Pre-surgical Implant Site Assessment

Part I - Precise and Practical Radiographic Stent Construction for Cone Beam CT Imaging

Dale A. Miles* and Ronald K. Shelley**

Abstract

Implant placement is getting simpler, but precise, pre-surgical radiographic site evaluation is one of the major components ensuring success. This article outlines the need for the dentist to adopt radiographic imaging protocols to assess possible implant sites, and describes a simple methodology for constructing a radiographic stent to make this precision practical.

Introduction

The single biggest fear that dentists have when placing implants is erroneously placing a fixture in an anatomic space or encroaching upon the inferior alveolar nerve resulting in an implant failure and a symptomatic – and potentially litigious - patient. Spaces to be avoided include the nasal fossa (figure 1), the maxillary sinus (Figure 2), and the submandibular fossa (Figure 3). Avoiding the mandibular or inferior alveolar nerve speaks for itself. No one wants a patient with paraesthesia or anesthesia following implant placement. No one wants an implant to fail.

Conventional, two dimensional images like periapicals or panoramics do NOT adequately allow dentists to assess ridge width. In addition, with the potential for projection geometry error in both techniques, the assessment by periapical images or panoramics is, at best, little more than guesswork. Until now the most suitable radiographic technique for evaluating the pre-surgical implant site was tomography 1.

Furthermore, proper radiographic assessment allows dentists and dental specialists to determine more precisely where anatomic structures truly lie in relation to the proposed implant site and to visualize when and where pre-surgical implant site procedures such
as bone grafts and “sinus lifts” are required. And, if constructed properly, these radiographic stents can also be helpful in selecting the precise site for surgical stent construction and use.

**Figure 1a**

Cross-sectional view of mandibular implant site note the maxillary implant in close proximity to the nasal cavity.

**Figure 1b**

Color image of nasal cavity and maxillary sinus improving visualization of anatomy in potential implant site location.

**Figure 2**

*Implant inadvertently placed into maxillary sinus.*
Why do I need an “X-ray marker”? 

I have written about implant imaging before. Over 20 years ago, I tried to convince dentists and dental specialists that they should use the appropriate imaging modality for a specific implant procedure\(^2\). At that time the best modality was “corrected axis tomography”, supplemented by periapical and panoramic imaging. Those techniques have persisted to date and served dentists well. Medical CT using dental specific software became the most exotic radiographic technique with data being translated into useable information and place implant fixtures more precisely. Today that technique is “outdated”. Cone Beam CT imaging is more affordable, more realistic and more convenient than conventional medical CT.

Successful implant surgery is not just about reducing your risk, but risk is something that can be virtually eliminated by proper planning, proper patient assessment and
proper x-ray information. The most precise imaging modality available to dentists today is Cone Beam CT (Cone Beam Computed Tomography). The technique is cost effective, widely available and extremely precise. It will, I predict, become the “standard of care” for pre-surgical, radiographic implant assessment. When used with a radiopaque marker, the assessment becomes almost “fool proof”.

Using a radiographic marker and Cone Beam CT makes the most sense, and is the best technology currently available.

An x-ray site marker allows the radiologist to pinpoint exactly where the ROI (region of interest) lies for the potential implant fixture. The marker material should be easily identifiable in the CT scan and not produce scatter artifact such as that seen in CT scans from metallic dental materials (Figure 4).

Figure 4

Scatter artifact in “star” pattern from several metallic restorations and surgical screws.

Gutta percha is an ideal material. It is non-metal, radiopaque, readily available in almost all dental offices and inexpensive. Figure 5 shows a typical image of a proposed implant site identified in the Cone Beam CT using the radiographic stent construction technique outlined below.
How do I make a simple, useful “X-ray marker”?

The following section is a simple, step-by-step illustrated technique description for radiographic stent construction. The technique uses a Ney (Dentsply, formerly Degussa) articulator and readily available and inexpensive materials.

**Step 1**  
Locate ideal implant fixture location on your stone model using a felt tip marker.

**Step 2**  
Determine the ideal implant angulation and lock the model’s position.

**Step 3**  
Mark reference lines on the model for future re-alignment of model on the surveyor.

**Step 4**  
Verify the alignment
**Step 5**
Block out all undercuts with wax.

**Step 6**
Lubricate the model.

**Step 7**
Using a coffee stir stick, trim away one of the two tubes leaving some “flash” to prevent rotation of the tube.

**Step 8**
Place the tube into the surveyor at the ideal implant location and angulation.
**Step 9**
Our radiographic stent is made from a sheet of Triad tray material (Dentsply).

**Step 10**
The resin material is formed over the teeth and ridge and around the plastic tube. The material is then light cured.

**Step 11**
The stent is trimmed after curing and its fit verified on the model.

**Step 12**
Size 70 gutta percha points are placed into each tube.
**Step 13**
A heated instrument is used to sear off any excess gutta percha and lock the materials into place.

**Step 14**
The stent is now ready for placement into the patient’s mouth at the time of Cone Beam CT image acquisition.
Conclusions
Dentists are quick to realize the incredible benefits to 3D visualization of proposed implant sites. Cone Beam CT has now become quite commonplace, and appears to have significant advantages over conventional plain film techniques and even medical CT. We have discussed these advantages and offered a simple, in-office technique for the construction of a radiographic stent. With this article, and the data available by imaging centers offering Cone Beam 2d/3D images, dentists should simplify their pre-surgical radiographic evaluation and feel more confident of their assessment when planning their implant cases.

In the next article, we will present information on the use of surgical guides for performing the surgical portion of the implant procedure quicker and more precisely.
References


* Dr. Miles is the former Associate Dean for Clinical Affairs of the Arizona School of Dentistry & Oral Health. Currently he is Director of Radiology for ClearSCAN Imaging Centers, Phoenix, AZ (www.clear-scan.com)

** Dr. Ronald Shelley is a general dentist in full-time practice in Glendale, AZ