The Brown

PerioDontaLetter

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Winter

From Our Office to Yours...

The replacement of missing teeth with osseointegrated implants has proven to be a reliable, and in most situations, a preferable alternative to other fixed and removable prosthetic devices. In most clinical situations, it produces predictable and satisfactory treatment results. Abundant research shows that dental implants have exceptional long-term survival rates and a proven ability to maintain the integrity of the alveolar bone.

This current issue of The PerioDontaLetter reviews the many new technologies now available to overcome the major difficulties associated with implant placement to ensure their long-term success.

As always, we welcome your comments and suggestions regarding these matters and look forward to participating with you in implant treatment planning for your patients.

Dental Implants - New Horizons in Diagnosis and Treatment Planning

The major difficulties associated with dental implant placement are related to inadequate quantity and quality of available bone at the proposed implant site. Placement of implants in sites with inadequate bone may cause complications such as impingement on vital anatomic structures such as the mandibular canal and neurovascular bundle, and perforation of cortical plates by implant threads.

In an effort to overcome such anatomic problems, a short implant may be required and could be too short to sustain the occlusal loads to which the resulting prosthesis will be subjected. Normal bone, and especially bone of poor quality, placed under such levels of functional loading may result in microfractures of the crestal bone adjacent to the implant. This, in turn, can result in loss of osseointegration.

Figure 1. This patient wanted to replace two Maryland bridges which were replacing congenitally-missing lateral incisors.

Figure 2. The Maryland bridges were removed and minor tooth movement completed prior to surgery to permit implant placement.

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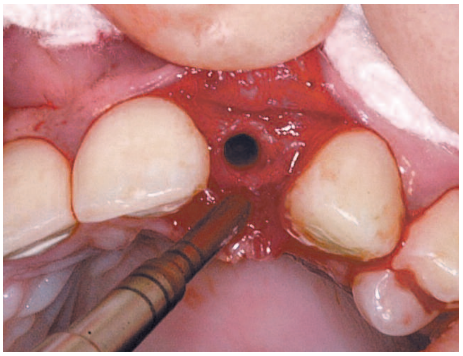

Figure 3. Osteotomes were utilized to widen the edentulous ridge, thereby creating enough buccal-lingual width for implant placement.

Figure 4. The ridge expansion allowed for ideal implant placement, which facilitated a pleasing cosmetic restoration.

Furthermore, when implants are placed in bone of poor quality, they often lack adequate initial stability. Micromovement of the implant of as little as 100 microns (.01mm) causes a fibrous rather than bony union, producing an increased incidence of short- or long-term implant failure.

Radiographic Techniques

To ensure implant success, thorough clinical examinations must be supported by radiographic techniques which permit an assessment of the length, height and width of bone, as well as degree of mineralization and density. Both Branemark and Misch have developed classifications of the bone available for dental implants which may be used to assist the clinician in case planning. Osseointegration may also be negatively affected by local and systemic conditions, such as osteoporosis, menopause, diabetes or smoking. Smoking represents the greatest challenge to the healing response around dental implants and bone-grafted sites.

With the advent and accessibility of more sophisticated radiographic techniques to evaluate the potential for successful implant placement, it is now incumbent upon the clinician to determine what level of radiographic evaluation is case appropriate. The optimum level and quality of radiographic information must be obtained while minimizing risk and expense to the patient. A variety of possibilities exist which will satisfy the individual and varied needs of each patient.

In some situations, a single, periapical film obtained using the long cone, paralleling technique, may be sufficient; for example, when immediate implant placement following extraction is anticipated and the site is well defined, bordered by adjacent teeth and without the presence of associated pathology. Ensuring implant success using single films is dependent upon radiographic evidence illustrating that the implant can be well positioned to fill the residual socket. The x-ray film must also provide information ensuring that the clinician can engage native bone beyond the former tooth apex, providing the implant with enhanced stability. Even when sufficient radiographic evidence is available, clinical bone sounding along with a knowledge of tooth root anatomy (size and shape) should be employed to support the radiographic findings.

A panoramic radiograph is more desirable than a periapical radiograph alone when the proposed implant length creates a risk of impinging on neurovascular sites, such as the mandibular canal, mental foramen and nasopalatine canal. Adjustments can be made for the inherent 25-30% distortion attributed to panoramic films by placing a radiopaque marker of known diameter in the area to be studied (Babbush, 1991). The measurements can then be extrapolated to produce useful data regarding length and height. It is axiomatic, however, that panoramic films cannot define the buccal-lingual (third dimension) width of the alveolus. Therefore, clinical bone sounding should also be undertaken.

Sites with multiple missing teeth are best x-rayed with radiopaque markers defining each of the projected placement sites. Such markers are incorporated into a stable template appliance (stent) precisely fabricated to fit the edentulous ridge and/or adjoining teeth (made from a diagnostic waxup). It is desirable to supplement panoramic radiographs with periapical films. In conjunction with bone sounding, this combination of radiographs can produce a good estimate of the three dimensions of the edentulous area.

CT Scanning

Computer assisted tomography (CT Scan) and complex motion tomography are two techniques which are recommended for more complex planning, for multiple sites, and to assess the true width of available bone as well as its length and height (Jacobs, 1998). Spiral CT (one of several available CT methods) produces extremely accurate radiographic data (accurate to within 0.5mm) with minimal radiation exposure. These scans permit three-dimensional visualization of multiple sites with a single scan of the individual arch to be treated. A newer technique, cone beam CT scanning, requires less radiation and is also well suited for dental implant treatment studies.

Films produced by the CT scanner can be viewed in all three planes of space. The most typical formatting of the CT data produces panoramic, axial, and cross-sectional oblique views. Utilizing one of several

Figure 5. A single tooth implant was desired to replace the upper first molar.

available software programs, the clinician can simulate the placement of implants on the computer screen.

Case planning software programs provide the clinician with the opportunity to "place" the implants in optimal positions, making certain that the sites chosen will provide sufficient surrounding bone for each implant and good positioning of the implants in relation to each other. One can easily alter the locations of the implants to provide proper functional positioning and, in addition, to measure the quality (density) of alveolar bone surrounding each implant fixture. Software programs for treatment planning are available for complex motion tomography and cone beam CT machines.

Using available CT data, in hard copy or on a computer monitor, the current programs can reformat the data into a three-dimensional image from which a stereolithographic model can be constructed. The model is machined with CADCAM technology into an accurate replica of the hard tissues of the jaw which will receive the implants.

Using the size and positional data of the implants from a CT study created on the computer, a surgical template can be fabricated which precisely fits the model of the patient's jaw. This surgical guide ensures precise implant placement in the exact positions and inclinations that were worked out during the planning process.

Multiple researchers have shown that these implant guides can be machined to accommodate the requisite drill sizes of most implant systems. The clinical application of this methodology allows the clinician to create implant osteotomies, with a rotational error of less than two degrees and a translation error of less than 0.3mm.

The availability of such precise drilling tolerances opens the door for flapless, less invasive surgery and permits the placement of implants directly through the soft tissues. This technique has been developed for completely edentulous (all bone supported) surgical guides, as well as tooth- and soft tissue-supported guides for partially dentate patients.

As the cost of computed tomography continues to decline and the availability of such sophisticated placement methods increases, the use of CT scans becomes much more advantageous when indicated. Recently there have been some reports in the literature regarding the future potential of Magnetic Resonance Imaging, which uses no ionizing radiation, for dental implant application.

We are excited about these new horizons in implant diagnosis and treatment planning as they continue to expand our ability to provide quality services. Along with currently available regenerative procedures and enhanced surgical tools, these new diagnostic techniques now make it possible for an implant surgeon to place implants precisely where they are needed in order to produce functionally and cosmetically excellent restorations with outstanding predictability.

These new technologies promise to deliver greater ease of implant placement, shorter treatment protocols, and less invasive surgery. We anticipate that these innovations will make implant therapy possible for increasing numbers of your patients. Dental implants have truly become the FIRST choice for the replacement of many missing teeth and the current Standard of Care from a medico-legal standpoint.

Examination Protocols

Single Tooth Implant
1. Clinical Examination
2. Periapical Radiograph
3. Bone Sounding
4. Panoramic Radiograph as Indicated
5. Occasionally, Tomograms and/or CT Scans

Multiple Tooth Implants, Partially Dentate
1. Clinical Examination
2. Periapical Radiograph
3. Panoramic Radiograph
4. Bone Sounding
5. Tomograms and/or CT Scans as Indicated
6. Articulated Models with Diagnostic Waxup

Edentulous Mandible or Maxilla with Intact Residual Ridge
1. Clinical Examination
2. Periapical Films as Indicated
3. Panoramic Radiograph
4. Bone Sounding
5. Tomograms and/or CT Scans
6. Articulated Models with Diagnostic Waxup
7. Stereolithographic Models with Implant Drill Guides

Highly Resorbed, Complex Sites; Multiple Implant Placements; Compromised Bone Quality, and Combinations of All Three
1. Clinical Examination
2. Periapical Films as Indicated
3. Panoramic Radiograph
4. Tomograms and/or CT Scans
5. Stereolithographic Models with Implant Drill Guides
6. Articulated Models with Diagnostic Waxup
7. MRI as Indicated

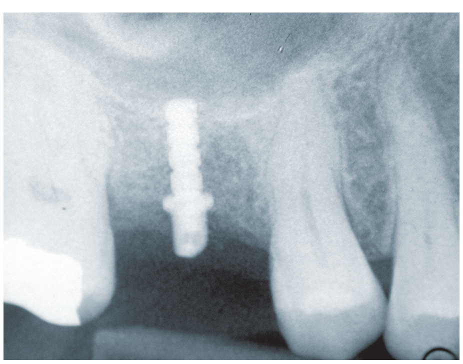

Figure 6. Radiographs revealed 4mm of alveolar bone below the floor of the sinus.

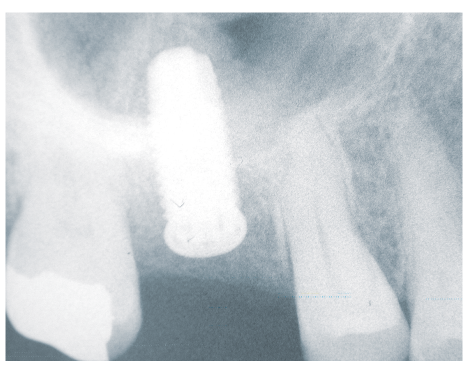

Figure 7. Osteotomes were utilized to tap up the floor of the sinus and a bone graft and implant were placed simultaneously.

Figure 8. Five months following implant placement, the final restoration was placed.

Success, Complications and Failure Rates of the Most Common Tooth Restorations

Dr. Jaime Lozada, a prosthodontist and Director of the Implant Department at Loma Linda Dental School, and his residents recently reviewed 50 years of literature on the success, complications and failure rates of the most routinely recommended tooth restorations.

His findings are paralleled in another excellent literature review on this topic by Goodacre published in the Journal of Prosthetic Dentistry in 1999.

Conventional Single Crowns (8 studies)
- The failure and complication rate in 1- 4 years was 16%.
- The failure and complication rate after 5 years dropped to 7% for a total failure rate of as high as 23%.

Three-Unit Fixed Bridge (15 studies)
- The failure rate at 10 years was 15%.
- After 15 years, the failure rate rose to 16% - 31% for a total failure rate of as high as 46%
- At 10 years, 5% of all abutment teeth had to be extracted.

All Ceramic Crowns (22 studies)
- The failure and complication rate at 1- 4 years was 5%.
- The failure and complication rate after 5 years rose 13% for a total failure rate of 18%.

Resin Bonded Prostheses (48 studies)
- The failure and complication rate at 1-4 years was 25%.
- The failure and complication rate after 5 years rose to 28% for a total failure rate of 53%.

Post and Cores (12 studies)
- The failure and complication rate at 1- 4 years was 14%.
- The failure and complication rate after 5 years dropped only to 13% for a total failure rate of 27%.

Endodontic Treatment: (3 studies)
- A study by Bennett published in the Journal of Endodontics, May, 2002 showed a 91% initial success rate for endodontic therapy delivered in a school environment, but only 84% long-term success rate in private practice.
- A presentation by Gulabivala to the Irish Dental Association provided a meta-analysis of 67 studies published in England, Ireland and the US, which showed that the failure rate of endodontic treatment averaged 16-22%.

Surgical Endodontics
- A study by Hepworth in the Journal of the Canadian Dental Association, 1997, showed a failure rate of 41%. However, the report further indicated that there was an uncertain healing rate of another 22%.

Based on such data defining an unexpectedly high level of complications and failures for many routine dental procedures, Dr. Lozada's clear message is that clinicians MUST critically evaluate the true long-term value of ANY TOOTH before suggesting a patient submit to multiple, conventional dental procedures.

In many clinical situations, Dr. Lozada believes that a well-planned, well-executed and well-restored dental implant offers patients a more predictable, more efficient and a longer lasting solution to tooth replacement. The average success rate of implants is more than 90 percent.

Prosthodontic treatment planning has changed, he says, because it is no longer appropriate to consider high-risk procedures when a more predictable alternative such as an implant is available. Higher risk endondontic or periodontal procedures to save teeth for prosthodontic abutments are of questionable value because of the predictable alternative of dental implants.

He acknowledges that implants placed in grafted bone are somewhat less predictable than those placed in edentulous sites where adequate healing has resulted in good quality bone; and, that implants placed in some maxillary anterior areas, in patients who were smokers, and very short implants were subjected to higher complication/failure rates when compared to implants in general. Notwithstanding these special situations, he says, implants still appear to be the restoration of first choice for a great majority of tooth replacements.

Dr. Lozada's final recommendation is: do not extract teeth (especially in the maxillary anterior region) before discussing possible implant-supported restorations with the surgical team member. Without anticipating the requisite regenerative procedures, the soft tissue shrinkage and bone resorption following extraction make highly esthetic and functional implant restorations substantially more difficult.

We periodontists have many non-surgical and surgical techniques to save teeth. We certainly acknowledge that healthy natural teeth are our best "implants." On the other hand, there has been a clear paradigm shift in our thinking regarding teeth which require multiple dental procedures.

The question of whether to "save the tooth" or "save the bone" must still be answered by each individual clinician. Considering the increased evidence of less than ideal long-term outcomes for many procedures, the dental implant has emerged as a particularly appealing alternative.

When faced with the decision-making process inherent in delivering optimum levels of dental care, we encourage you to call upon us to assist in the decision-making process BEFORE presenting comprehensive treatment plans to your patients, especially when multiple "tooth related" procedures are anticipated.

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