

2010 Guidelines of the Academy of Osseointegration for the Provision of Dental Implants and Associated Patient Care

In 2008 the Academy of Osseointegration (AO) published its first document to provide guidelines for the provision of dental implants.¹ The purpose of this document was to establish guidance based on the provision of patient care and the results of AO's 2006 Consensus Conference on the State of the Science on Implant Dentistry.² The current document is aimed at providing an update and expansion to these guidelines that should be of value to both specialist and general dentist alike.

Implant dentistry has become a recognized method for tooth replacement that should now be considered a standard of care in particular when related to the treatment of the atrophic mandible, according to the ADA Council on Scientific Affairs,³ and the McGill Consensus statement.⁴ As such dental implants should be presented to patients as an alternative to replacing missing teeth, since the Council recognizes that evidence-based care requires the judicious use of current best evidence. It is nonetheless recognized that much of the current evidence base lacks consensus² and, to this end, implant dentistry is often practiced on the basis of best anecdotal evidence, which may or may not be supported by lower echelon studies and/or case reports. As such, there is a responsibility for individual clinicians to avail themselves of the parameters for patient care for the safe and effective provision of dental implants and to continue to avail themselves of ongoing documentation. This paper is intended to provide the AO's position on these parameters while recognizing that the reader should also consider recommendations set out in comparable documents offered by other specialist bodies and organizations.^{3,5-8}

When considering placing dental implants, the practitioner has a legal and ethical responsibility to choose a medical device which has a sufficient outcome assessment based on published data and, to this end, the Food and Drug Administration (FDA),⁹ the American Dental Association (ADA),^{3,10} and the European Union's Medical Devices Directive (EUMDD)¹¹ have all provided established guidelines for safety and efficacy in the use and application of dental implants. On March 21, 2010, the EUMDD 2007/47/EC amended previous versions requiring manufacturers to fulfill more stringent "essential requirements which implantable medical devices must satisfy in order to be lawfully placed on the market" and recently the FDA established a new accreditation to identify dental devices that are proven to maintain marginal bone levels at significantly improved levels than previously recognized by the Albrektsson et al criteria of 1986.¹²

In addition to outlining parameters for patient care, dental professionals may find answers to critical questions regarding their approach to implant therapy in the following guidelines, which have been developed by the AO.

TRAINING

Whether a specialist or general dentist, the AO is determined to underline the importance of adequate training in the surgical and/or prosthodontic aspects of implant dentistry. Training pathways now exist through monospecialty training programs, as well as a wide variety of courses offered through institutions both in the United States and abroad, as well as by private individuals and companies. Training guidelines have been proposed by some individuals for basic implant surgery,¹³ in order that dentists can make fully informed decisions regarding their course of study, as well as how they might incorporate implant surgery into their existing practices. Furthermore, the document aims to help dentists determine if the courses they might be considering meet the legal standard of care.

The following headings are covered in this document and the reader is directed to this publication if they require further information:

1. Understanding Implant Dentistry
2. Patient Selection, Patient Education, Documentation, and Risk Management
3. Diagnosis, Treatment Planning, Radiographic Techniques, and Presurgical Work-up
4. Fundamental Surgical Procedures, Anesthesia, and Sterile Protocols
5. Surgical Procedures for Basic Cases
6. Complications, Long-term Management, and Analysis
7. Overview of Advanced and Complex Surgical Procedures and Prosthetic Treatment Options
8. Postinstruction Written Evaluation, Ethical Considerations, and Recommendations for Additional Training

LEGAL STANDARD

The law holds that any practitioner (generalist or specialist) undertaking any surgical and/or prosthodontic procedure, particularly one deemed to be of a complex nature, should do so to the same standard of care expected of a specialist or, in the case of a specialist, to a standard equal to a reasonable body of his/her peers. In particular, the ability of a practitioner to predict, recognize, and treat complications arising from treatment is of paramount importance.

Patients in need of tooth replacement MUST be informed about the potential benefits of dental implants in light of alternative options, the long-term survival, risks, and potential complications. In addition, they should be informed about the importance of maintenance and long-term follow-up, including their specific responsibilities regarding these matters. Once again, practitioners are directed to the evidence-based research available that dental professionals may utilize to inform their patients.

THERAPEUTIC GOAL

The therapeutic goal of implant dentistry is to deliver a replacement for a missing tooth or teeth, providing a functional restoration that both the patient and observer perceive to be in harmony with the natural dentition. To this end, it is clear that implant dentistry should be a restoratively driven therapy whereby the therapeutic goal determines the treatment plan and subsequent surgical placement of dental implants.

Furthermore, to assist in the ongoing maintenance of the remaining intraoral and perioral structures and tissues remains part of the therapeutic goal.

PRETREATMENT CONSIDERATIONS

The pretreatment prerequisite is always to establish accurate diagnoses upon which a practitioner can formulate and recommend appropriate treatment. It is necessary to emphasize that the need for a dental implant is a prosthodontic diagnosis and the prescription of a dental implant is part of a restorative treatment plan.

This will involve a number of stages which can be distilled into the following headings:

- Appropriate medical and dental history
- Thorough intra- and extraoral examination
- Appropriate radiographic examination and any other relevant investigations
- Provision of a comprehensive report, treatment plan (including schedule), and estimate of treatment cost

Patients must be evaluated by a dentist prior to the initiation of treatment to ensure the appropriateness of care. When dental implants are considered, it may be advantageous to involve one or more dental specialists in the evaluation process. A systematic and coordinated plan delineating the responsibilities of each member of the team should be developed and followed.

In establishing an examination to test core competence and knowledge in the field of implant dentistry, the Royal College of Surgeons of Edinburgh (RCS, Ed)⁸ developed a list of learning outcomes that should help to guide the clinician through the key elements necessary to complete an appropriate clinical assessment.

An evaluation of implant patients should include the following:

- Elicit and record a comprehensive medical and dental history and understand the relevance of that information to the individual case
- Complete a thorough extraoral and intraoral examination, including detailed assessment of the teeth, restorations, periodontal tissues, oral mucosa, residual alveolar ridges, and esthetic requirements
- Assess the occlusion and its relevance in relation to the proposed treatment
- Identify the need for appropriate further evaluations, be able to request and interpret them, and record or write a report of the findings

- Collate and interpret the information gathered in the history and examination process and arrive at the correct diagnosis
- Arrive at a prognosis for the remaining dentition and oral structures
- Communicate clearly to the patient, verbally and/or in writing, the findings of the examination, the diagnosis, and the treatment options
- Be aware of the evidence base relating to the patient's alternative options, including dental implants
- Produce a treatment plan considering options for tooth replacement and the patient's preventive, functional, esthetic, psychological, and financial requirements
- Understand the interface between implant dentistry and other clinical disciplines
- Understand the difference between fixed and removable prostheses and be able to evaluate these treatment options
- Understand the current evidence relating to the different types of implant placement techniques
- Understand the relationship between proposed implant sites and adjacent vital structures such as roots, nerves, arteries, sinus cavities, etc
- Understand the need for hard and/or soft tissue grafting where appropriate
- Consider and recommend the timing of implant placement and restoration
- Obtain the patient's informed consent for the proposed treatment
- Provide or refer the patient for appropriate allied treatment and reevaluate prior to implant therapy
- Recognize complex cases and assure that all members of the team (including you) have adequate education, training, experience, and proven ability with respect to the contemplated treatment, and refer patient to the appropriate specialists, when indicated, in service of the patient's best interests

The last item on the list is a cause for some concern since practitioners will have different attitudes on how to gauge the limitations of their own skills and those of their team and, hence, when to refer. As such there is a need to recognize where the boundary lies between a straightforward and a complex implant case. This has been the subject of consideration by both the Academy of General Dentistry (AGD)¹⁴ and the Faculty of General Dental Practitioners of the United Kingdom (FGDP).¹⁵ Both organizations have published clear definitions for straightforward and complex cases which are generally stated as follows:

STRAIGHTFORWARD CASE

The therapeutic goal and treatment protocols are readily understood by the providing clinician. The desired tooth position is clear and surgery involves minimal anatomical risks which can be carried out without the need for significant hard or soft tissue grafting or modification of anatomical structures.

COMPLEX CASE

The therapeutic goal and treatment protocols are not readily determined without extensive diagnostic and planning techniques and may include multiple stages to achieve the desired outcome. Anatomy is such that optimal tooth positions are not easily identifiable and surgery may require extensive hard and soft tissue grafting with alteration of anatomical structures and increased risk to anatomical structures.

A list of educational objectives are provided to help clinicians determine whether they have the necessary core knowledge and competence to undertake either straightforward and/or complex procedures and guidance is also provided by the AGD on when it is more appropriate to refer patients for specialist care.¹⁶

In addition to the above, the International Team for Implantology (ITI) have in their SAC (Straightforward/Advanced/Complex) classification the parameter of the esthetic zone as a determinant and this would automatically place an implant case into the advanced or complex category.¹⁷

DIAGNOSTICS

The following aids are recommended for use in reaching a presurgical diagnosis to assist in determining the complexity of the case as well as the number, location, type, and angulation of the implants and abutments to be placed:

- Mounted diagnostic casts
- Imaging techniques
- Radiographic guides and templates
- Computerized planning software

The use of computerized tomography (CT) has become mainstream in aiding the diagnosis of available bone volume and quality at potential implant sites as well as location of related anatomical structures including, but not limited to, the maxillary sinuses, inferior alveolar nerve, and teeth. The use of medical CT remains a principle source for most clinicians but the advent of cone beam computed tomography (CBCT) scan imaging techniques are rapidly increasing in popularity, not least due to the significantly lower effective dose of radiation, consistent with principles of good radiation practice. To this end, it has been proposed that CBCT now fulfills the requirements to be considered a standard of care in the diagnosis and planning of implant treatment.¹⁸

For implant dentistry, indications for the use of CT imaging have been proposed by the Working Group of the European Association of Osseointegration (EAO).¹⁹

The incorporation of CBCT machines into some dental practices, and their subsequent use and reporting on the acquired field of view, is of concern to radiologists and authorities responsible for radiation protection. In 2009, extensive provisional guidelines were published within the European Union by the SEDENTEX CT project²⁰ (www.sedentext.eu).

The document considers amongst other details:

Equipment. CBCT machines have differing average doses which may vary from the recommended Diagnostic Reference Levels (DRLs). These represent the agreed standards for dosing levels for a given image. An objective quality assurance program is therefore a prerequisite. Unfortunately, standardized DRLs do not yet exist for CBCT and, as such, one can only compare technical specifications for CBCT machines with each other and practitioners would be well advised to consider opting for that with the lowest effective surface dose or dose area product (DAP). Ideally, the CBCT should provide a readout of the DAP.

Equipment should offer a choice of volume sizes with optimization through the use of flat panel detectors and image intensifiers. In addition, a choice of voxel sizes would be ideal, thereby reducing the radiation dose even further for a given clinical situation.

Imaging room layout. It is advised that CBCT equipment be installed in a protected and controlled enclosure or as specified by local building codes for radiographic equipment. There should be systematic studies of the dose due to scattered radiation in surrounding areas and appropriate shielding should be installed.

Quality standards and assurance. Image quality standards need to be developed for CBCT. Equipment will require a critical examination and an acceptance test, as well as routine tests and assessment of representative patient doses, probably using DAP. To this end, a read-out of DAP after each exposure would be desirable.

Radiation dosage and associated risk. The document recognizes that the dose and risk from CBCT are generally higher than conventional dental radiography (including panoramic), but lower than medical CT. The dose will be dependent upon the equipment (see above), exposure settings (kV, mA), and the field of view (FOV). The smallest FOV is recommended for any single investigation.

Effective doses for dentoalveolar scans have been shown to vary from as little as 11 μ Sv up to 652 μ Sv for a variety of tested CBCT machines. This compares to < 8.3 μ Sv for an intraoral radiograph and between 2.7 to 23 μ Sv for a panoramic radiograph.

Justification and referral criteria. Every CBCT examination requires justification that it will add new information to aid diagnosis and patient management.

CBCT should not be selected unless a full history and clinical examination has been undertaken. Routine imaging would be strongly discouraged. When accepting referrals for CBCT, the referrer must supply sufficient clinical information to allow the CBCT practitioner to determine justification.

Large volume CBCT (FOV \geq 80 mm \times 80 mm) should not be routinely used if possible. However, when used, the CBCT provider is required to provide a comprehensive report on everything imaged within the FOV even if not within the maxillofacial region.

Staff protection. Staff not trained or qualified in the use of radiography should not be allowed to use the CBCT equipment. Staff that are trained should be completely familiar with all protocols relating to the use of the CBCT equipment and should familiarize themselves with the

SEDENTEX or similar documents. Consideration should be given to providing staff with personal dosage monitors.

The SEDENTEX CT document offers a comprehensive set of guidelines and the reader is recommended to review it in full for a more thorough understanding of requirements related to cone beam CT.

THE AT RISK PATIENT

Many articles have been written on the possible contraindications to implant therapy and risk factors for implant failure. The AO has considered this subject in some depth and Section 7 of the Consensus Conference on the State of the Science on Implant Dentistry (SSID), published in 2007, considers some of these factors.²¹ For additional literature review, the reader is directed to Section 1 of the 4th ITI Consensus Conference published in the 2009 supplement of the *International Journal of Oral & Maxillofacial Implants*.²²

Smoking

The results of the SSID demonstrated that smoking has an adverse effect on implant survival and success.²¹ The effect of smoking on implant survival appeared to be more pronounced in areas of loose trabecular bone.

Diabetes

Diabetes (types 1 and 2) may also have an adverse effect on implant survival rates,²¹ but the limited number of studies included in the review for the SSID did not permit a definitive conclusion.

Periodontal Disease

A history of treated periodontal disease does not appear to adversely affect implant survival rates,²¹ but ongoing or untreated periodontitis may have a negative influence on implant success rates and the health of the peri-implant tissues, particularly over longer periods and when associated with smoking.²³ It is therefore recommended that a periodontal evaluation and appropriate treatment be provided prior to implant placement and on an ongoing basis.

Osteoporosis

While osteoporosis has not been shown to place a patient at risk of implant failure,^{24,25} patients who have been treated with intravenous bisphosphonates for metastatic disease have been shown to be at moderate risk of developing bisphosphonate-related osteonecrosis of the jaws (BRONJ) following oral surgical procedures. Patients who have taken long-term oral bisphosphonates or intravenous bisphosphonates for the treatment of osteoporosis or osteopenia may be at potential risk of developing BRONJ.²⁵ At present, many organizations including the American Association of Oral and Maxillofacial Surgeons have recommended against any elective surgery involving oral osseous structures for patients who have been on intravenous bisphosphonates, particularly for metastatic disease, for any period of time. Since the half-life of these medications is known to often exceed 10 years,²⁶ cessation does not reduce or eliminate

the risk of BRONJ. Oral bisphosphonates, however, carry a much smaller risk than intravenous bisphosphonates used for metastasis control, especially if used for less than 3 years. Nonetheless, some insurance organizations and the ADA consider it essential that patients are fully informed of the potential risk for BRONJ to occur. In its second Consensus Conference in 2009, the EAO concluded that the placement of an implant may be considered a safe procedure in patients taking oral bisphosphonates for less than 5 years. Moreover, the intake of oral bisphosphonates did not influence short-term (1 to 4 years) implant survival rates.²⁷

Radiotherapy

Therapeutic tumoricidal irradiation remains a potential contraindication to implant therapy although numerous studies have confirmed the effectiveness of hyperbaric oxygen therapy in reducing the risk of implant failure. Nonetheless it remains a predictor for implant failure along with tooth position and jaw.²⁴

IMPLANT PLACEMENT

The surgical approach should be based on the pretreatment evaluation and the type of implants and/or graft procedure to be utilized.

The surgical risk should be assessed and classified according to the Surgical Classification System (scale 1 to 4) as set out in the Parameters of Patient Care document of the American Association of Oral and Maxillofacial Surgeons (AAOMS).⁵ Only category 1 should be considered for implant dentistry within the dental office setting and specialist referral is recommended where surgery is likely to fall into category 2, with sedation or general anesthesia, or category 3. Category 1: Minimal risk to the patient independent of anesthesia. Minimally invasive procedures with little or no blood loss often done in an office setting. Category 2: Minimal to moderately invasive procedures with blood loss less than 500 mL. Mild risk to patient independent of anesthesia.

For very complex/advanced maxillofacial implant procedures involving extraoral graft harvesting, category 3 may be an appropriate risk assessment, requiring an inpatient hospital setting. Category 3: Moderate to significant invasive procedure. Blood loss potential 500 to 1500 mL. Moderate risk to patient independent of anesthesia.

All patients undergoing oral surgery with intravenous/inhalation sedation or general anesthesia should be thoroughly assessed including a more extensive physical examination of the cardiorespiratory system and categorized according to the American Society of Anesthesiologists' (ASA) physical status classification system.

- ASA Class 1: A normal healthy patient
- ASA Class 2: A patient with mild systemic disease
- ASA Class 3: A patient with severe systemic disease
- ASA Class 4, 5, and 6: Preclude oral surgery

During the execution of the surgical procedure, the following should be considered:

- Aseptic technique
- Appropriate use of systemic antibiotics
- Appropriate use of surgical templates
- Appropriate surgical protocol
- Delayed [numbered list]
 - (1) One-stage submerged
 - (2) Two-stage transmucosal
- Early placement 4 to 6 weeks postextraction
- Immediate placement at time of tooth extraction
- Appropriate postoperative instructions

With respect to protocol, a delayed approach would still be considered most conventional, with no differentiation between the submerged and transmucosal methods in respect of outcome. However, implants may be placed at the time of dental extraction and even loaded at the time of placement. The question of timing was considered in Section 8 of the AO 2006 Consensus Conference on the State of the Science on Implant Dentistry²⁸ and in Section 3 of the Proceedings of the 4th ITI Consensus Conference.²² Results on a consensus were equivocal due to the heterogeneity of studies published to date; as such it is not possible to compare the outcomes of immediately placed implants with implants placed in healed sites. Nonetheless, most studies have reported high survival rates for immediate implant placement. Immediate implant placement offers the advantages of shorter treatment time and fewer surgical procedures. However, there is some concern about the potential for soft and hard tissue complications after immediate implant placement and, to this end, it is currently the AO's position that immediate implant placement be considered a more complex than straightforward procedure.

Clinicians must consider, understand, and weigh the potential risks versus benefits and consider that anatomical factors may have an impact on the functional and esthetic outcomes of immediate implant placement. Despite an ongoing tendency favoring the longest time-to-loading protocols, no generalized clinical recommendations can be made because potential influencing factors on outcomes have been underrepresented in the literature. Existing limited data suggest that immediate and/or early loading of implants placed in the interforaminal area can be considered as an acceptable alternative to delayed loading. However, the applicability of immediate or early loading protocols to other clinical situations must be considered in the context of the unique anatomic, biomechanical, and host factors and the competency of the clinician.

GRAFTING PROCEDURES

For the purposes of classification, grafting can be categorized as follows:

1. Dentoalveolar
2. Anatomical

Dentoalveolar grafts involve the repair of alveolar ridge defects or alteration of the ridge form, eg, to increase ridge width. Such procedures fall into the "Straightforward" or Category 1 surgery and can competently be performed in the office setting by an appropriately trained clinician.

Anatomical grafts generally involve either an invasion of or a change to anatomical structures, eg, sinus lift, or the harvesting and/or grafting of bone which places vital structures at risk, eg, the inferior dental nerve. Such procedures are classified as "Complex" and may fall into the Category 2 type procedure which demands a greater level of training and expertise or specialist referral.

In either case, grafting can be accomplished using a variety of materials. Broadly speaking, these fall into the following groups:

- Nonautogenous
- Autogenous
 - (1) Intraoral
 - (2) Extraoral

Both the use of nonautogenous bone and intraoral harvesting using a bone trap or scraper are considered "Straightforward" and fall well within the remit of the appropriately trained clinician. The harvesting of ramus, symphysis, and tuberosity are considered to be "Advanced" as it is recognized that these procedures can incur considerable risk to vital structures not least of which are the adjacent teeth, mental nerve, and inferior dental nerve, among others. As such, it is felt that only surgical specialists or general dentists with advanced training in such procedures, and who have proficiency in dealing with potential complications, should undertake such cases.

All extraoral harvesting is considered complex, necessitating referral to an appropriate surgeon.

With respect to outcome, several grafting procedures have proven successful in providing adequate bone quantity and quality for implant placement in patients who have bone loss. The AO Consensus Conference on the State of the Science on Implant Dentistry reported that the maxillary sinus augmentation procedure has been well documented,²⁹ and the long-term clinical success and/or survival (> 5 years) of implants placed into grafted sinuses, regardless of graft material(s) used, compares favorably to implants placed conventionally with no grafting procedure. The 2nd EAO Consensus Conference could find no overall evidence to support the use of autogenous bone over bone biomaterial substitutes.³⁰ Alveolar ridge augmentation techniques do not have as much detailed documentation or long-term follow-up studies, with the exception of guided bone regeneration.^{29,31} However, studies that met the inclusion criteria were comparable and yielded favorable results supporting dental implants. The alveolar ridge augmentation procedures may be more technique-sensitive, and implant survival may be a function of residual bone supporting the dental implant rather than grafted bone. More in-depth, long-term, multicenter studies are required to provide further insight into augmentation procedures to support dental implant survival.³¹

POSTOPERATIVE MANAGEMENT

It is a central requirement in all patient care documents that a patient be provided appropriate instructions for postoperative care. These instructions may be verbal but a written, individualized, instruction sheet is recommended with information on bleeding, pain control, swelling, the need for antibiotics, the use of chlorhexidine or similar mouthwashes, etc. In addition, patients being treated under sedation or general anesthesia should be escorted home by a responsible adult.

Patients should be evaluated at appropriate intervals. These are typically scheduled at 1 week, 1 month, and then 3 months. These intervals may be modified depending on the specific nature of the procedure and patient. The following considerations should be reviewed prior to the commencement of the restorative phase:

- Quantity, quality, and health of soft and hard tissues
- Implant position and healing abutment selection
- Implant stability
- Radiographic appearance
- Health of the adjacent teeth and/or restorations

Decisions regarding the appropriate time to restore a dental implant are based upon a variety of factors. Clinicians must understand the effects of bone quality and systemic health on healing; the effects of micromovement on potential osseointegration; differences in force application relative to location within the dental arch; risks and benefits associated with grafting; general healing times; and other factors that influence short- and long-term prognosis. A thorough understanding of the principles of occlusion and biomechanics as they relate to the implant-prosthetic assembly is deemed an essential criterion for restoration since this aspect of implant dentistry combines the physicommechanical interaction of engineered components with each other as well as the interaction between implanted device and bone.

Numerous attempts have been made to provide both subjective and objective assessments of osseointegration including, but not limited to, percussion sound, tactile mobility, Periotest, and Resonance Frequency Analysis. The literature is somewhat equivocal about the value and correlation of these tests with the degree of osseointegration and there is no clear consensus as to when an implant achieves a minimum degree of stability to allow restoration into functional loading. As such the clinician may continue to have to rely on clinical and/or radiographic interpretation and personal experience. As conventional healing times continue to diminish by improvements in implant design, surface technology, and surgical techniques, clinicians are encouraged to take a cautious approach in this matter.

PROSTHODONTIC CONSIDERATIONS

As stated above, implant dentistry is a restoratively driven therapy and as such the prescription of implants will have been taken in light of all other prosthetic considerations which will have included an evaluation of the preexisting

condition of teeth adjacent to edentulous spans, alternative methods of tooth replacement, and the condition of the soft tissues, which may be critical to the anticipated results. A typical example of this would be if a patient presents with a loss of interdental papilla and how this might impact upon the esthetic outcome, since it is unlikely that implant intervention will recreate the lost papilla. Clearly patients need to be informed prospectively about such compromises or limitations.

The initial prosthodontic evaluation will include:

- Indications for care, including implant specific indicators
- Therapeutic goals
- Number and location of missing teeth
- Interarch distance
- Consideration of lip support and the need for pink acrylic and/or ceramics
- Consideration for the number, type, and location of proposed implants
- Existing and proposed occlusal scheme
- Design and type of planned restoration
 - (1) fixed versus removable
 - (2) cement versus screw-retained
 - (3) ceramic versus acrylic
- The impact of the design and type of restoration on the surgical position of the implant(s) (ie, angulation for screw versus cement retention)
- Diagnostic wax-up, radiographic templates, and appropriate radiographic images

Once implants are deemed ready for restoration, the clinician must consider the following:

- An appropriate method for implant uncovering (if required)
- Adequacy and health of peri-implant mucosa
- The time to loading
- The method of loading ie, progressive versus nonprogressive
- The magnitude of force application
- Material choices
- The occlusal scheme
- The need for protective occlusal guards

For a more extensive list, the reader is directed to the parameters of care document of the American College of Prosthodontists (ACP).⁶

It is worthy of note that in the ACP document it states: "With rapid advancements in soft tissue and bone augmentation, the placement of implants outside the normal anatomic location to support prosthodontic replacement is becoming less acceptable unless there has been informed consent by the patient for alternative implant location and angulation."⁶

At all times it remains paramount to bear in mind the therapeutic goal to deliver a prosthetic replacement that provides a functional restoration that both the patient and observer perceive to be in harmony with the natural dentition.

For guidance on such matters as outcome measures for survival and complication rates of implant-supported fixed bridgework, cantilever fixed bridgework, and single-tooth restorations as well as choice of abutment material, influence of crown-to-implant ratio, occlusal designs, etc, the reader is directed to the proceedings of the 2nd EAO Consensus Conference³² as well as of the 1st European Workshop on Evidence-Based Reconstructive Dentistry.³³

MANAGEMENT OF IMPLANT AND PERI-IMPLANT TISSUES

Periodic evaluation of implants is a requisite component of patient care. The responsibility to perform this evaluation falls on the providing clinician(s). In the case of a team approach, an agreement should be in place as to whether one or both members of the team (ie, surgeon and/or prosthodontist or general dentist) will follow the patient. Recall appointments are generally recommended within 6 months of restoration, and at least annually thereafter. If the patient was treated entirely in a specialist referral setting there should be no assumption that the patient's general dentist will take responsibility for monitoring the implant unless previously agreed upon. It is important that patients be made aware of their responsibility to attend review and maintenance appointments as well as the potential risk to their implant-supported restorations if they do not attend.

Recall appointments should involve a careful examination of the suprastructure, the surrounding peri-implant tissues, and an assessment made of the patient's oral hygiene. Considerations recommended by the American Academy of Periodontology (AAP)⁷ in the evaluation of implants at recall are:

- Oral hygiene status
- Clinical appearance of peri-implant tissues
- Bleeding on probing and/or presence of exudate
- Pocket probing depths and alveolar bone level
- Radiographic appearance of implant, peri-implant bone, and alveolar bone levels relative to the implant-abutment junction
- Stability of prostheses and assessment of occlusal screws or cement
- Assessment of veneering material for presence of fractures
- Occlusal assessment
- Patient comfort and function
- Assessment of appropriate maintenance intervals (The assessment of an appropriate maintenance interval is defined by the AAP Parameter on Periodontal Maintenance as an interval that will increase the probability of locating and treating disease in a timely manner. For most patients with a history of periodontal disease, a 3-month interval has been found to be effective in maintaining periodontal health.³⁴)

Particular consideration needs to be given to peri-implant mucositis and peri-implantitis.

Peri-implant mucositis and peri-implantitis are an inflammatory process that affects both the hard and soft tissues around a functional implant. Peri-implant mucositis is generally defined by its restriction to inflammation of the soft tissues with bleeding on probing while peri-implantitis results in marginal bone loss which may eventually lead to loss of osseointegration. Bacterial infection is known to play a major role in the etiology of this disease although there remains some debate as to whether this is a host-susceptibility related or implant surface related phenomenon or both.

Prevention and/or control of these infections are a major factor when reviewing and maintaining patients with implants, particularly if they present with a history of periodontal disease, have certain systemic conditions or are cigarette smokers. The need for an effective decontamination protocol and subsequent surgical intervention for the treatment of peri-implant mucositis and peri-implantitis may be necessary. This may necessitate referral.

OUTCOMES ASSESSMENT

The desired outcome of successful implant therapy is not only the achievement of the therapeutic goal but the maintenance of a stable, functional and esthetically acceptable tooth replacement for the patient. Variations from the desired outcome of implant placement include⁷:

- Implant mobility or implant loss
- Inability to restore the implant
- Persistent pain, neuropathy, and/or loss of function
- Persistent peri-implant radiolucency
- Progressive bone loss
- Increased probing depths
- Persistent uncontrolled inflammation and/or infection
- Prosthesis instability
- Fractured occlusal materials
- Fractured or loosened prosthetic components
- Implant fracture

The etiology of implant complications can be multifactorial, involving both structural components and related tissues. Routine evaluation may reveal the need for procedures to prevent and treat complications. Clinicians must be familiar with interventions and approaches to manage the complications that are listed above.

DISCLAIMER

These Guidelines provide information and recommendations regarding the provision of patient care in regard to dental implant therapy. The Guidelines are not intended to be all-inclusive or otherwise limit the reader's inquiry. To this end, the reader is advised to look at other selected resources and references for a more complete consideration applicable to the provision of dental implants. The Guidelines neither endorse nor make any representation regarding the qualifications, capabilities, skill, or competence of any individual dentist. The Guidelines present

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ACKNOWLEDGEMENTS

The Academy of Osseointegration (AO) wishes to thank the Task Force responsible for the development of the 2010 Guidelines for the Provision of Dental Implants and Associated Patient Care including: Dr Michael R. Norton, BDS, FDS, RCS(Ed) (Chair, Oral Surgeon); Dr Jeffrey Ganeles, DMD (Periodontist); Dr Scott D. Ganz, DMD (Prosthodontist); Dr Lambert J. Stumpel, DDS (General Dentist); and Dr Joseph M. Schmidt, DDS (Oral Surgeon).

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