Optimizing Implant Placement and Aesthetics:

Technology to the Rescue!

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The continually evolving science of implant dentistry has led to a growing recognition that many treatment options offer predictable long-term results. Dental implants have certainly developed into a viable alternative to conventional prosthodontic reconstruction of edentulous spaces, and have afforded us a restorative tool for use in difficult aesthetic cases. Optimizing aesthetics in the anterior maxillary incisor area is critical to a successful outcome.

The therapeutic goal of implant dentistry is not merely tooth replacement, but total oral rehabilitation. Implants provide excellent support for fixed appliances, increasing function as compared to conventional dental therapies. Implant dentistry has gone through many phases over the years. Modern design allows us to predictably place dental implants in immediate extraction sites.[1-3] Single tooth-by-tooth reconstruction provides the patient with easy access to floss and clean the affected area compared with the relative difficulty of maintaining splinted crowns. There is now a low risk of abutments loosening under function, as was the case in the past.

This case study will serve to demonstrate a maxillary anterior reconstruction using immediate placement of dental implants, following diagnosis using Computed Tomography (CT) scanning software, immediate loading using transitional abutments, splinted composite crowns, and dynamic and aesthetic smile design using zirconia abutments and free-standing all-ceramic crowns.[4-6]

Advantages of Computed Tomography Scanning Technology

CT scanning is becoming more and more prevalent for use in ensuring proper dental implant placement. Bitewings, periapicals, panoramic radiographs, and even medical CT scans only give a two-dimensional image for implant planning. One of the latest CT planning software programs (NobelGuide™ CT [Nobel Biocare; Yorba Linda, CA]) provides as much information as possible to assist during surgical planning.

We can now visualize vital anatomy in 2-D and 3-D prior to surgery, and can virtually assess the location of implants prior to surgical intervention.[7] Diagnosing anatomic issues specific to the patient, planning the implant type, and determining position and orientation in the bone are

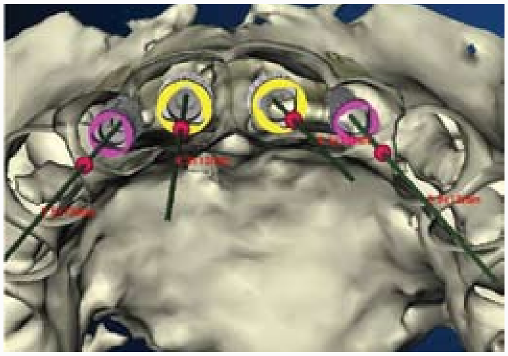

Figure 1: *NobelGuide software is used to idealize implant size and position.*

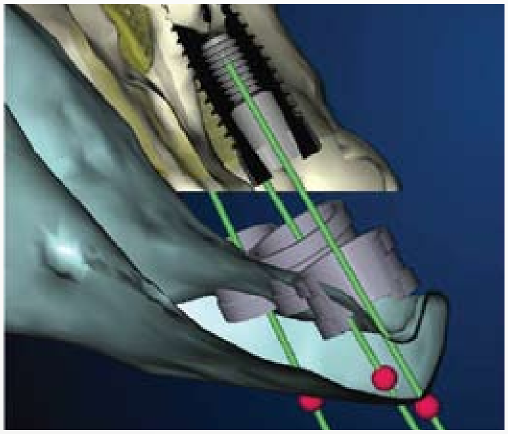

Figure 2: *Virtually planning the case proves a tremendous advantage.*

Figure 3: *Retracted view of preoperative dentition.*

all easily accomplished with the help of this technology. The process is both user-friendly and intuitive.

NobelGuide CT scanning software, as demonstrated in this article, allows us to simulate the placement of implants accurately prior to surgery. A Surgical Template created from the 3-D images helps place the implants in the proper positions, without the need for a flap incision.[8,9] This technique proves to be a cost-effective solution for assisting the implant dentist in the planning of an aesthetic final result and minimizing any surgical challenges that are faced. The CAD/CAM planning and placement system supplied by NobelGuide provides a high level of comfort and safety for the patient by reducing surgical and restorative time. This is done by utilizing an accurate 3-D plan prior to implant placement. There are obvious advantages, including: easy visual understanding for clear case presentation, reduced surgical chairtime, reduced restorative chairtime in certain cases, reduced stress for the clinician and the patient, the avoidance of surprises during surgery, implants that are placed optimally for long-term implant and prosthetic success and, most importantly, an improved aesthetic result.[10-12]

Computed Tomography Scanning Technique

Prior to the CT scan, a Radiographic Guide is fabricated. This will serve to aid in the visualization of the optimal prosthetic outcome. The teeth are positioned properly in wax, and then a master cast is fabricated to illustrate what the case will look like finished before ever starting. All appropriate dental anatomy is included. The Radiographic Guide is placed in the mouth during the CT scan. This allows us to see the ideal position of the teeth on a 3-D model. The entire 3-D image is analyzed and the implant planning and simulation of implant placement completed using the computer *(Fig. 1, 2)*. The surgical placement of dental implants can be done in a conventional manner using the newly created Surgical Template to help direct the implant in the ideal position. However, optimally the surgery can be completed without making any incisional flap. The implants are placed to the desired depth using the computer software and Surgical Template.

Materials and Methods: Advantages of Tapered Design

Nobel Biocare's Replace Implant System has evolved considerably since its introduction in 1997. The implants and all related surgical and prosthetic components incorporate a color-coded system that allows users to identify at a glance which restorative parts go with which size implant placed. In 1999, the Replace Tapered Implants became available with an internal connection that simplifies the impression technique, seating of abutments and crown & bridge placement. Three locking channels guide the positioning of the abutment. Once torqued into place, the zirconia abutment does not loosen, making single-tooth restoration reliable. The system can be used in one- or two-stage surgical procedures. Primary stability is the key factor for successful early and immediate loading.

The tapered design of Replace Select gives placement alternatives in sites with anatomical limitations, such as labial concavities in the premaxilla and converging adjacent tooth roots. Since they approximate the shape of a natural tooth root, they provide better stability in extraction sites.

Figure 4: *This radiograph illustrates severe root resorption.*

Figure 5: *Laboratory casts and components used for immediate transitional splinted crowns for teeth #7-10.*

Figure 6: *Laboratory casts and components used for immediate transitional splinted crowns for teeth #7-10.*

Figure 7: *Flapless extraction site.*

There are several collar heights and designs available in these titanium surface-treated (TiUnite; Nobel Biocare) implants, including no collar, 1.5 mm and 2 mm. The shorter collar designs are indicated for aesthetic areas. Nobel Biocare's NobelProcera™ process produces custom-shaped zirconium oxide abutments to create the most natural form and emergence profile. The ultimate aesthetic solution, especially for patients with a high smile line and thin tissue, is achieved using NobelProcera abutments. Every aspect of the implant system makes the restoration of teeth on implants as easy as crown & bridge.[13-15]

The Replace Select implant has a tapered body and an internal prosthetic connection. The internal connection is tri-channeled. The internal lengths of the channels are approximately 1.5 mm. The implant has a wide crestal interface with a tapered thread design. The diameters, at the crest of the implant, are 3.5 mm, 4.3 mm, 5 mm and 6 mm. This allows for a better emergence profile from the top of the implant. Anatomical considerations for the use of the implant include converging roots and concavities with the bone, which makes placing a parallel-walled implant more difficult. Interface of the implant increases dramatically as implant diameter increases. This may be more relevant than implant length.

The tapered design of the implant promotes elevated levels of fatigue endurance because the coronal portion is wider in diameter than the apical portion. This taper also ensures a tight fit and promotes function coronally to help offset stress shielding along the narrow, smooth crestal band on the implant. This reduces bone resorption that may result from hypo function, which is especially important during placement of the implant in a fresh extraction site.

Taper also reduces the incidence of cortical plate bone perforation during osteotomy preparation near anatomic undercut areas and protects adjacent natural tooth roots. Also, the tapered design of the implant often allows for better angulation of the implant. It is important to have an implant design that allows for placement of the fixture in a way that places the forces down the long axis. The implant has versatility and allows for aesthetic and variable bone morphology.

Case Report

A 38-year-old female presented with mobile maxillary anterior lateral and central incisors. These teeth had been orthodontically treated in the years before, resulting in resorption, mobility and aesthetic problems *(Fig. 3)*. Her main concerns were that she would have to go without teeth for any length of time, or the possibility of having to wear a removable appliance. The patient requested something she referred to as "teeth in a day." Oral and radiographic evaluation indicated severe root resorption around teeth #7-10 *(Fig. 4)*. Her teeth were deemed to be untreatable using traditional dental techniques.

Diagnosis and Treatment Planning

The decision was made to have a Cone Beam CT scan done and evaluated using the NobelGuide software. Virtually placing the dental implants using the computer, prior to ever touching the patient, would prove to be a tremendous advantage in diagnosing and preparing for this case *(Fig. 5, 6)*.

Figure 8: *NobelGuide Surgical Template with precision openings for drills.*

Figure 9: *The NobelGuide Surgical Template with precision openings for drills is placed in the mouth.*

Figure 10: *Surgical Template in place with narrow platform guide, used for pilot drill angulation and depth.*

Figure 11: *. A 3.5 mm surgical drill is used.*

There were no medical conditions, allergies or sensitivities that would preclude the use of necessary implant procedures or medications. Because there was no need to work around any habits involving the use of nicotine or alcohol, healing was expected to be good and uncomplicated.

Proper diagnosis for dental reconstruction is the most critical aspect of any surgical intervention. Determining the design of the final prosthetic reconstruction may be the most difficult procedure. It is this author's belief that the restoring dentist should be dictating dental implant position and angulation prior to surgical placement. To help achieve this goal, Diagnostic Wax-Ups, modern computer-generated scanning or simple common-sense design should be considered.

The Diagnostic Wax-Up is an invaluable aid in determining the proper placement of implants in the center, between the proposed abutment teeth. The wax-up is particularly valuable when cement-retained or screw-retained crown & bridge is planned. NobelGuide software is used to create a Surgical Template that is used pre-surgically in determining the ideal location and angulation of the implant site, and to optimize placement of dental implants for maximum aesthetic and functional results.

Surgical Template, Extractions and Implant Placement

Prior to extraction of the mobile teeth *(Fig. 7),* a surgical template was fabricated using a master cast of the patient's existing bridgework *(Fig. 8, 9)*. Tapered drills of increasing widths were used to prepare the bone to accept the proper-size implant. Replace Select 3.5 x 13 mm dental implants were guided into place using the NobelGuide surgical template in the #7 and #10 areas, and 4.3 x 13 mm Replace Select implants surgically guided into the #8 and #9 areas *(Fig. 10, 11)*.

A color-coded threadformer, corresponding to the implant diameter selected, was then used. The maximum recommended setting is 30 rpm. Firm pressure was applied to the threadformer and it was rotated slowly. Once the threads were engaged, the threadformer was allowed to feed without pressure. The osteotomy was threaded to the single depth reference line on each drill. The dental implants were then removed from their sterile packaging and threaded into the prepared site. When more torque is needed to complete the placement, a ratchet and insertion assembly is used to place the implant to its final depth. A marking indicates that one of the three tri-channeled internal connections is placed to the facial *(Fig. 12-14)*.

Immediate loading of dental implants has proven to be a predictable method of improving emergence profile and smile design. The Nobel Biocare immediate temporary abutments were used to secure transitional splinted crowns and allow the gingiva to respond positively *(Fig. 15)*. Immediate aesthetics and function were achieved *(Fig. 16)*. Simple color-coded transfer assembly can duplicate the position of the dental implant on a working cast. NobelProcera abutments were reshaped in the dental laboratory with slightly subgingival margins. These abutments were tightened to 35 Ncm to ensure that they would not loosen *(Fig. 17)*.

Figure 12: *A 3.5 mm Replace Select (Nobel Biocare) dental implant treated to depth and angulation using the Surgical Template.*

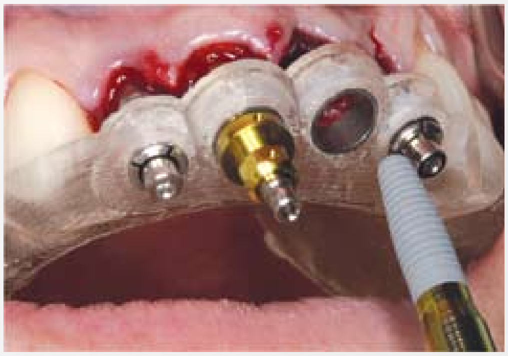

Figure 13: *A 4.3 mm Replace Select dental implant is positioned.*

Figure 14: *Implants placed ideally with flapless procedure.*

Figure 15: *Immediate conical abutments positioned.*

Summary

The goal for this patient was to create an aesthetic smile design using individual dental implants to reconstruct the edentulous spaces. NobelProcera crowns aesthetically restored the separate and distinct teeth *(Fig. 18, 19)*. The patient was thrilled with the final aesthetic result, and she was able to smile confidently again *(Fig. 20)*. ■

Figure 16: *Retracted view of transitional splinted crowns, cemented temporarily during healing.*

Figure 17: *NobelProcera abutments torqued into position.*

Figure 18: *Individual NobelProcera crowns in place.*

Figure 19: *Panoramic view of implant, zirconia abutments and crowns in place.*

Figure 20: *Final smile line, with individual all-ceramic crowns (NobelProcera Zirconia) in place.*

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