Editors' Note: Both Assistant Editors were asked to voice their opinions regarding the following: "*Although within the framework of implant dentistry, it appears that there is a dichotomy in the current evolutionary stages of the surgical and prosthetic aspects of this discipline. In essence, while the surgical fronts have proceeded through such modes as osseodistraction, the use of platelet-rich plasma, autologous platelet concentrate, and other advanced techniques and methods, there appears to be a 'dumbing-down' of the prosthodontic phases. The trend in implant prosthetic procedures appears to be simply 'to make it like everyday crown and bridge dentistry.' Will this divergence detract from, or improve, the ultimate end-results of implant dentistry as it is being practiced today?*" What follows are the responses of two well-respected, knowledgeable clinicians, **Scott D. Ganz, DMD,** (a prosthodontist) and **Richard A. Kraut, DDS** (an oral and maxillofacial surgeon).

Scott D. Ganz says...

The trend in the restorative phase of implant reconstruction is to "make it like everyday crown and bridge dentistry." Will this divergence detract from, or improve, the ultimate end-results of implant dentistry as it is being practiced today? This opinion piece will examine the relationship between recent surgical advances that enhance dental implant treatment, such as distraction osteogenesis, platelet-rich plasma, or immediate loading, and what some have described as a "dumbing-down" of the prosthetic phases with the aim to make it like everyday crown and bridge dentistry. To properly discuss these topics, it might be prudent to review some history as it applies to current trends in implant dentistry today.

Implant dentistry gained popularity among very early adopters with the modern development of the subperiosteal and plate-form or blade implants in the late 1960s. These modalities were designed to help partially or fully edentulous patients gain function and esthetics within the various presentations of remaining bone. Subperiosteals sat on top of the severely resorbed bony ridges, and blade implants were inserted into the bone after an appropriate channel had been cut with a high-speed handpiece. The implant systems had narrow necks that protruded from the body of the frame supporting the post that attached to the restoration. These narrow posts did not resemble the morphological shape of the particular tooth to be replaced. Tooth form was created solely by the prosthesis. What may surprise clinicians who have recently adopted implants into their practices and who are influenced by the "new and improved" methods of accelerating dental implant treatment today is that these early nonroot form designs, the subperiosteal and blade implants, were placed into function *immediately*. Most of these implants were placed and restored by general dentists, many of whom called themselves "implantologists."

During the early 1980s the term "osseointegration" was introduced to the world through the work of Dr. Branemark and the surgical and restorative protocols that were established for root form titanium implants. While there were many other systems in existence at that time, the detailed research by Branemark supported design concepts that lead to long-term successful integration of implants with the human jaw bone. Osseointegration was established through the now traditional two-stage surgical approach of placing the implants into the bone, submerged under the gingival tissue without function for a period of 4 months in the mandible and 6 months in the maxilla. Once this time had passed, the underlying implants were uncovered with a separate surgical procedure, and titanium abutments or healing collars were attached to allow for new healing of the tissue and for connection to the final prosthesis. To create the final restoration, a new set of instrumentation was needed, facilitated by the associated prosthetic kit. A series of impressions were made, and newly designed parts were selected from the catalog or by the laboratory to allow for the fabrication of the prosthesis. Most of these early designs were of the "high-water" fixed-detachable, screw-retained design that reflected the state of resorption of the bone, with minimal concern for normal root morphology, emergence profile, and esthetics.

The Team Approach

During this early evolution, implants were placed only by trained surgeons, and restored by trained prosthodontists in the TEAM approach that left the generalist out of the loop. In addition, early in the surgical learning curve, implants were often placed "where the bone was" due to a lack of preprosthetic planning that would help guide the implants into a position that would better support the ultimate tooth position. In order to create the prosthesis, the restorative dentist had to somehow con-

nect the implants to the framework through what I have long described as "prosthetic gymnastics." The early parts and pieces necessary for the surgical and restorative phases were unlike any that were utilized in the undergraduate dental school curriculum for the replacement of missing teeth. Therefore, it was quite intimidating for most clinicians. This required a substantial behavior change, a costly investment for both the surgical and prosthetic kits, and a steep learning curve to meet the demands of each individual case.

Despite some of these early obstacles, in the late 1980s and throughout the 1990s root-form implant protocols gained immense popularity and credibility through presentations at major meetings, various research, and countless articles published in respected journals. Modern implant dentistry started to evolve again. The TEAM approach became more refined as the walls came down and the general dentists could once again become more involved. Implant placement started to become guided by tooth position rather than available bone. Implant manufacturers started to listen to frustrated and innovative clinicians regarding implant designs, delivery systems, variations in on-hand inventories, abutment shapes, or confusion about the myriad restorative parts represented in thick product manuals. Root-form implants started to emerge from the tissue with prosthetic parts that more closely resembled actual tooth shapes, and there was a recognition that emergence profiles were important to enhance esthetics and long-term maintenance. In the late 1990s, changes in the original protocols were challenged with concepts of placement into extraction sockets and immediate, or delayed, loading to accelerate the treatment time lines associated with implant reconstruction. By the year 2000 there was "teeth in a day," and more recently we have "teeth in an hour." We have now come almost full circle from the days of the subperiosteal or blade implants (as most patients did receive "teeth in a day" from these ancient modalities), with today's implant manufacturers competing once again for the general dentist market. However, have these advancements resulted in a "dumbing-down" of the prosthetic phase, or have there been substantial developments that make implant dentistry a more predictable treatment modality?

Attitude and Behavior Changes

To address this assignment directly, I must start out with a question. Do patients come to any of us (surgeons, periodontists, prosthodontists, or general dentists) for dental implants? The answer of course is no. Patients do not come to us for dental implants—they come to us for *teeth*. Not a new concept, but a philosophy that is necessary to deliver the most predictable replacements for missing oral anatomy. The problem has been that the original manufacturer parts were not designed to resemble individual teeth—especially because most early cases were fully edentulous. Today, patients demand both function and esthetics to a very high degree, including beautifully contoured interdental papillae surrounding the implant-supported ceramometal restoration. We have now evolved into replacing all aspects of the missing anatomy: the tooth, the surrounding gingival tissue, and the supporting bone.

Because many of us were never taught implant dentistry at the undergraduate dental school level, it was a major behavioral change to deal with titanium abutments and screws rather than cutting enamel. One trend that has been obvious during the past 15 years is the shift away from screw-retained prosthesis design to the cementable restoration. This transition occurred in response to a better understanding of the needs of both the patient and the practitioner. The basic restorative problem, however, is the same for either method. When we look at the implant as it emerges through the gingival tissue, it is a *round* cylinder. Regardless of the implant system utilized, the restorative dentist is faced with changing this round shape into that of tooth-specific anatomy. The advent of stock abutments that could be prepared to receive a cementable crown allowed many clinicians to make the jump to implant reconstruction with tools that they did learn in dental school. Unfortunately, most stock abutments did not resemble natural tooth form, nor did the abutments have adequate width of metal for proper reduction necessary for the metal and ceramic overlay copings. Another problem inherent with round stock abutments is achieving antirotation of the coping on the abutment, and not relying on the adjacent tooth contacts to prevent this movement. The challenge has been to address issues of margin design, biological width, emergence profile, and passive fit, concepts that should equate to the natural tooth when conditions are ideal.

Customization and Accomadation

When stock abutments were not sufficient to re-create the desired morphology or emergence profile, custom cast abutments became the next logical option. Custom abutments with their machined implant interface allowed the laboratory technician to overcome size and shape limitations. These were created after transfer impressions located the intraoral implant position, usually employing a soft tissue model. Utilizing custom abutments allowed clinicians to direct the laboratory technician to overcome the round implant emergence and create a more desirable shape of the abutment in all dimensions so as to conform to the configuration of the surrounding soft and hard tissues. Traditionally, because this method requires laboratory time for fabrication, it is usually inserted many months after implant placement. If the shape of the cast alloy abutment fits the site well, then the definitive coping

will be fabricated. If it is not acceptable, it can be adjusted by the clinician to achieve the desired result. To make this method similar to conventional "crown and bridge" dentistry, the custom cast post would be inserted, and a temporary restoration was created to allow the patient limited function. With proper tooth form, the surrounding soft tissue would mature around the transition (interim) restoration. A secondary crown and bridge impression would thus be required to capture the shape and margins of the custom cast post. This method requires little behavior change for the restorative clinician because it resembles conventional crown-and-bridge procedures. However, these methods may not be the most accurate to achieve the best fit for long-term success. Creating the custom cast post and the coping at the same time usually ensures proper marginal adaptation. But what does the patient then have intraorally to maintain function during the laboratory phase? Usually a round healing collar that does not conform tissue with correct tooth morphology.

Control and Precision

Implant dentistry affords what I have described as the "great advantage": the ability to remove the parts and pieces from the patient, and to prepare and examine the fit outside of the mouth under magnification. Simply stated, when we need to prepare a natural tooth to receive a conventional crown-type restoration we must do all of the preparation in the mouth, fighting off saliva, the tongue, patient movement, bleeding, discrepancies in soft tissue heights, difficulties in visibility, along with many other factors. Although certain implant manufacturers advocate intraoral preparation of titanium posts, it should be clear that abutments that are modified outside of the mouth are more accurate and definitive. There lies the "great advantage": the ability to control margin design, angulation, taper, and integrity of fit of transitional acrylic or definitive restorations outside of the mouth. In understanding this methodology, implant dentistry is far more exact and easier to accomplish than conventional crown and bridge dentistry on natural teeth. Would this be considered "dumbing-down?" It is my opinion that these are innovations that are advantageous to both clinician and patient.

The next level of precision and esthetics for the prosthetic phase was introduced several years ago in the form of computer milled abutments (CMA) and all-ceramic abutments. The move from stock abutments to custom cast abutments to computer milled abutments enabled clinicians to provide a more consistent end-product, while ceramic abutments offer highly esthetic outcomes. These prosthetic advances give clinicians a wider range of options to meet the demands of implant reconstruction. Perhaps the most compelling technology involves the computer milling of original and duplicate, or clone, abutments. From a fixture-level impression and a patented process, site-specific and tooth-specific abutments are fabricated using similar machines that create titanium implants through the same milling procedures. A CMA abutment is created using guidelines for correct tooth morphology. This is based on the desired restorative result using virtual design specification and virtual occlusion on the computer. The fabrication process is directed by prescription from the clinician in an automated process untouched by human hand. The ability to then process a second identical CMA abutment from the digital file enables the clinician to place one abutment in the mouth, whereas the second abutment serves as the die, or foundation, for the final ceramometal restoration. The clinician can now deliver to the patient a morphologically correct abutment with a processed temporary that allows for proper tissue healing rather than maturation around a round healing collar, while in the functional scheme of choice.

Accelerated Treatment Protocols

As tissue maturation occurs, the margins are evaluated to meet the esthetic demands of the case. If there is tissue recession, the margin of the original abutment can be easily and quickly modified, and sent to the laboratory for the definitive restoration. The duplicate abutment can then replace the original intraorally and, if necessary, the temporary restoration can be relined. One abutment stays in the mouth, and the clone goes to the laboratory. With proper presurgical and preprosthetic planning, the entire restorative procedure can often be completed with only a single fixture-level impression. Computer-milled abutments, although state of the art, do not add complexity to the procedure. In fact, it is simpler and more predictable than any other current methodology. In addition to benefits related to accuracy of fabrication, consistency of product, and precision fit (especially with multiple restorations), the chairtime savings can be remarkable. As the industry moves toward accelerating treatment protocols and immediate loading, the development of sophisticated technology may solve many issues for clinicians and patients. Is that "dumbing-down" or is it true advancement of the industry?

We are still developing new parameters that guide clinicians to place implants properly to support tooth positions, as evidenced by improved tools for diagnosis and treatment planning, continued anecdotal reports, and scientific research. If we accept the notion that the tooth is the final goal, then having implant procedures resemble traditional crown and bridge dentistry should be desirable. However, for the prosthetic phase to truly resemble crown-and-bridge dentistry, the implant(s) need to be ideally placed. Therefore, the greatest chance of success comes from first knowing what is missing, estab-

lishing the best plan to replace those missing structures (tooth, bone and soft tissue), and executing that plan. In a TEAM approach, total communication between surgeon and restorative dentist is essential to reach the common goal.

Unfullfilled Preprosthetic Planning

Diagnosis and treatment planning is perhaps the major overall weakness in fulfilling successful requirements for the surgeon, the restorative dentist, and the patient. Three-dimensional imaging techniques (tomography) can now be utilized to show cross-sectional images of the residual bone as a potential receptor site for implants. Yet, the information gleaned from these images is not nearly as useful or predictable without the superimposition of a radiopaque tooth shape to provide the ultimate guide. The restorative dentist should direct this phase of implant, from a proper diagnostic wax-up and understanding of the desired final occlusal scheme. Having this information can mean the difference between long-term success or eventual failure. State-of-the-art computed tomography (CT) scanning software allows for the creation of virtual three-dimensional models that clearly demonstrate the relation between the bone, the desired tooth position, and the placement of the implant. This information can then be translated into templates that guide the surgical placement of the implant based on the virtual plan. But, this advanced application's effectiveness is diminished greatly if the preprosthetic planning is not incorporated into a radiopaque template that indicates the final desired tooth position. Based on these proven scientific methods, a patient can have a complete diagnostic work-up, a CT scan, template fabrication, followed by the surgical procedure where the implants will be placed, prefabricated abutments attached, and an immediate set of processed teeth dropped into place. This restoratively driven sequence is the future of implant dentistry, and cannot in my opinion be described as a "dumbing-down" of the prosthetic phase of treatment.

Implant prosthetics has evolved through technological advancements that allow clinicians at every level of expertise to achieve success. Combined with improved methods of diagnosis and treatment planning, this success is now more widely available to most clinicians rather than to a select few. If the prosthetic phase becomes easier and yet more consistent, accurate, and predictable, who will ultimately benefit? Our patients.

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Richard A. Kraut says...

The surgical phase of endosteal-implant surgery can appropriately be divided into simple and complex surgery. The placement of an implant anterior to the mental foramina where ample bone exists is surgically less challenging than surgery that requires osseous augmentation, or one that requires nerve repositioning. In the maxilla, implants placed in the anterior esthetic zone in patients with a high lipline, are more surgically challenging than those placed in patients with low liplines with ample osseous volume for implant placement. A major advancement in implant surgery over the past 10 years is the ability to increase bone volume in the posterior maxilla via the use of allografts enhanced with growth factors from the patient's platelets. There are now a variety of techniques utilized for augmenting the posterior maxilla that take advantage of this relatively simple surgical procedure and provide the patient with more predictable, allograft-supported implants.

In the past 10 years, the surfaces of implants have improved, enabling the implants to achieve integration earlier; perhaps even more importantly, integration in less dense bone appears to have become more predictable. The future of bone augmentation will involve minor modification of the use of allograft and platelet-rich plasma, as well as the use of autogenous bone, in those cases in which either a cortical cancellous graft or a bone marrow graft is needed because of the severity of the atrophy present at the time the patient presents.

The future of surgery will be enhanced when bone morphogenic protein becomes available to implant surgeons. Because of marketing priorities, the drug company that has developed bone morphogenic protein has chosen to introduce it only into the spine surgery market. When bone morphogenic protein becomes available for implant dentistry, there will be considerable research necessary to determine the appropriate carrier for this protein to ensure that the protein will have ample time to stimulate bone growth and adequate volume will result to support the endosteal implant reconstruction that the patient is ultimately seeking.

Understanding and Differentiating

The most significant surgical advance in implant dentistry over the past 10 years has become the common acceptance of CT scanning as part of implant treatment planning. Through the use of CT scanning, one can clearly identify those cases that are going to be surgically and prosthetically challenging and differentiate them from those that are surgically routine and restoratively less challenging. It is this ability to understand the osseous and soft

tissue foundation on which the restoration will be built that has enabled us to differentiate those cases that are routine from those cases that are challenging. I function in a tertiary care center in which 85% of our patients who receive endosteal implants are classified as "surgically less challenging patients" compared with the 15% that truly are surgically and prosthodontically challenging.

As an oral and maxillofacial surgeon who is very interested in implant placement and reconstruction, I have followed the prosthodontic evolution of implant dentistry with great interest. Our industry partners have offered us a variety of new abutments that simplify implant restorations. They have continued to offer the full diversity of implant componentry that is necessary for the more challenging cases. However, they have recognized that there are many cases that can be restored quite simply with a minimum number of parts and screws, making implant dentistry comparable with conventional crown and bridge. This is a natural evolution in the implant dentistry arena and one that should be welcomed. The companies still provide the diversity of abutments needed to restore the most challenging cases; yet, those cases that can be more simply and successfully managed with fewer components should certainly be managed in that way.

Who is Treating What

Change in health care is inevitable. We have been fortunate that over the past 10 years, implant dentistry has become well established as part of American dental care. Implant dentistry is no different than any other form of dentistry. The well-trained generalist may take out numerous teeth, yet will refer the difficult impaction to an oral and maxillofacial surgeon. A similar situation should exist with regard to the surgery for placing implants. If a generalist feels that a patient has adequate bone and soft tissue, and he or she feels comfortable in placing an implant, I see no reason why the generalist should not go ahead and treat the patient. Those cases that the generalist believes to present more of a surgical challenge than he or she wishes to undertake can and should be referred to either an oral and maxillofacial surgeon or a periodontist who has greater experience in the surgical phases of implant dentistry, such as distraction osteogenesis or complex grafting. A similar situation exists with the restoration of implants. Well-trained generalists can restore many implants quite eloquently. However, there are cases that are extremely challenging to restore where the added training and expertise of a prosthodontist are truly critical to the long-term success of a case.

The American Dental Association has made it clear that in the United States, we are not going to see a specialty called "implant dentistry." The majority of American dentists are general dentists and serve the American public well. It is for the generalist to decide which cases are appropriate for referral. The current dental specialties are ready and able to meet the needs of those patients who need specialty care, be it the surgical or restorative phase of implant dentistry.

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