The CT/CBCT-Based Team Approach to Care: Part 3: Identifying Prosthetic Options Through Team Communication

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InNTRODUCTION

This is the final article in a 3-part series on how cone beam computed tomography (CBCT) can bring the implant team together to deliver ideal treatment for the patient.

Part 1 of this series discussed the importance of CBCT, and how an online team meeting among the surgeon, prosthetic dentist, radiologist, and dental laboratory technician can create an ideal treatment plan for dental implants. Concepts that were considered were: the width and diameter of the implants, the appropriate number, angulations, and the crown-to-implant ratio of the dental implants in the plan. Part 2 of this series emphasized the surgical aspects and parameters of the implant treatment sequence including: the medical history considerations of treatment, site development with hard- and soft-tissue grafts, assessment of bone quality and anatomy, methods of provisionalization during treatment, influence of anatomy on the prosthetic treatment plan, and considerations for implants in the aesthetic zone. The interrelationship of the surgical-laboratory-restorative team was emphasized as the foundation for successful implant-restorative treatment.

Figure 1. An example of a cement-retained PFM fixed implant supported bridge.

Figure 2. An example of a screw-retained fixed partial milled zirconia bridge.

Figure 3. An example of a metal-reinforced removable bar supported overdenture. The bar is splinting the implants together for added implant stabilization.

Figure 4. An example of nonsplinted implant overdenture attachments to support an overdenture.

This article will emphasize the choices of implant prosthetic options and how they are related to the communication that occurs among the implant team members. The diverse choices of implant prosthetic options, as well as a rationale for a final selection of a prosthetic choice for a patient, will be outlined. This article will also discuss the inclusion of the patient into the implant team. The patient joins the surgical doctor, prosthetic doctor, laboratory technician, and the radiologist as the part of the team; in the end, it is the patient who makes an educated final decision on the implant prosthetic choice based upon quality-of-life and financial issues. It is our opinion that an informed consent decision by the patient requires appropriate information, gathered from the CBCT diagnosis by the professional members of the treatment team, be appropriately relayed to the patient.

Ideally, the surgical aspects of treatment should be driven by the restorative end result, as the implant prosthetics are responsible for the long-term implant results.[1] Communication of the prosthetic options available to a patient is most often conveyed by the dentist performing the restorative aspects of implant treatment. Therefore, the restorative implant dentist is usually in the best position to

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explain the proposed prosthetic plan to a patient.

Parts 1 and 2 of this article series emphasized online communication among the implant team members. It has been suggested that online communication with a free software product such as Skype (Microsoft) may be an excellent platform for such a collaboration.[2] However, when the restorative dentist is communicating available treatment options to the patient, it is our opinion that this important step should be done in person, face to face. While technology can also be utilized to facilitate the communication process, in the end, it is the personal relationship between doctor and patient that defines treatment.[3] The recommended protocol (the implant team should meet and discuss treatment options prior to the restorative doctor conveying treatment choices) enhances ideal treatment outcomes. Additionally, this protocol provides excellent medical legal protection from an informed-consent standpoint. The blend of CBCT technology, interactive online meetings, followed by interpersonal communication between the restorative doctor and patient, creates a technologically advanced and yet personal experience for a patient.

AVAILABLE PROSTHETIC OPTIONS AND THE TREATMENT PLAN PRESENTATION

The clinician has 4 general choices to present to a patient when considering replacing missing teeth with an implant supported restoration: A cement-retained fixed prosthesis (Figure 1); a screw-retained fixed prosthesis (Figure 2); a splinted bar-retained removable prosthesis (Figure 3); and a nonsplinted removable implant prosthesis (Figure 4).[4]

Each one of these choices has different variations in prosthetic design, componentry, and materials. The ultimate choice for a patient should be based on an informed consent decision after the risks and benefits of each option is presented.[5] The treatment choices of a fixed versus removable option, cement versus screw-retained fixed options, and splinted versus nonsplinted removable options need to be determined in advance by the implant team and ultimately accepted by the patient.[6] During the CBCT online meeting, ideal clinical options will be reviewed based upon the patient presentation. This decision by the implant team is based on a CBCT scan, occlusal relationship, lip-line position, bone levels, soft-tissue availability, retrievability issues, retention needs, occlusal contact positions, final restorative material choices, and other clinical and prosthetic factors (Figure 5). These clinical and prosthetic choices should be conveyed to a patient in an understandable and organized manner by the clinician. After careful consideration, the patient must decide which treatment modality will best accommodate finances, lifestyle, aesthetic concerns, length of treatment, provisionalization choices, prosthetic longevity, and other concerns.[7] The inclusion of the patient as part of the team is critical for the determination of the final prosthetic outcome. Without the clinical information gained from the CBCT-based dental team, intelligent choices and assessment of long-term prognosis cannot as accurately be presented to a patient.[8]

Figure 5. A 3-dimensional view of CBCT plan showing how implant positions support a final prosthetic position.

Figure 6. Screw-retained fixed maxillary bridge showing lingually placed screw hole positions. This avoids screw holes from exiting the facial aspects of anterior teeth.

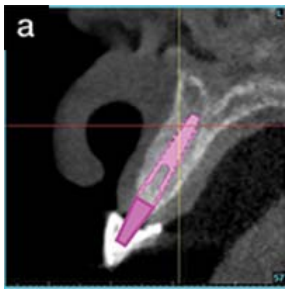

Figure 7a. Cross-sectional view of implant planning for a cement-retained crown. Note the angulation of the implant.

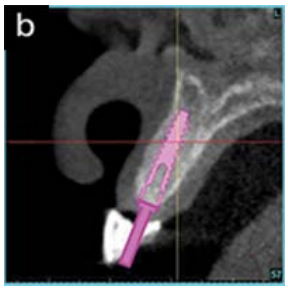

Figure 7b. Cross-sectional view of implant planning for a screw-retained crown with access hole on lingual aspect of tooth.

Implant dentistry is a restoratively driven discipline and therefore the ideal implant position should be dictated by the final prosthetic design. The final prosthetic outcome should also influence the need for ancillary bone grafting and soft-tissue preparation.[9] For example, a screw-retained prosthetic design may require lingual placement of the implant within the envelope of the tooth to allow for proper emergence of the screw-access holes and to aid aesthetics (Figure 6). This and other prosthetic paradigms are important considerations and focus for the CBCT based team as presented in this articles series. Utilizing interactive treatment planning software allows clinicians to evaluate each potential implant receptor site for the length and width of the implant. The facial-lingual angulation of the implant within the alveolar bone can provide information regarding the use of a cement-retained restoration as seen in Figure 7a, or a screw-retained restoration as seen in Figure 7b. These important images can be utilized during the online meeting to discuss variations in the placement of implants and the impact on the restorative components that will be required to complete the case. When the restorative dentist presents treatment alternatives to the patient, they are team-derived options, based on group input from all members of the treatment team. The final presentation and delivery of these options in a clear manner is paramount to helping a patient make an informed decision.[10]

It is the authors' recommendation that the latest available technology be utilized to present the options available to a patient. These options include computer treatment plan presentation software programs Consult-PRO, XCPT, CASEY, PowerPoint Presentations (Microsoft), iPad presentations (My Dental Hub), model-based demonstrations (Salvin Dental), or patient education books (Figures 8a and 8b).[11] Computer treatment planning presentation programs offer the advantage of documentation while providing another level of informed consent. Through utilization of the latest technology, the treatment options are conveyed in the clearest manner possible.

Figure 8a. A "demonstration" model of a screw-retained zirconia bridge helpful for patient education and instruction.

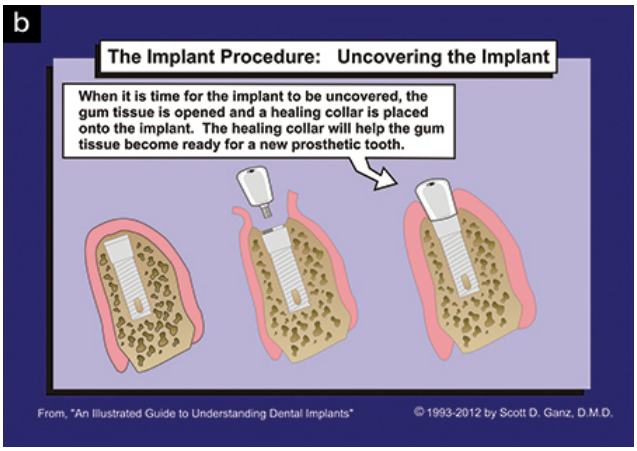

Figure 8b. A page from An Illustrated Guide to Understanding Dental Implants patient
education book.

One important aspect of case presentation is to discuss financial options for a patient. Often implant treatment is not covered by dental insurance, and educating patients as to potential financial options for the patient is quite helpful. Utilization of third party dental finance companies can often facilitate treatment options that otherwise would not be possible (Care Credit or Springstone). Nuances of dental finance companies' interest rates and payment terms needs to be carefully conveyed to aid patients in making the right financing choice. Having a financial coordinator that is adept at presenting treatment plans and financing can be a great asset to any office. Assistance by the dental office in obtaining patient financing is often an integral part of treatment planning and can alleviate stress for the patient and enhance office cash flow.

When financial issues present barriers to ideal treatment, the concept of staging treatment should be considered. For example, while an ideal plan for a patient might be a fixed screw-retained bridge, a nonsplinted implant retained denture may be the only affordable option. If the ultimate fixed restoration is a future consideration, through careful planning followed by staging of treatment, a patient could initially receive the nonsplinted screw-retained option converted to a fixed screw-retained prosthesis in the future. This may entail placing the original implants in strategic positions to allow for additional implants in the future for better support of the prosthesis. Staging often allows patients to immediately improve their current condition while building a foundation for future treatment. Staging could also start out with a non-implant supported denture in anticipation of implants at a later date. Therefore, many derivations of staging treatment are possible.[12]

FIXED VERSUS REMOVABLE PROSTHETIC OPTIONS

The implant team and the patient must initially decide whether the final implant supported prosthetic choice is going to be a fixed or removable design.[13] The general advantages of an implant-supported fixed prosthesis versus removable options are: secure and improved ability to masticate, a more natural, dentitionlike feeling to the patient, increased prosthetic longevity due to fewer moving parts, and less occlusal space requirement. The general disadvantages to a fixed implant-supported prosthesis versus removable options are as follows: more exacting placement position of implants because of aesthetic concerns; diminished hygiene access; potential for bone and soft-tissue grafting in order obtain correct implant positions and emergence profiles; increased difficulty to repair prosthetic fractures; and the higher cost of treatment (Figure 9). The advantages of a removable implant supported prosthesis versus fixed options are: easier hygiene maintenance of implants once the prosthesis has been removed; the prosthesis can provide improved lip support; less exacting implant placement positions by the surgeon; less bone grafting needed; easier repair of prosthetic fractures or chipping; and a lower overall cost, depending upon the choice in a final prosthesis. The disadvantages of an implant-supported removable prosthesis versus fixed options are: reduced masticatory function versus fixed; increased prosthetic maintenance over time due to parts replacement; diminished longevity of the prosthesis; lack of a "natural tooth" feeling for the patient; and the potential for impaired speech due to required prosthetic size (Figure 10).

Figure 9. Example of the importance of precise positions of implants for aesthetic reasons with a cement-retained fixed prosthesis.

Figure 10. Illustration of worn prosthetic attachments on an overdenture.

Figure 11. When there is less than 5.0 mm of prosthetic space, a screw-retained prosthesis is indicated.

Figure 12. CAD/CAM custom milled implant abutment for a cement-retained crown with abundant retention.

Based upon clinical findings and the volume of available bone, the implant team should determine which treatment options are possible. The prosthetic design, whether removable or fixed, should be decided early in the planning phase to help guide the team in determining: strategic implant positions; the need for grafting; implant angulations; abutment components; and the recommended number of implants. An initial discussion with the patient about fundamental treatment options and the financial differences entailed can be done early in the treatment planning stage. However, there are risks if this discussion occurs prior to a thorough review of the CBCT data. Once a decision has been made for either the fixed or removable option, the implant team can further define the entire treatment sequence and importantly the anticipated time frame of treatment. Often implant positions can be planned that allow for prosthetic changes in the future and, therefore, the option of staging a removable prosthetic situation to a fixed option in the future could also be discussed.

Cement Versus Screw-Retained Fixed Prosthetic Options

If a fixed prosthetic implant-supported option is determined to be the final restorative plan, the next step is to decide whether the prosthesis will be cement-retained or screw-retained.[14,15] The choice of a cement-retained or screw-retained prosthetic design affects the surgical placement of the implants, cost of the prosthetic components, treatment sequencing for the patient, hygiene protocol for the patient, and final material choices.16 Good communication by the team members will help to explain the advantages and disadvantages of each option, allowing the patient to determine the final choice based on personal needs combined with clinical realities. Often, it is the available bone volume, bone levels, clinical occlusion, soft-tissue levels, and potential for retention that ultimately aid in determining the final choice of a screw-retained versus cement-retained prosthesis (Figure 11).

Figure 13. Example of an acrylic hybrid-type bridge with a prosthetic failure.

Figure 14. The Prettau zirconia bridge has many advantages over acrylic.

Figure 15. Nonsplinted implant supported overdentures rely on tissue for support.

Figure 16. Splinted milled titanium overdenture bar, showing substantial support and retention.

The advantages of a cement-retained prosthesis are: fewer prosthetic parts; less stress on splinted implants due to casting inaccuracies; easier access in posterior areas; absence of screw access hole openings on occlusal or aesthetic areas; and less material fracture due to the absence of screw holes (not true for full-contour zirconia). The disadvantages of a cement-retained implant

prosthesis are: less predictable retrievability; increased prosthetic space needed; more difficult repair of chips and/or fractures; more difficult repair of abutment screw loosening; retention of prosthesis is more variable and dependent on cement; and potential for cement being introduced into the soft-tissue sulcus (Figure 12).

The advantages of fixed screw-retained implant supported prosthetics are: less space is needed for retention of acrylic prosthetics (not for full-contour zirconia or PFMs); easier retrievability; and absence of cement that can be introduced into the sulcus. The disadvantages of screw-retained implant supported prosthetics are: increased material fracture due to screw access holes (unless full contour zirconia); screw access hole restorations being discolored because of underlying metal (except full-contour zirconia); and stress on splinted implants from inaccurate castings (except milled full-contour zirconia) (Figure 13).

The milled zirconia screw-retained bridge offers certain prosthetic advantages over acrylic/metal hybrid bridge and PFM screw-retained choices.[17] The zirconia milled bridge is CAD/CAM designed, and does not suffer from casting distortion in the fabrication process.[18] To ensure intraoral accuracy of fit, a verification jig is required for the stone or epoxy model. The screw access holes of the zirconia milled bridge are not susceptible to fracture as with acrylic of porcelain.[19] The hardness of zirconia allows for screw access holes to be larger if needed for screw access without susceptibility to chipping. After screw tightening, the screw access hole is covered with composite; shades will blend well due to the lack of a metal substructure otherwise found in acrylic-metal or PFM restorations. The zirconia screw-retained bridge is impervious to staining or occlusal wear, unlike acrylic bridge alternatives. CAD/CAM designed zirconia screw-retained bridges also offer custom shapes and colors unlike acrylic screw-retained hybrid type bridges that utilize denture tooth moulds (Figure 14).

It is important to plan the implant positions precisely for a fixed screw-retained implant bridge design so that the screw access holes are within the envelope and lingual for anterior teeth, and within the central groove of posterior teeth. If implants are placed in an off-angle direction, the resulting screw access holes could exit through the facial aspects of anterior teeth, creating aesthetic issues. Multiunit angled abutments can be used to redirect screw holes, but require additional components and cost for the dental laboratory phase of an implant case. The CBCT-based treatment planning can direct ideal implant placement positions with respect to not only screw access hole placement but for correct spacing of implants and optimal restorative positions.[20]

SPLINTED VERSUS NONSPLINTED REMOVABLE PROSTHETIC OPTIONS

If the treatment decision for a patient is a removable implant-supported denture option, an additional choice is required to determine if the implants should be splinted or nonsplinted. The nonsplinted implant-supported removable denture option offers the advantages of decreased cost, relatively easier prosthetic steps, easier hygiene management versus splinted implant-supported denture options, the potential availability to upgrade to a different type of prosthesis, more versatility to make corrections to a denture if an implant fails, and need for less prosthetic space. The disadvantages of nonsplinted implant-supported removable denture options are: less prosthetic stability, the potential for bone loss in denture bearing areas, increased potential for soft-tissue sores and problems, and more stress on the implants due to their not being splinted. Various abutments and attachments are available to retain a denture to nonsplinted implants. The processing of the prosthetic components within the denture can be done either at the dental laboratory or in the mouth, directly with acrylic (Figure 15).[21]

Splinted implant-supported removable denture options offer the advantages of increased prosthesis stability, better implant stabilization through cross-arch splinting, and less soft-tissue contact by the prosthesis (Figure 16).[22] The disadvantages of splinted implant-supported denture options are: increased prosthetic space is required for the superstructure bar, increased laboratory time and patient visits, increased costs over nonsplinted options, and more difficult hygiene over nonsplinted options. Different bar designs and attachments are available offering different levels of retention and support. The dental laboratory members of the implant team can best advise regarding the design of the bar and available attachment options.[23]

CLOSING COMMENTS

This concludes a 3-part series of articles that have outlined the concept of how the team of the surgical doctor, restorative doctor, laboratory technician, and radiologist can collaborate with the use of CBCT technology to plan and deliver ideal treatment.

The team approach protocol, as presented in this series, has been based on the acquisition and diagnostic capabilities afforded by a CBCT scan.

After careful diagnosis and review by the implant team, the patient benefits from being able to choose between sound clinical options that have been communicated in an effective manner. This allows for ideal dental implant treatment utilizing the latest state-of-the-art technology. While there are many different methods to treat patients who are missing teeth, the protocol as presented takes into consideration a foundation of restoratively driven implant dentistry based upon a 3-dimensional assessment of patient anatomy. Through clear communication between the implant team and patient, an educated decision can be made that will ensure successful outcomes.

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Disclosure: Dr. Ganz has received past lecture honoraria from Imaging Sciences, Inc, Anatomage, Materialise Dental, and BioHorizons.

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