Quality Resource Guide

Implant Placement by the General Dentist

Author Acknowledgements

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Educational Objectives

Following this unit of instruction, the practitioner should be able to:

1. Describe the relative and absolute contraindications to implant placement.
2. Describe the risks of this surgical procedure as well as the anticipated success rate.
3. List the most common reasons for osseointegration failures.
4. Describe several preoperative steps dentists should take to maximize their chances of a positive outcome.
5. Understand contemporary trends in implant treatment planning, including the use of three-dimensional imaging, digital workflows and 3-D printed surgical guides.

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Introduction

Root form titanium dental implants first came into vogue in this country during the 1980's. Initially they were placed almost exclusively in the edentulous mandible. Currently, implants are used to restore anything from a single missing tooth to complex maxillofacial reconstructions where patients lost teeth and bone from trauma or tumor resections. Patients are now also offered an extraction/implant placement option as an alternative to saving compromised teeth needing endodontics, root resections, crown lengthening, or extensive post-core buildups. The success of extraction/ implants versus endodontics/ crowns appears to be similar.[1,2]

There are two steps to completing implant restorations; surgical implant placement, and following an osseointegration phase, prostheses construction. Either a periodontist or an oral and maxillofacial surgeon traditionally performed the surgical phase, with the prosthetic phase completed by the general dentist or prosthodontist. Increasingly, general dentists are performing both phases, a convenience for many patients. Whether or not a dentist places or restores implants, they must be able to understand and explain to their patients the risks and benefits of using implants to replace missing teeth. This document will review current protocols for the surgical phase of implant dentistry with the general dentist in mind.

Like any other procedure in dentistry, one must acquire both didactic and clinical skills in order to achieve competency in implant placement. Towards that goal, many universities and implant manufacturers offer classroom and hands on courses, placing implants in xenogenic or alloplastic bone.

Contraindications: relative and absolute

Clinicians must know the medical conditions that increase the risk of complications during or after implant placement.

Patients with coagulopathies, typically from medicines, must be identified and appropriately managed. Those on Coumadin® (warfarin sodium) will usually have a current INR. Working with the patient's physician, the dentist may opt to have the patient temporarily discontinue the anticoagulant, especially if the current INR is above 2.5-3.0. An INR below 2.5-3.0 typically does not cause any problems relative to implant surgery.[3] Coumadin is being replaced with newer direct acting oral anticoagulants like Pradaxa® (dabigatran), Xarelto® (rivaroxaban) or Eliquis® (apixaban). Compared to Coumadin, they are shorter acting (~ 24 hours), have less drug interactions, and do not require INR testing. The few studies published to date suggest minor oral surgery, including the placement of implants, can be accomplished without discontinuing these agents.[4]

Post-operative infection is another complication that may be preventable. Patients with decreased infection-fighting abilities, such as those with poorly controlled diabetes or immunosuppression (drug-induced or systemic) possess relative contraindications to implant placement. Pre-operative prophylactic antibiotics for the healthy patient is controversial,[5] but they should be used for a patient with compromised immune function. Although no definitive guidelines exist for implants, other surgical literature suggests infections are reduced if blood sugar at the time of the surgery is 180 mg/dl or less.

Smoking is an area of some debate relative to its impact on implant healing and success. With the many recent advances in implant systems, most authorities currently feel that smoking is not an absolute contraindication for implants; however, it is a relative contraindication, especially in the maxilla, and makes patients more susceptible to post-integration peri-implantitis.[6,7]

Bisphosphonates and implant placement is a topic of considerable research and importance. Patients receiving antineoplastic doses of intravenous bisphosphonates (for metastatic cancer or multiple myeloma) should not be treated with implants as the incidence of failure and osteonecrosis is quite high. Patients on oral bisphosphonates are implant candidates, and in fact, thousands of implants were successfully placed in these patients before the profession became aware of a possible problem.[8,9] However, implant therapy is an elective procedure and the prudent dentist should take all steps prior to surgery to minimize complications. A contemporary strategy for patients who have taken oral bisphosphonates for more than three years is to, following consultation with the patient's physician; have the patient stop taking their medication for approximately four to six months prior to implant insertion. The bisphosphonate treatment can be resumed several months following the procedure. There seems to be little deleterious effects from this "drug holiday" relative to the patient's osteopenia or osteoporosis. Newer drugs like Prolia®, and Xgeva® (denosumab), are designed to improve bone density, and are often called "antiresorptive" agents. They may predispose the patient to osteonecrosis and implant failure just like intravenous bisphosphonates, warranting a discussion with the prescribing physician about stopping these drugs in the peri-operative period.[10] Newer antiangiogenic drugs, often used to combat cancer, may also increase the risk of osteonecrosis following implants.[11] Dentists considering placing implants should stay current on all drugs that alter bone metabolism.

Placing implants during pregnancy is a relative contraindication, and extreme caution should be used when placing implants in patients who have received tumorcidal (5000-6000 RADS) levels of radiation to the operative field. Although implants have succeeded in irradiated jaws, there is a risk of serious complications (osteoradionecrosis, mandible fracture). Referral of such patients to practitioners with specialized skills is logical. Implants should not be placed in young growing patients. Serial cephalometric x-rays, taken 9-12 months apart and then superimposed, are a simple way to check on growth.

Complications

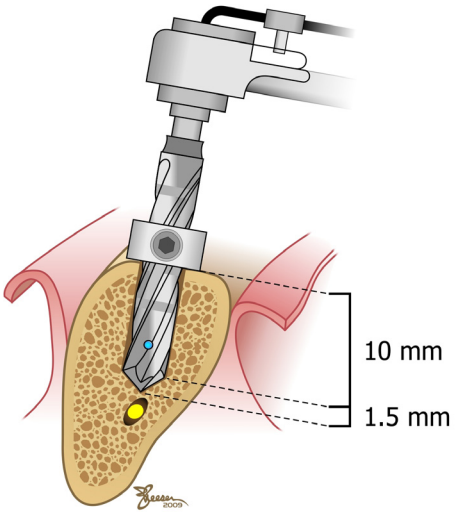
Complications can occur during or after implant placement even in the healthy ASA Class I patient. Analogous to surgical extractions, the risks of implant placement typically includes bleeding, infection, possible damage to adjacent teeth and sometimes, the necessity to perform additional surgical procedures such as bone and/or soft tissue grafting.

Several complications bear specific mention. Implants placed in the posterior mandible must not violate the inferior alveolar nerve. Unfortunately, temporary or permanent damage to the nerve is a relatively common complication for the inexperienced surgeon. Careful pre and intraoperative radiographic assessment and the placement of stops (**Figure 1**) on the surgical drills are good preventative strategies. Another complication, unique to implant surgery, is perforation of the floor of the nose, maxillary sinus, or one of the cortical plates with the drill or implant. Perforation of the lingual cortical plate in the mandibular canine region has produced life-threatening complications, as a rapidly forming, airway-compromising hematoma. This is thought to be from damage to terminal branch of the lingual artery.[12,13] The use of surgical guide splints, discussed further below, is an excellent way to help with drill and implant alignment.

Because of these and other complications, clinicians placing implants should use a specific consent form for the implant procedure. Other risks, ideally specified in the consent, describe what happens if the implant fails to integrate. Does the surgeon replace it at no additional cost? What happens if a bone graft is required following the first failure? Would this, too, be a waived expense?

The goal of implant placement is achieving osseointegration between the implant and the patient's bone. Osseointegration is defined as a direct structural and functional connection between the load-bearing implant and the patient's bone. The ability to achieve osseointegration is dependent on several factors, such as the dental implant material itself (roughened titanium with contemporary systems), the healing capacity of the patient, and perhaps most importantly, the skill of the operator. The operator must prepare a precise osteotomy in the bone in an atraumatic fashion, two prerequisites for successful osseointegration. Too big a gap between the implant and the osteotomy site (caused by imprecise or wobbly drilling) will yield collagenous scar-like tissue formation, leading to subsequent failure. A precise osteotomy site that was unfortunately created with too much

Figure 1



Osteotomy being created in posterior mandible. Blue circle indicates exit port for internal irrigation (note tubing on top of drill). Also note depth limiting "stop" set at 10 mm reference line. The tip of drill, 1.5 mm on this illustration, is not accounted for on most drill's indicator lines.

heat can also yield granulation tissue to form between the implant and bone, again leading to failure. Understanding these two surgical factors, coupled with improved implant materials and designs, have led to today's integration success rates of 95-99%.

The time necessary for osseointegration to occur continues to shorten, as surgical and restorative techniques are refined. Historically, clinicians waited six months in the maxilla and three months in the mandible before restoring and loading the implants. Today, some clinicians are "immediately loading" the implants by placing provisional restorations the day of surgery. While this often works on compliant patients who keep excellent hygiene and do not function on the provisional, caution is warranted. Waiting at least three months before beginning final prosthesis construction, especially in esthetically or functionally demanding cases is prudent.

An implant that successfully integrates may still fail months to years after it has been restored. These "late failures" may be due to either occlusal overload or peri-implantitis, a process analogous to periodontal breakdown around natural teeth. Peri-implantitis is now estimated to compromise 15-20% of all implants placed, and is thought to be caused by poor hygiene, smoking, extruded cement, or even reaction to titanium particles caused by implant/abutment wear. There is an incredible amount of research now devoted to the prevention and treatment of this disease, interestingly almost unheard at the turn of the century.[14] Placing an adequate number of appropriately sized implants, controlling occlusal function, good home care, and re-evaluating the patient at six-month intervals minimizes these complications.

Many experts feel that the most important factor at preventing peri-implantitis is to have adequate quantity of bone, about 2 mm, encasing the implant. This often mandates bone grafting (site development), either before or during implant placement. Caution should be taken regarding the grafting material used, as some patient have ethical or religious issues with allogenic (from other people) or xenogenic (from other species) bone.[15]

Benefits

The advantages of an implant retained or supported prosthesis versus a conventional removable prostheses include bone preservation (implants under function preserve bone, analogous to teeth), improved retention, and superior comfort and function. These benefits are so great, especially in the edentulous mandible, that some feel that not offering implants as a treatment option breaches the standard of care.

Advantages of implants versus fixed partial dentures include enamel/dentin preservation, (no tooth preparation), the ability to floss through the contact region, and possibly improved esthetics. Decay under bridge abutments can also be a common problem, making implants the better option in the caries prone patient. Patients often ask, "what would look better, a bridge or an implant?" An ideally performed implant yields superior esthetics, but the range or "esthetic

standard deviation" is much greater with implants. There are multiple well-documented esthetic nightmares from poorly placed implants in anterior maxilla. Logic dictates not to challenge esthetically demanding cases early on in one's learning curve.[16,17]

Treatment Planning

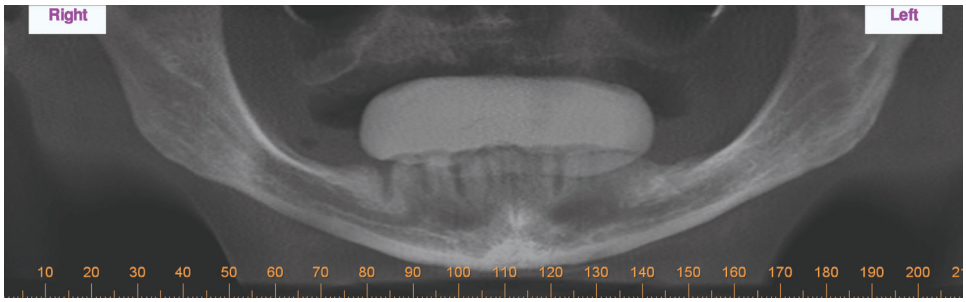
If a patient is missing one tooth, the number of implants necessary to replace it is obvious. The number of implants necessary to replace a quadrant of teeth or a fully edentulous arch is less clear and is contingent upon the size of the implants to be used, whether the patient wants a fixed or removable prosthesis, and finally the forces the implants will be asked to bear. Implants splinted together by a prosthesis or bar typically have a better survival rate than if restored by individual crowns.[18] Four implant fixtures, of proper width and length, splinted together may be all that is needed in a completely edentulous arch.[19,20] However, even six splinted implants can fail when they are opposed by natural teeth in a patient that bruxes. Each patient should be carefully examined and appropriately treatment planned for the correct number of implants and design of the final prosthesis.

Prior to implant placement, the surgeon must determine whether the patient has satisfactory bone volume and position. In general, there should ideally be 1-2 millimeters of bone around the implant, and the implant must be at least 7 to 8 mm long. It is recommended to stay 1.5 mm away from adjacent teeth and have at least 3 mm of bone between adjacent implants. Finally, the implant should be away from the inferior alveolar nerve by at least 2 mm, noting that the tip of the implant burs are typically not factored in on the indicator lengths of the drills themselves (**Figure 1**).

Most long-term studies have been performed on implants at least 3.5 mm in diameter[21] making the minimal acceptable bone width 5.5 mm. However, data supporting the use of 3.0 mm diameter implants, when used to replace maxillary lateral or mandibular incisors, is encouraging.[22] It is generally preferable to use the longest, widest implant possible as long as important structures such as adjacent teeth and nerves are not violated. When inadequate bone exists, grafting may be considered, the details of which are beyond the scope of this article. There has been some early promising results using "mini" dental implants, those 1.8-2.9 mm in diameter, especially for removable prosthesis in the edentulous mandible. Little long-term data exists for using these implants for totally fixed restorative options, thus, they are not recommended for that situation.

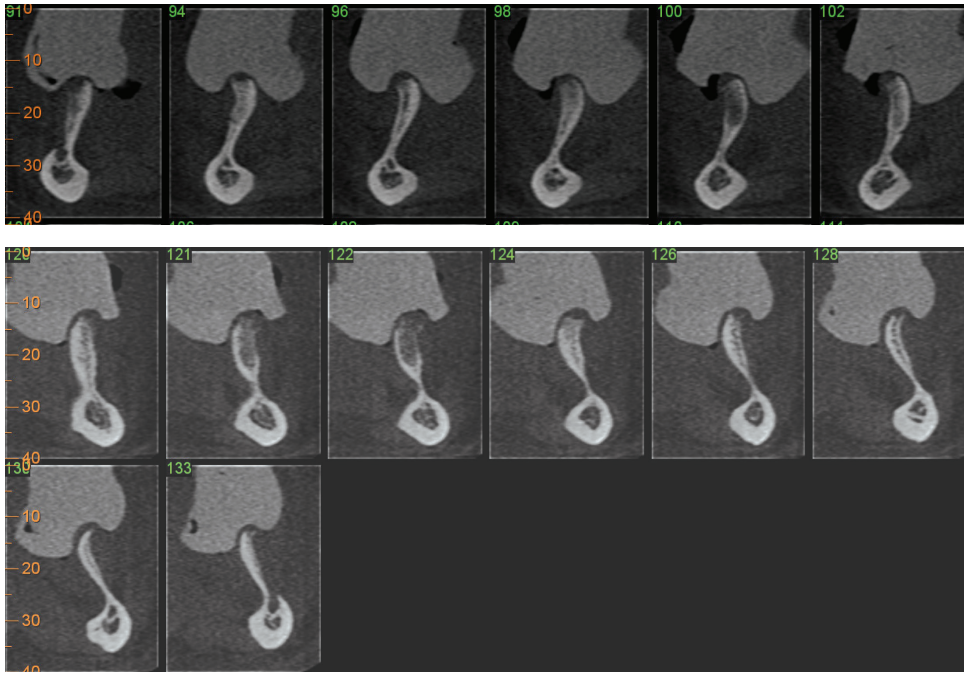
Classically, bone height has been assessed using periapical or panoramic radiographs, realizing that most panoramic films magnify length by 20-25%. Buccal-lingual width was estimated by physical exam, models, or occasionally measuring an anesthetized patient's ridge with bone calipers. Since the early 2000s, dentists have had access to cone beam computerized tomography (CBCT) scanners, devices that can give accurate bone volume assessment in 3 dimensions. The additional cost of and radiation exposure from this technology is warranted in cases where traditional methods of bone assessment are equivocal (**Figures 2, 3, 4**). Using the CBCT images, software programs can

Figure 2



Panoramic view of edentulous mandible revealing good bone height.

Figures 3 & 4



Severe buccal/lingual atrophy revealed on Cone Beam CT scan. Placing implants would be impossible in these regions.

be used to plan implant position, and generate custom surgical guides. This digital treatment planning requires inputting data from intra-oral scanners, (an optical impression) and merging the files. The resultant surgical guides can precisely dictate the depth and direction of the osteotomy site. (**Figure 8, 9**) 3D printers are now being used to fabricate guides in the dental office. (**Figure 10**)

Many offices have now gone to an entirely digital workflow, making traditional impressions, plaster casts, and hand fabricated surgical guides and even cast crowns techniques from the past.

Surgical Technique

Following an antiseptic mouth rinse, access to the surgical site is typically done by making crestal incisions, bisecting the zone of keratinized gingiva. Ideally, the implant abutment exits the bone through a region completely surrounded by keratinized tissue. If the surgeon is planning to place a healing abutment or temporary prosthesis the day of surgery, and if a broad area of keratinized gingiva exists, tissues punches may be considered as an alternative to a full flap. However, this "flapless" technique limits visualization, making the punch method best suited for more experienced operators.

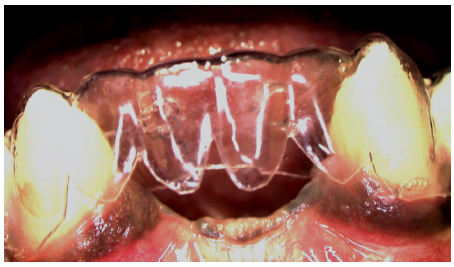
Most surgical protocols (all slightly different depending on the manufacturer) recommend marking the site of the implant with a small round bur and then preparing the osteotomy with implant burs of increasing diameter. It cannot be overstressed that all preparation of implant sites in the bone must be done under copious irrigation to prevent overheating. The use of burs that irrigate internally (through the bur itself) make cooling much easier and more predictable (**Figure 1**). Although dense cortical bone is preferable to the soft cancellous type for improved initial implant stability, it is easy to overheat, much like drilling in hard dense oak versus a softer pine. Implant burs, like any other dental drills, become dull with increased use, contributing to heat buildup. Burs should be discarded at the first sign of decreased cutting efficiency, with some companies advising one time use. The RPMs used during drilling and implant insertion is another variable that is carefully prescribed by the implant manufacturer.

A useful technique during osteotomy preparation is taking intraoperative radiographs, leaving the drill in place. The angle relative to adjacent teeth as well as the distance from important structures can be visualized and possibly corrected prior to implant insertion. Following the completion of the recommended bur sequence, it is often helpful to measure the depth one last time before fixture insertion. This is especially important for implants in an esthetic region where depth of insertion is critical. The platform of the implant is ideally placed 2-3 mm apical to the CEJ of the tooth/teeth the implant is designed to support. Having a guide splint fabricated with the ideal position of the prosthetic teeth aids tremendously in visualizing this. It often becomes obvious that some type of bone graft is needed prior to implant placement; otherwise compromises such as poor crown/implant ratios or suboptimal esthetics will result (**Figures 5, 6, 7**). Surgical guides may also be fabricated with sleeves that mandate the exact angle of the twist drills (**Figure 8, 9**). The accuracy of these guides are generally very good if they are supported by adjacent teeth. However, those that rest on mucosa or bone often shift or slip during surgery, and as a result, the position of the implant may be different compared to the computer-aided plan.[23]

Figure 5

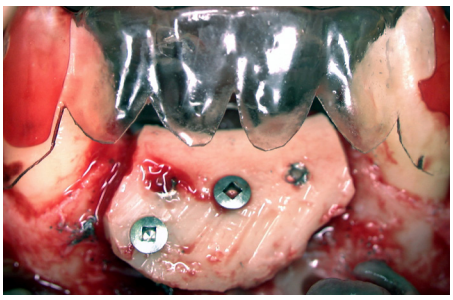
Wax up of prosthesis shows ideal tooth position.

Figure 6



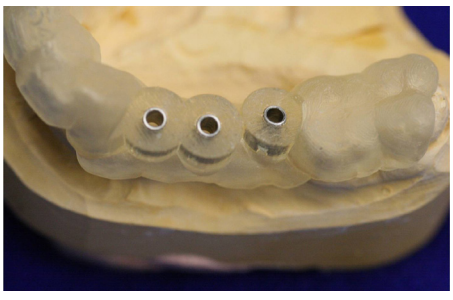
Vacuum-created splint was created from a wax up. Hard and soft tissue deficiencies are obvious when splint is in position.

Figure 7



Block bone graft is placed in region of deficiency.

Figure 8



Surgical guide splint (with sleeves) in place.

Figure 9

Surgical guide in use.

Post-Op Management

The post-operative instructions given and the pain management used following placement of implants are similar to any surgical procedure. Depending on the amount surgery involved, prescription strength analgesics may be appropriate. Nonsteroidal anti-inflammatory drugs, albeit excellent for pain control, may delay osseous healing around implants.[24] Some surgeons therefore advise avoiding this class of drugs for several weeks following surgery, especially on challenging cases like the posterior maxilla in elderly patients.

Conclusion

Many advantages exist for the general dentist who is capable of placing and restoring implants for his/her patients. One of the biggest is the ability to have control over all aspects of planning, care and follow-up while maximizing convenience for the patient. Dentists considering placing their own implants are encouraged to take high quality hands-on training courses, and to stay current in this rapidly evolving field.

Figure 10

Intraoral scanner, 3D printer, and image from planning software

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POST-TEST

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(1.0 CE Credit Contact Hour) Please circle the correct answer. 70% equals passing grade.

1. **All of the following are common reasons for implants failing to integrate except one. Name the exception:**
   a. bone overheating during osteotomy creation
   b. titanium allergy
   c. imprecise osteotomy creation
   d. compromised bone healing secondary to radiation therapy or intravenous bisphosphonate use

2. **A patient has religious/ethical objections to receiving products derived from other humans. Which bone grafting product should be avoided?**
   a. xenografts
   b. autografts
   c. allografts
   d. alloplasts

3. **An absolute contraindication to implant placement is:**
   a. pregnancy
   b. radiation therapy to operative field
   c. Coumadin use
   d. antineoplastic doses of IV bisphosphonates

4. **All of the following statements relative to implant guide splints are true except one. Name the exception:**
   a. they help to determine the need for bone or soft tissue grafting.
   b. they help to dictate drill angulation and position.
   c. they improve visibility by retracting and retaining the soft tissue flap.
   d. they aid in visualizing how deep to place the implant platform.

5. **Common ways to decrease heat build-up during osteotomy creation include all except one. Name the exception:**
   a. using internally irrigated burs.
   b. using diamond coated drills under maximum RPMs.
   c. using extra time and caution while drilling in dense cortical bone.
   d. utilizing only new or sharp burs.

6. **The best indication for obtaining a cone beam CT scan is to measure the:**
   a. precise mesial/distal space between teeth.
   b. exact height from ridge crest to maxillary sinus.
   c. burr angulation during osteotomy creation.
   d. buccal lingual width of available bone.

7. **Which statement is true?**
   a. prophylactic antibiotics should be used during all implant surgery.
   b. most experienced clinicians obtain the patient's verbal (not written) consent before initiating implant surgery.
   c. surgical grade stainless steel is the implant material of choice.
   d. use of a preoperative antiseptic rinse is advisable prior to the surgical procedure.

8. **Which statement is false?**
   a. Implants can usually be performed on patients with INR levels 2.5 or below without complications.
   b. The platform of the implant is ideally placed at the height of the CEJ of the tooth to be restored.
   c. Using a tissue punch to gain surgical access is less traumatic than a flap but often decreases visibility.
   d. Implants under function help retain alveolar bone analogous to natural teeth.

9. **Which drug is most likely to increase the risk of osteonecrosis following implant placement?**
   a. Dabigatran
   b. Rivaroxabran
   c. Denosumab
   d. Teriparatide

10. **Peri-implantitis is potentially caused by all of the following except?**
    a. extruded cement in the sulcus
    b. occlusal overload
    c. implant placement without CBCT guidance
    d. titanium particles secondary to wear and corrosion

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8. The level to which your personal objectives were satisfied.	☐	☐	☐	☐	☐	
9. Please rate the administrative arrangements for this course.	☐	☐	☐	☐	☐	

10. How likely are you to recommend MetLife's CE program to a friend or colleague? (please circle one number below:)

10	9	8	7	6	5	4	3	2	1	0
extremely likely					neutral					not likely at all

What is the primary reason for your 0-10 recommendation rating above?

11. Please identify future topics that you would like to see:

Thank you for your time and feedback.

MetLife

To complete the program traditionally, please mail your post test and registration/evaluation form to:
MetLife Dental Quality Initiatives Program | 501 US Highway 22 | Bridgewater, NJ 08807