Parameters of Care:
Clinical Practice Guidelines
for Oral and Maxillofacial Surgery
(AAOMS ParCare 2017)

DENTAL AND CRANIOMAXILLOFACIAL
IMPLANT SURGERY

©Copyright 2017 by the American Association of Oral and Maxillofacial Surgeons.
This document may not be copied or reproduced without the express written permission of the American Association of Oral and Maxillofacial Surgeons.
All rights reserved.
J Oral Maxillofac Surg

THIS SECTION IS 1 OF 11 CLINICAL SECTIONS INCLUDED IN AAOMS PARCARE 2017, WHICH IS VIEWED AS A LIVING DOCUMENT APPLICABLE TO THE PRACTICE OF ORAL AND MAXILLOFACIAL SURGERY. IT WILL BE UPDATED AT DESIGNATED INTERVALS TO REFLECT NEW INFORMATION CONCERNING THE PRACTICE OF ORAL AND MAXILLOFACIAL SURGERY.
INTRODUCTION

Reconstructive dental and craniomaxillofacial implant surgery encompasses the use of implants to rehabilitate and restore form and function to the edentulous or partially edentulous jaws and the craniomaxillofacial skeleton of patients using fixed and removable prostheses. Implants also assist in the stabilization of prostheses that replace missing maxillofacial parts, such as the nose, eyes, and ears. Implant reconstruction enables patients to regain normal mastication, speech, and deglutition; resolves pain, gagging, and dysfunction from conventional removable prostheses; and improves the symmetry and appearance of the face. Thus, it promotes self-esteem and restores both masticatory function and a sense of well-being in patients with congenital, developmental, and acquired orofacial deficits and deformities. The conditions are described generically and listed without any judgment regarding priority.

Advances in implant science, biomaterials, and biotechnology, together with a better understanding of the biology of osseointegration, the bone-implant interface, and biomechanics, have resulted in improved outcomes and expanded applications for implants. Improved methods of imaging for diagnosis, a diverse availability of implants with varied geometry and surfaces, and refinement of augmentation and reconstructive techniques have enabled previously rejected or inadequately rehabilitated patients to be treated. Nanotechnology manipulates biomaterials on an atomic and molecular scale. The reconstruction techniques include guided bone regeneration, autogenous grafting from the maxillofacial region and other sites, and use of bone substitutes, composite grafts, and bone. The techniques involve materials using the concepts of osteogenesis, osteoinduction, osteoconduction, and osteopromotion. Soft tissue procedures, in combination with implant surgery, have improved the health and aesthetics of the peri-implant tissues. Increased understanding of biologic, biomechanical, and patient- and clinician-related risk factors, as well as a growing consensus of biologically acceptable patient treatment protocols, has improved the safety and efficacy of dental and craniomaxillofacial implant surgery.

The use of implants (temporary, provisional) may provide function and aesthetics during the reconstructive phase of treatment.

The team approach, involving a restorative dentist, in the management of dental implant patients emphasizes that the restoration is the primary factor that drives the implant placement and the requirements for adjunctive grafting procedures. It is essential that there is proper patient selection and presurgical consultation with a restorative dentist involved in the treatment planning using appropriate available assessment tools. Implant dentistry is a recognized method for reconstruction and rehabilitation of missing parts in the maxillofacial region.

GENERAL CRITERIA, PARAMETERS, AND CONSIDERATIONS FOR DENTAL AND CRANIOMAXILLOFACIAL IMPLANT SURGERY

INFORMED CONSENT: All surgery must be preceded by the patient's or legal guardian’s consent, unless an emergent situation dictates otherwise. These circumstances should be documented in the patient’s record. Informed consent is obtained after the patient or the legal guardian has been informed of the indications for the procedure(s), the goals of treatment, the known benefits and risks of the procedure(s), the factors that may affect the risk, the treatment options, and the potential favorable and unfavorable outcomes.

PERIOPERATIVE ANTIBIOTIC THERAPY: In certain circumstances, the use of antimicrobial rinses and systemic antibiotics may be indicated to prevent failure of and infections related to surgery. The decision to employ prophylactic perioperative antibiotics is at the discretion of the treating surgeon and should be based on the patient’s clinical condition as well as other comorbidities which may be present.

DEALING WITH NEUROLOGIC DEFECITS: Injuries to the terminal branches of the trigeminal nerve (e.g., lingual, inferior alveolar, long buccal nerves), as well as the facial nerve, are known risks of oral and maxillofacial surgery. It should be noted that the presence of a pathologic craniomaxillofacial condition, dentoskeletal or craniofacial abnormality, or traumatic craniomaxillofacial injury may result in nerve injury prior to surgical management. In addition, the use of local anesthesia (e.g., mandibular block) may increase the risk of nerve injury. Most nerve injuries resolve spontaneously, but some do not, and these may require consideration for non-surgical
and/or surgical intervention. Microneurosurgical repair should be considered when the disability is of concern to
the patient, and there is clinical evidence of moderate, severe, or complete neurosensory impairment of various
areas of the orofacial region (eg, lips, chin, tongue); paresis or paralysis of facial muscles; loss, decreased, or
abnormal taste sensation; or neuropathic pain of peripheral origin. Surgical repair should incorporate specialized
microsurgical techniques (eg, operating magnification, nerve grafting), when indicated. Also see the

Reconstructive Surgery chapter.

USE OF IMAGING MODALITIES: Imaging modalities may include panoramic radiograph, periapical and/or
occlusal radiographs, maxillary and/or mandibular radiographs, computed tomography, cone beam computed
tomography, positron emission tomography, positron emission tomography/computed tomography, and magnetic
resonance imaging. In determining studies to be performed for imaging purposes, principles of ALARA (as low
as reasonably achievable) should be followed.

DOCUMENTATION: The AAOMS ParCare 2017 includes documentation of objective findings, diagnoses, and
patient management interventions. The ultimate judgment regarding the appropriateness of any specific
procedure must be made by the individual surgeon in light of the circumstances presented by each patient.
Understandably, there may be good clinical reasons to deviate from these parameters. When a surgeon chooses
to deviate from an applicable parameter based on the circumstances of a particular patient, he/she is well advised
to note in the patient's record the reason for the procedure followed. Moreover, it should be understood that
adherence to the parameters does not guarantee a favorable outcome.

GENERAL THERAPEUTIC GOALS FOR DENTAL AND CRANIOMAXILLOFACIAL IMPLANT
SURGERY:

A. Restored function
B. Improved appearance
C. Improved social and psychological well-being
D. Limited pain (enhanced function, comfort and minimize pain and discomfort)
E. Limited period of disability
F. Provision of stable anchorage
G. Achievement of uncomplicated healing
H. Achievement of patient satisfaction
I. Appropriate understanding by patient (family and/or significant other) of treatment options and
   acceptance of treatment plan
J. Appropriate understanding and acceptance by patient (family) of favorable outcomes and known risks and
   complications
K. Preservation and protection of existing bone from continual resorption

GENERAL FACTORS AFFECTING RISK DURING DENTAL AND CRANIOMAXILLOFACIAL IMPLANT
SURGERY:

A. Magnitude of deformity/anomaly
B. Inadequate quality or quantity of alveolar bone and soft tissues
C. Presence of bone and/or soft tissue infection, (eg, periapical and periodontal disease, maxillary sinus)
D. Presence of bone and/or soft tissue pathology
E. Factors that are known to influence osseointegration adversely
   1. Implant material
   2. Implant geometry (macrostructure)
   3. Implant surface (microstructure)
   4. Status of recipient bone (eg, inadequate bone quality and volume)
   5. Trauma to host bone (eg, fracture, thermal injury, dehiscence)
   6. Bone healing potential
F. Inadequate prosthetic or surgical treatment planning
G. Unfavorable prosthetic design and loading conditions
H. Presence of behavioral, psychological, neurologic, and/or psychiatric disorders, including habits (eg,
substance abuse, including tobacco and alcohol), seizure disorders, self-mutilation that may affect
surgery, healing, and/or response to therapy

I. Degree of patient and/or family understanding of the origin and natural course of the condition or
disorder, therapeutic goals, and acceptance of proposed treatment

J. Parafunctional habits

K. Preexisting neurologic dysfunction

L. Presence of local or systemic conditions that may interfere with the normal healing process and
subsequent tissue homeostasis (eg, previously irradiated tissue, diabetes mellitus, chronic renal disease,
liver disease, blood disorder, steroid therapy, contraceptive medication, immunosuppression,
malnutrition), history of local trauma, acute or chronic infection(s) including active or refractory
periodontal disease, failed endodontic therapy, osteoporosis, multiple surgical interventions at the site in
question that could interfere with healing. Various drug groups that promote the osteonecrosis of the jaw
includes intravenous bisphosphonates, oral bisphosphonates, RANK ligand inhibitors, and angiogenesis
inhibitors. The prevalence of medication-related osteonecrosis of the jaw (MRONJ) is seen more
commonly in cancer patients receiving antiresorptive therapy compared to those receiving treatment for
osteoporosis alone. The common oral bisphosphonates used are: alendronate sodium, risedronate sodium,
and ibandronate sodium. The common intravenous bisphosphonates used are ibandronate, pamidronate
disodium, and zoledronate. Denosumab (Xgeva® and Prolia®) is in a new group of medications that are
essentially a humanized monoclonal antibody administered subcutaneously. Other antiangiogenic agents
include sunitinib and sorafenib (tyrosine kinase inhibitors); bevacizumab, another humanized monoclonal
antibody; and sirolimus (rapamycin), an immunosuppressant for patients at risk of organ rejection
secondary to renal transplants.

M. Degree of patient’s and/or family’s cooperation and/or compliance

N. Inadequate hygiene

O. Age of patient (eg, developmental status of alveolar bone)

P. Proximity of implant placement site to adjacent structures (eg, teeth, other dental implants, nerve, brain,
sinus)

Q. Presence of coexisting major systemic disease (eg, disease that increases a patient's American Society of
Anesthesiologists classification to II, III, or IV) as detailed in the Patient Assessment chapter

R. Regulatory and/or third-party decisions concerning access to care, indicated therapy, drugs, devices,
and/or materials

GENERAL FAVORABLE THERAPEUTIC OUTCOMES FOR DENTAL AND
CRANIOMAXILLOFACIAL IMPLANT SURGERY:

A. Retained, stable, functional implant(s) capable of supporting a prosthesis for a minimum of 5 years

B. Minimal bone height loss after the first year of service

C. No evidence of peri-implant radiolucency

D. Peri-implant soft tissue health (absence of inflammation, exudate, and bleeding on probing of peri-
implant soft tissues)

E. Patient satisfaction with function, aesthetics, and ability to maintain implants supported prosthesis in a
healthy state

F. Improved social and psychological well-being

G. Limited period of pain and disability

H. Patient (family) acceptance of procedure and understanding of outcomes

GENERAL KNOWN RISKS AND COMPLICATIONS FOR DENTAL AND
CRANIOMAXILLOFACIAL IMPLANT SURGERY:

A. Unstable implant

B. Loss of implant

C. Anesthesia, paresthesia, hyperesthesia, hypoesthesia

D. Excessive vertical and horizontal bone loss greater than 2.0 mm

E. Presence of signs and symptoms, such as pain, infection, neuropathies, or paresthesia

F. Infection (acute and/or chronic)
G. Unanticipated bony deficiency, dehiscence, or fenestration
H. Dental injury during surgery, ie, injury to adjacent teeth
I. Mandible fracture
J. Unfavorable axial inclination of adjacent teeth
K. Failure of bone graft augmentation
L. Nasal or sinus fistulae
M. Nonrestorable implants
N. Implant or component failure (eg, fracture, screw loosening)
O. Improper implant positioning, causing prosthetic compromise
P. Hemorrhage
Q. Hyperplastic soft tissue response
R. Aberrant frenum or mobile mucosal tissues
S. Prolonged period of disability
T. Facial and/or trigeminal nerve dysfunction after surgery
U. Unplanned Caldwell-Luc, bronchoscopy, or other exploratory procedures associated with surgery
V. Ocular injury during surgery
W. Unanticipated repeat Oral and/or Maxillofacial Surgery
X. Core temperature of greater than 101°F 72 hours after elective surgery
Y. Postsurgical radiograph indicating presence of foreign body
Z. Unplanned transfusion(s) of blood or blood components during or after surgery
AA. Readmission for complications or incomplete management from previous surgery
BB. Respiratory and/or cardiac arrest
CC. Death

SPECIAL CONSIDERATIONS FOR PEDIATRIC DENTAL AND CRANIOMAXILLOFACIAL IMPLANT SURGERY

Craniomaxillofacial implants have three primary applications in the pediatric population: restoration of missing dentition, as an anchoring device for orthopedic manipulation, and for prosthetic reconstruction of the missing structures.

Dental implants can provide optimal restoration for children with hypodontia syndrome or with segments of lost dentition. Congenitally missing teeth are referred to as hypodontia (one to five missing teeth), oligodontia (six or more missing teeth), and anodontia (missing all permanent teeth in one or both jaws). Agenesis generally refers to missing individual teeth. Missing teeth in a growing individual can be a disabling condition, which must be addressed with consideration for both physical and psychological development. Achievement and maintenance of osseointegrated implants in healthy children have been shown to be possible. There is no fixed chronologic age at which implants may be placed in children. Children younger than 2 years may have unsuitably soft or thin cortical bone for implant placement. In general, growth and skeletal development should be completed or nearly completed before implants are placed. Skeletal maturity can be assessed in a number of ways, including superimposition of serial cephalometric films obtained at 6-month to 1-year intervals. In cases of anodontia and oligodontia, dental implants may be placed before the pubertal growth period. It must be understood, however, that dental implants will not erupt together with adjacent teeth during dentoalveolar development, and they will not be displaced in space as natural teeth are during growth and development. When dental implants are anticipated to manage situations where primary teeth have no successors, maintenance of the primary dentition to maintain the bone available for future implant placement may be appropriate. Orthodontic movement of teeth into and away from implant sites may also benefit the availability of bone to support implants.

Osseous dental implants may serve as anchoring devices for orthodontic and orthopedic mechanisms. In combination with elastic or active spring devices, dental segments may be moved into more ideal positions. This procedure should be undertaken in conjunction with an orthodontist familiar with these mechanisms.

Prosthetic reconstruction may be indicated for the missing ear or severe grade II type microtia. Currently, it is still difficult to achieve an aesthetic-appearing ear using autogenous materials and local flaps. A maxillofacial prosthodontist should see the child before surgery to determine the child’s suitability as a candidate for an
extraoral prosthesis and possible implant placement to retain the prosthesis. And that calvarial bone is of adequate dimension to achieve the necessary thickness for implant placement by approximately 5 or 6 years of age.

SPECIAL CONSIDERATIONS REQUIRING IMPLANTS

I. Neurologic Dysfunction

Certain motor disorders affecting the orofacial musculature and sensory disorders affecting the overlying soft tissues adversely affect masticatory function and the patient’s ability to function with a conventional removable prosthesis.

A. Pain
   1. Nerve compression
   2. Soft tissue irritation

B. Neuromuscular disorders
   1. Parkinsonism
   2. Cerebrovascular accident
   3. Multiple sclerosis
   4. Epilepsy
   5. Orofacial dyskinesia
   6. Oral mandibular dystonia
   7. Tardive dyskinesia
   8. Hyperactive gag reflex

C. Parafunctional habits (eg, bruxism, clenching, tongue thrusting, finger sucking)

II. Tissue Intolerance

Possible reactions to methyl methacrylate or base metal alloys; lack of fixed, keratinized soft tissue; and a propensity to chronic inflammatory or autoimmune conditions (eg, Sjögren’s syndrome) may contribute to masticatory dysfunction with a conventional prosthesis.

III. Inadequate Orthodontic or Orthopedic Anchorage

Use of implants can enable the orthodontist to manage a variety of clinical problems related to anchorage control and missing teeth. By virtue of its rigid orthopedic anchorage in bone, the osseointegrated implant or the biointegrated implant can be used both to move teeth orthodontically and as root form implants to support single or multiple tooth restorations.

Orthodontic implants may also be used as osseous handles to guide orthopedic development and as bone anchors for distraction osteogenesis.

Implants may be used as absolute anchorage where the anchoring unit remains stationary under orthodontic forces. Certain skeletal deformities may be corrected using titanium screw anchorage.

IV. Patients with congenitally missing teeth or developmental anomalies, including those with ectodermal dysplasia

ADJUNCTIVE DIAGNOSTIC/IMAGING AND SURGICAL PROCEDURES

A. Imaging for implant treatment planning
B. Guided surgery
C. Virtual treatment planning
D. Implant stability and resonance frequency analysis
E. Mini-implants
F. Flapless surgery
G. Orthodontic tooth extrusion
H. Immediate loading protocols
I. Vascularized pedicle flaps
J. Interpositional osteotomy for posterior mandibular ridge augmentation
K. Zygomatic implant placement
L. Angled implant placement
M. Ridge preservation and site development
N. Ridge expansion and splitting
O. Subepithelial connective tissue grafting
P. Bone morphogenetic protein
Q. Platelet-rich plasma and platelet-rich fibrin
R. Bone marrow concentrates

GENERAL AND SPECIFIC CONSIDERATIONS

I. Indications for Therapy

May include one or more of the following:

A. General
1. Prevention of alveolar bone resorption and loss of osseous support
2. Clinical or imaging evidence of hard or soft tissue defect(s) in the maxillofacial region, including
   defects resulting from tooth loss, oncologic therapy, and trauma (eg, mandibular, maxillary, nasal, orbital, ear)
3. Masticatory dysfunction (eg, maxillary and/or mandibular partial edentulism and/or alveolar atrophy)
4. Aesthetic deficiency and/or compromise
5. Speech impairment
6. Behavioral and/or psychological impairment
7. Neurologic dysfunction
   a. Nerve compression
   b. Soft tissue irritation
8. Intolerance to and/or inability to accommodate to tooth and/or soft tissue–borne prostheses
9. Reaction to materials used in tooth and/or soft tissue–borne prosthetic reconstruction

B. Specific
1. Partial edentulous ridge
   a. Preservation of natural tooth by avoiding tooth preparation for a fixed and/or removable prosthesis
   b. Inadequate natural teeth to support a fixed and/or removable prosthesis
   c. Prevention of occlusal overloading of remaining natural dentition
2. Isolated Partial Edentulism in the Esthetic Zone
   a. Restoration or improvement of aesthetics
   b. Preservation of natural tooth by avoiding tooth preparation for fixed and/or removable prosthesis
   c. Inadequate natural teeth to support a fixed and/or removable prosthesis
   d. Prevention of occlusal overloading of remaining natural dentition
3. Edentulous Mandible
   a. Absence of natural teeth to support a fixed and/or removable prosthesis
   b. Intolerance to and/or inability to accommodate to a complete denture
4. Edentulous Maxilla
   a. Absence of natural teeth to support a fixed and/or removable prosthesis
   b. Intolerance to and/or inability to accommodate to a complete denture
   c. Combination syndrome (anterior maxillary resorption, maxillary hyperplasia, bulbous tuberosities)
   d. Maxillary and/or mandibular vertical, transverse, and anterior-posterior skeletal discrepancies
5. Reconstructed Mandible (Partially and Edentulous)
   a. Preservation of natural tooth by avoiding tooth preparation for fixed and/or removable prosthesis
   b. Inadequate natural teeth to support a fixed and/or removable prosthesis
c. Prevention of occlusal overloading of remaining natural dentition 378
d. Relative position of genial tubercle 379
e. Relative position of the floor of mouth and salivary glands and ducts 380

6. **Reconstructed Maxilla (Partially and Edentulous)**
   a. Preservation of natural tooth by avoiding tooth preparation for fixed and/or removable prosthesis 381
   b. Inadequate natural teeth to support a fixed and/or removable prosthesis 382
   c. Prevention of occlusal overloading of remaining natural dentition 383
d. Combination syndrome (e.g., anterior maxillary resorption, papillary hyperplasia, bulbous tuberosities) 385

7. **Irradiated Bone**
   a. Unstable obturator 387
   b. Provision of a stable prosthesis in the irradiated jaw with low tolerance to soft and hard tissue irritation or trauma 389
   c. Provision of retention and anchorage for maxillofacial, nasal, orbital, and ear prosthesis in irradiated tissue 391
d. Provision of retention and support of a prosthesis in a xerostomic patient 392

8. **Reconstructed Alveolar Cleft**
   a. Inadequate ridge for prosthetic reconstruction (e.g., implant placement) 394
   b. Preservation of the natural tooth by avoiding preparation for fixed and/or removable prosthesis 395
c. Inadequate natural teeth to support a fixed and/or removable prosthesis 396
d. Prevention of occlusal overloading of remaining natural dentition 397

9. **Developmental or Acquired Craniofacial Deformities**
   a. Improvement on conventional retention of maxillofacial prosthesis 399
   b. Clinical or imaging evidence of hard or soft tissue defect (e.g., congenital, traumatic, or oncologic loss of eye, ear, nose, hair, or other hard or soft tissue structure) 401
c. Intolerance to and/or inability to accommodate a conventional prosthesis 402
d. Adverse reaction to materials used in prosthesis construction 403

II. **Therapeutic Goals**

   A. **General**

   The goal of therapy is to restore form and/or function. However, risk factors and potential complications may preclude complete restoration of form and/or function.

   The primary goal of implant reconstruction is to provide long-term, stable anchorage for a prosthesis. The implant, in combination with the prosthesis, may then provide one or more of the following:

   1. Presence of a general therapeutic goal, as listed in the section entitled General Criteria, Parameters, and Considerations for Dental and Craniomaxillofacial Implant Surgery
   2. Prevention of alveolar atrophy and loss of supportive bone
   3. Improved mastication
   4. Improved speech
   5. Improved deglutition
   6. Prevention of gagging
   7. Enhanced aesthetics

   B. **Specific**

   1. **Partial Edentulism**
      a. Preservation of remaining natural dentition
      b. Prevention of occlusal overloading of remaining natural dentition
      c. Enabling of successful orthodontic treatment
      d. Improved stability of obturators

   2. **Isolated Partial Edentulism in the Esthetic Zone**
      a. Maintenance or improvement of aesthetics
      b. Preservation of remaining natural dentition
      c. Prevention of alveolar atrophy and loss of supportive bone
      d. Prevention of occlusal overloading of remaining natural dentition
3. **Reconstructed Mandible (Partially and Edentulous)**
   a. Prevention of occlusal overloading of remaining natural dentition
   b. Prevention of loss of reconstructed alveolar and supporting bone
   c. Preservation of overlying soft tissue

4. **Reconstructed Maxilla (Partially and Edentulous)**
   a. Prevention of loss of reconstructed alveolar and supporting bone
   b. Preservation of overlying soft tissue
   c. Prevention of occlusal overloading of remaining natural dentition

5. **Irritated bone**
   a. Prevention of loss of soft tissue integrity to minimize contribution to osteoradionecrosis
   b. Provision of anchorage of maxillofacial, nasal, orbital, and ear prosthesis
   c. Diminished risk of osteoradionecrosis secondary to trauma from conventional removable prosthesis
   d. Preservation of remaining natural dentition
   e. Improved stability of obturators
   f. Provision of anchorage of maxillofacial, nasal, orbital, and ear prosthesis

6. **Reconstructed Alveolar Cleft**
   a. Prevention of loss of reconstructed alveolar bone
   b. Preservation of overlying soft tissue
   c. Prevention of occlusal overloading of remaining natural dentition

III. **Factors Affecting Risk**

A. **General**

   **Severity factors that increase risk and the potential for known complications:**

   1. Presence of a general factor affecting risk, as listed in the section entitled General Criteria, Parameters, and Considerations for Dental and Craniomaxillofacial Implant Surgery
   2. Ridge relationship of opposing arch (e.g., retrognathia, laterognathia, prognathia)
   3. Unfavorable ridge morphologic features
   4. Unfavorable access (e.g., trismus, macroglossia)
   5. Presence of severe atrophy
   6. Prior radiation
   7. Quality and quantity of alveolar bone

B. **Specific**

1. **Partial Edentulism**
   a. Position of the roots of the adjacent dentition within the alveolar bone
   b. Tooth/ridge relationship of opposing arch (e.g., overbite, overjet, cross-bite, supraeruption)

2. **Isolated Partial Edentulism in the Esthetic Zone**
   a. The presence of anatomical variations (e.g., “high smile line,” crown length, maxillary hyperplasia)
   b. Position of the roots of the adjacent dentition within the alveolar bone
   c. Insufficient or excessive interdental space
   d. Tooth/ridge relationship of opposing arch (e.g., overbite, overjet, cross-bite, supraeruption)
   e. Unfavorable ridge morphologic features
   f. Vertical maxillary deficiency with reduced reconstructive soft tissue envelope
   g. Compromised bone volume on adjacent natural dentition
   h. Unfavorable axial inclination of adjacent teeth
   i. Inadequate orthodontic retention
   j. Unrealistic patient expectations
   k. Gingival biotype (inadequate orofacial soft tissue thickness less than 2.0 mm required to mask underlying implant components or for lateral biologic width requirements)
   l. Shape of tooth crowns (triangular indicates high risk; ovoid, medium risk; and square, low risk)
   m. Restorative status of adjacent teeth (virgin indicates low risk; subgingival restoration with ideal biologic acceptance, medium risk; and subgingival restoration with inflammatory response, high
3. **Edentulous Mandible**
   a. Relative position of soft tissue, muscle attachments, and the inferior alveolar and mental nerve foramen
   b. Location of adjacent vascular structures
   c. Relative position of genial tubercle
   d. Relative position of the floor of mouth and salivary glands and ducts

4. **Edentulous Maxilla**
   a. Relative position of soft tissue and muscle attachments
   b. Location of adjacent vascular structures
   c. Pneumatized maxillary sinuses
   d. Maxillary sinus disease (eg, obstructed ostium)
   e. Enlarged incisive canal

5. **Reconstructed Maxilla (Partially and Edentulous)**
   a. Potential vascular compromise of grafted area
   b. Position of the roots of the adjacent dentition
   c. Anatomical relationship of maxillary sinus and nasal fossa
   d. Size and location of incisive canal

6. **Reconstructed Mandible (Partially and Edentulous)**
   a. Potential vascular compromise of grafted area
   b. Potential for grafted bone to be inadequately fixated, consolidated, and/or incorporated

7. **Irradiated Bone**
   a. Tissue hypoxia
   b. Tissue hypocellularity
   c. Potential for tumor recurrence
   d. Xerostomia
   e. Diminished reparative capability of tissue
   f. Potential for radiation-induced cervical caries
   g. Low tolerance of overlying mucosa and skin to trauma
   h. Radiation dose
   i. Absorbed radiation dose to the implant region
   j. Diminished potential for osseointegration
   k. Correlation between implant lengths and implant losses
   l. Higher frequency of implant loss in craniofacial bones (frontal bone, followed by zygoma, maxilla, and mastoid process of the temporal bone)
   m. Interval between irradiation and implant placement
   n. Smoking habits of patient
   o. Radiation-associated trismus and with difficult surgical access
   p. Radiation source (eg, internal source of radiation, such as iridium implants, increase risk for radiation damage)
   q. Radiation fractionation
   r. Potential for reparative fibrosis, demineralization of bone, and increased susceptibility to infection and avascular necrosis

8. **Reconstructed Alveolar Cleft**
   a. Ridge relationship of opposing arch
   b. Presence of severe atrophy
   c. Position of the roots of the adjacent dentition
   d. Size and location of incisive canal

9. **Developmental or Acquired Craniofacial Deformities**
   a. Relative position of vital structures (eg, nerves, cranial contents, vasculature)
   b. Relative position of craniofacial sinus
IV. Indicated Therapeutic Parameters

The presurgical assessment includes, at a minimum, a clinical and imaging evaluation, as well as a prosthetic treatment plan. Also see the Patient Assessment chapter.

Proper patient selection; flap design; prevention of thermal injury; selection of site, angle, position, and trajectory; and primary implant stability are critical factors in achieving favorable outcomes. Magnitude and time of implant loading must be taken into consideration.

The following procedures for the management of are not listed in order of preference:

A. General

1. Placement of osseointegrated type implant(s), including, when appropriate, immediate placement and immediate provisionalization with and without occlusal loading
2. Augmentation with autogenous, allogeneic, xenogeneic, or alloplastic graft(s) or growth factors, bone morphogenetic protein, and autologous and allogeneic stem cells to facilitate implant reconstruction, including sinus/nasal floor grafts
3. Harvesting of autogenous grafts from intraoral or extraoral sites, including but not limited to mandibular ramus, ramus body, symphysis, alveolar ridge and retromolar region, maxillary tuberosity, zygomatic buttress ilium, cranium, tibia
4. Supplemental procedures:
   a. Guided tissue regeneration (resorbable guided tissue regeneration, nonresorbable)
   b. Soft tissue augmentation (eg, grafts and local flaps)
   c. Maxillary or mandibular osteotomy with or without bone graft and rigid fixation or osseous distraction
   d. Ridge preservation at time of extraction and hard or soft tissue site development
5. Instructions for posttreatment care and follow-up

B. Specific

1. Partial Edentulous Ridge
2. Isolated Partial Edentulism in the Esthetic Zone
   a. Placement of osseointegrated type implant(s), including, when appropriate, early and/or immediate placement and immediate provisionalization without occlusal loading
3. Edentulous Mandible
   a. Placement of transossseous implant
   b. Placement of subperiosteal implant
4. Edentulous Maxilla
   a. Supplemental procedures:
      i. Placement of pterygoid, zygomatic, and palatal implants
      ii. Alveoloplasty, alveolectomy, vestibuloplasty
5. Reconstructed Mandible (Partially or Edentulous)
   a. Placement of transossseous implant
   b. Placement of subperiosteal implant
6. Irradiated Bone
   a. Use of microsurgically revascularized bone grafts
   b. Use of hyperbaric oxygen
   c. Instructions for posttreatment care and follow-up (implant maintenance procedure)
7. Reconstructed Alveolar Cleft
   a. Placement of pterygoid, zygomatic, and palatal implants
8. Developmental or Acquired Craniofacial Deformities
   a. Use of absolute anchorage implants for correction of some skeletal deformities

V. Outcome Assessment Indices

Indices are used by the specialty to assess aggregate outcomes of care. Outcomes are assessed through clinical evaluation and may include an imaging evaluation.

A. General
1. Favorable therapeutic outcomes
   a. General favorable therapeutic outcomes, as listed in the section entitled General Criteria, Parameters, and Considerations for Dental and Craniomaxillofacial Implant Surgery
   b. Improved speech
   c. Achievement of favorable aesthetics
   d. Improved deglutition
   e. Improved mastication
   f. Preservation of alveolar supportive bone
   g. Prevention of gagging
   h. Improved patient social confidence and self-esteem

2. Known risks and complications associated with therapy
   a. Presence of a general known risk and/or complication, as listed in the section entitled General Criteria, Parameters, and Considerations for Dental and Craniomaxillofacial Implant Surgery

B. Specific

1. Partial edentulous ridge
   a. Favorable therapeutic outcomes
      i. Preservation of natural dentition
      ii. Prevention of occlusal overloading of remaining natural dentition
      iii. Successful orthodontic treatment
      iv. Improved stability of obturators
   b. Known risks and complications associated with therapy
      i. Loss of or damage to adjacent dentition

2. Isolated Partial Edentulism in the esthetic Zone
   a. Favorable therapeutic outcomes
      i. Achievement of favorable or harmonious aesthetics
      ii. Preservation of natural dentition
      iii. Prevention of occlusal overloading of remaining natural dentition
   b. Known risks and complications associated with therapy
      i. Loss of or damage to adjacent dentition
      ii. Fibrotic wound healing, resulting in an unaesthetic result
      iii. Loss of alveolar bone and soft tissues, resulting in aesthetic, phonetic, and functional compromise

3. Edentulous Mandible
   a. Favorable therapeutic outcomes
   b. Known risks and complications associated with therapy
      i. Mandibular fracture
      ii. Salivary duct/gland injuries
      iii. Soft tissue hyperplasia
      iv. Life threatening hemorrhage

4. Edentulous Maxilla
   a. Favorable therapeutic outcomes
      i. Improved stability of obturators
   b. Known risks and complications associated with therapy
      i. Oral nasal and oral antral fistulae
      ii. Maxillary sinus infection and/or disease

5. Reconstructed Mandible (Partially and Edentulous)
   a. Favorable therapeutic outcomes
   b. Known risks and complications associated with therapy
      i. Salivary duct/gland injuries

6. Reconstructed Maxilla (Partially and Edentulous)
   a. Favorable therapeutic outcomes
      i. Prevention of occlusal overloading of remaining natural dentition
      ii. Improved stability of obturators
   b. Known risks and complications associated with therapy
      i. Oral nasal and oral antral fistulae
ii. Maxillary sinus infection and/or disease

7. **Irradiated Bone**
   a. Favorable therapeutic outcomes
      i. Preservation of remaining dentition
      ii. Improved stability of obturators
      iii. Provision of anchorage of maxillofacial, nasal, orbital, and ear prosthesis
      iv. Diminished risk of osteoradionecrosis secondary to trauma from conventional removable prosthesis
   b. Known risks and complications associated with therapy
      i. Diminished potential for osseointegration
      ii. Osteoradionecrosis
      iii. Delayed healing of overlying mucosa skin
      iv. Risk of tumor recurrence mimicking inflammation/infection
      v. Longer healing periods

8. **Reconstructed Alveolar Cleft**
   a. Favorable therapeutic outcomes
      i. Prevention of occlusal overloading of remaining natural dentition
   b. Known risks and complications associated with implant therapy
      i. Neurosensory disturbances
      ii. Soft tissue hyperplasia
      iii. Failed implant
      iv. Periimplantitis

9. **Developmental or Acquired Craniofacial Deformities**
   a. Favorable therapeutic outcomes
      i. Preservation of natural dentition
      ii. Improved stability of obturators
      iii. Improved retention of maxillofacial prosthesis
   b. Known risks and complications associated with therapy
      i. Loss of remaining soft or hard tissue
      ii. Need for replacement of implant and/or prosthesis
      iii. Damage to adjacent structures (e.g., intracranial contents, neurovascular structures, craniofacial sinus)

**SELECTED REFERENCES – DENTAL AND CRANIOMAXILLOFACIAL IMPLANT SURGERY**

This list of selected references is intended only to acknowledge some of the sources of information drawn on in the preparation of this document. Citation of the reference material is not meant to imply endorsement of any statement contained in the reference material. The list is not an exhaustive compilation of information on the topic. Readers should consult other sources to obtain a complete bibliography.

**SPECIAL CONSIDERATIONS FOR PEDIATRIC DENTAL AND CRANIOMAXILLOFACIAL IMPLANT SURGERY**

Maxillofac Implants 23:520, 2008


DENTAL AND CRANIOMAXILLOFACIAL IMPLANT SURGERY


30. Bahat O, Daftary F: Surgical reconstruction – a prerequisite for long-term implant success: a philosophic...


47. Brägger U, Hämmérle CH, Lang NP: Immediate transmucosal implants using the principle of guided tissue regeneration. II. A cross-sectional study comparing the clinical outcome 1 year after immediate to standard approach. Pract Periodont Aesthet Dent 7:21, 1995


47. Brägger U, Hämmérle CH, Lang NP: Immediate transmucosal implants using the principle of guided tissue regeneration. II. A cross-sectional study comparing the clinical outcome 1 year after immediate to standard approach. Pract Periodont Aesthet Dent 7:21, 1995
133. Grunder U: Crestal ridge width changes when placing implants at the time of tooth extraction with and without soft tissue augmentation after a healing period of 6 months: report of 24 consecutive cases. Int J Periodontics Restorative Dent 31:9, 2011
137. Hammerle CH, Chen ST, Wilson TG: Consensus statements and recommended clinical procedures
regarding the placement of implants in extraction sockets. Int J Oral Maxillofac Implants 19(Suppl):26, 2004


1036. Regeneration in Implant Dentistry. Chicago, IL, Quintessence, 1994, p. 235
Maxillofac Implants 7:203, 1992
1038. Jensen OT, Perkins S, Van de Water FW: Nasal fossa and maxillary sinus grafting of implants from a
1042. Jovanovic SA, Spiekermann H, Richter EJ: Bone regeneration around titanium dental implants in dehisced
81:34, 2010
Maxillofac Implants. 25:970, 2010
1045. Kahnberg KE, Nystrom L, Bartholdsson L: Combined use of bone grafts and Branemark fixtures in the
placement and provisionalization of maxillary anterior single implants: a 2- to 8-year follow-up. Int J Oral
Maxillofac Implants 26:179, 2011
effects of incisal guidance, fixture orientation, and loss of bone support. Int J Oral Maxillofac Implants
8:512, 1993
Palate Craniofac J 34:520, 1997
1050. Keller EE, Eckert SE, Tolman DE: Maxillary central and one-stage inlay composite bone graft: preliminary
1052. Kent JN, Block MS: Simultaneous maxillary sinus floor bone grafting and placement of hydroxylapatite-
1055. Kordatzis K, Wright PS, Meljer JA: Posterior mandibular residual ridge resorption in patients with
rehabilitation of orbital defects in irradiated cancer patients: a report of clinical outcomes and
20:1375, 2009
1058. Koutrakis M, Nimmo A: Preservation of existing soft-tissue contours in the transition from a tooth to an
1061. Landsberg CJ, Bichacho N: A modified surgical/prosthetic approach for an optimal single implant


243. Orthodontics as a restorative option: implant anchorage to close posterior extraction sites. Orthodontic Dialogue 7, 1994
268. Ronchi P, Chiapasco M, Frattini D: Endosseous implants for prosthetic rehabilitation in bone grafted...


322. Touati B: Improving aesthetics of implant-supported restorations. Pract Periodontics Aesthet Dent 7:81, 1995


