 11).

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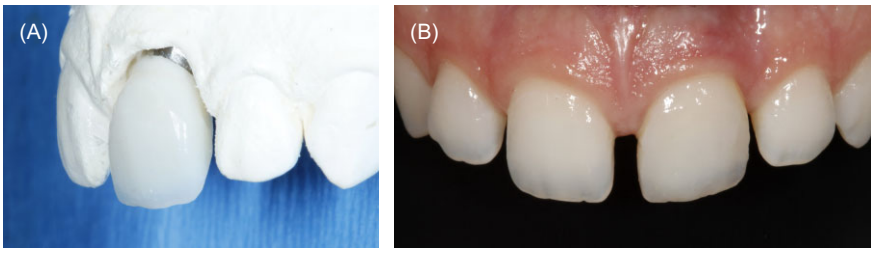

FIGURE 7. A and B, removal of the existing temporary crown and abutment are performed. A properly contoured abutment and provisional restoration are fabricated. It is crucial that space exists between the cervical portion of the temporary restoration and mucosa. This allows the possibility of coronal migration of soft tissue and correction of the gingival asymmetry.

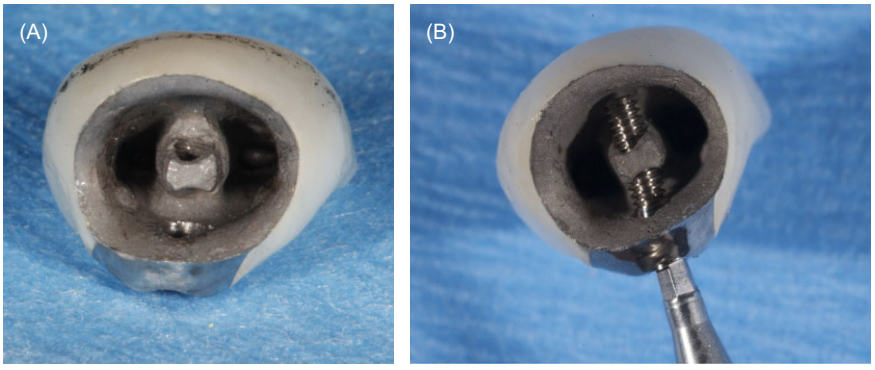

FIGURE 8. A and B, the facial positioning of the implant resulted in minimal room available to develop proper emergence profile. Thickness of the submucosal restoration must be limited to maximize tissue health and volume. Intaglio view shows: A, crown ready to accept a lingual screw through the lingual with a pencil mark on the buccal-gingival area showing the gingival margin in the mouth. From the pencil mark to the margin on the crown, the emergence profile must be modified to a concave form to allow for gingival tissue to occupy such space and B with the custom crown which has duplicated the channel of the abutment screw. The lingual transversal screw engages the lingual wall of the crown, lingual wall of the abutment, intaglio of the abutment-screw access duplicated inside the crown, buccal wall of the abutment and finally resting on the metal-buccal inner wall of the crown.

FIGURE 9. Lingual screw retained crown.

FIGURE 10. Final restoration. (crown and abutment fabricated by Toshiyuki Fujiki, RDT).

DISCUSSION

The objective of this article is to point out the surgical and restorative aspects of implant-related esthetics. Understanding the physiologic changes that occur following tooth loss and the rationale for countering these processes can be the difference between long-term success and failure. Diagnosis and case selection cannot be overlooked. Not every tooth requiring extraction is a good candidate for immediate implant placement and not every immediate implant is

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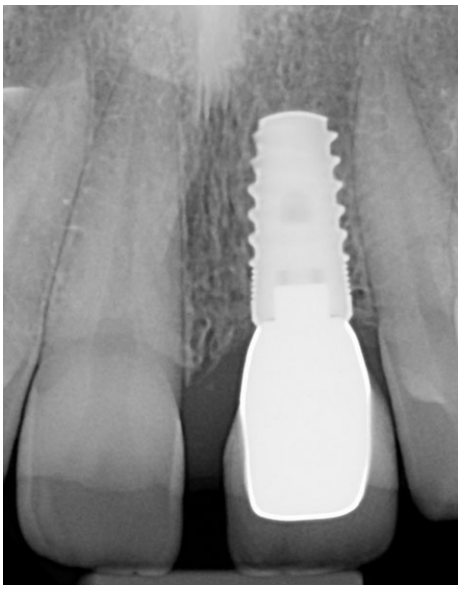

FIGURE 11. Radiograph of final restoration showing proper fit and platform switching.

a good candidate for immediate provisionalization. Starting with recognition of patient desires, limitations of therapy, and proper treatment execution, esthetic success can be achieved in most situations. When conditions for immediate tooth replacement are present, Tarnow and colleagues[20] demonstrated the efficacy of augmentation and graft containment via an immediately placed provisional crown or contoured healing abutment to preserve ridge dimensions.

Recognition of patient biotype (thick or thin) and the anticipated tissue changes following extraction should be performed before treatment. It may be prudent in some patients with thinner soft and hard tissues, pre-existing gingival asymmetry, and high esthetic expectations to select a staged-approach. Extraction and hard and soft tissue augmentation prior to implant placement is often a more predictable route to achieve esthetic success. Some of these patients can still be candidates for immediate tooth replacement, though the requirement of significant augmentation is almost always required. Autogenous soft tissue grafts are utilized for alteration of tissue thickness and more efficacious than dermal allografts in these types of patients. In sites with thicker soft tissue dimensions, dermal allografts can frequently be utilized with great success and eliminating the morbidity associated with a second, palatal donor site required for autogenous graft procurement.

Occlusal analysis cannot be overlooked prior to therapy as well. If it is impossible to provide a provisional restoration without occlusal contact with the opposing arch in centric occlusion and excursions, it may be advisable to delay temporization at least until osseointegration (often 6–8 weeks) occurs and then develop soft tissue contours with a provisional restoration. Patient compliance also plays a role, where patients unwilling to avoid mastication in the operated region for at least 6–8 weeks may be better served with delayed provisionalization. These patients are best served with fixed or removable, tooth-born temporary restorations.

CONCLUSIONS

Starting with proper diagnosis, understanding patient desires and expectations and recognizing the limitations of treatment, esthetic success is often possible. When hopeless teeth can be removed with minimal trauma, restoratively driven implant placement, described by Garber and Belser,[21] is anticipated and tissue preservation via grafting and temporization is executed, immediate tooth replacement and with long-term stability is realistic. Understanding the importance of surgical and restorative guidelines demonstrated here are critical for success. Failure to do so may result in less than esthetically acceptable outcomes, often impossible to correct after the initiation of treatment.

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