

Goodacre CJ, Bernal G, Rungcharassaeng K. et al. Clinical complication with implants and implant prostheses. J Prosthet Dent 2003;90:121-32. (218 Refs)

Purpose: To identify the types of complications that have been reported in conjunction with implants and implant prostheses

Materials and Methods: A medline search

Findings and Conclusions:

•Surgical complication

There are many surgical complications such as hemorrhage-related complications, neurosensory disturbance, adjacent tooth devitalization/damage, mandibular fractures, life-threatening hemorrhage, air emboli, implant displacement into mandibular canal, screwdriver aspiration, descending necrotizing mediastinitis, intraocular hemorrhage, and singulutus.

	Number of patients studied/affected
Mean incidence	
Hemorrhage-related complications 24%	379/92
Neurosensory disturbance 7%	2142/151
Mandibular fracture 0.3%	1523/4

•Implant loss

(1) Prosthesis/arch

Arch/prosthesis	Number of implants studied/lost
Mean incidence	
Maxillary overdentures 19%	1103/205
Maxillary fixed complete denture 10%	4559/443
Maxillary fixed partial dentures 6%	3297/213
Mandibular fixed partial dentures 6%	2567/157
Mandibular overdentures 4%	5683/242
Mandibular fixed complete denture 3%	9991/255
Maxillary and mandibular single crowns 3%	1512/42

(2) Timing of implant loss

Prosthesis	Number of implant lost	Number lost before prosthesis placement (%)	Number lost after prosthesis placement
Implant fixed complete dentures	248	135 (54%)	113 (46%)
Implant overdentures	293	176 (60%)	117 (40%)

Implant fixed partial dentures	170	104 (61%)	66 (39%)
Implant single crowns	15	7 (47%)	8 (53%)

(3) Implant length

	Number of implants studied/lost
Mean incidence	
10mm or less in length 10%	2754/272
Greater than 10mm in length 3%	3015/105

(4) Bone quality

	Number of implants studied/lost
Mean incidence	
Type I to III 4%	3192/113
Type IV 16%	1009/160

(5) Systemic conditions

Several factors produce systemic changes that have been evaluated for their effect on implant success/failure. Smoking, radiation therapy, diabetes, chemotherapy, osteoporosis, hormone replacement therapy, scleroderma, Sjogren's syndrome, Parkinson's disease, multiple myeloma, and HIV-seropositive status have been studied. From the limited information, it appears that osteoporosis, scleroderma, chemotherapy, and hormone replacement therapy do not negatively affect implant success.

	Number of implants studied/lost
Mean incidence	
Smoking 5% S: 11%	Nonsmoker 4862/239 Smoker 1668/178 NS:
Radiation Mx: 25% Mn: 6%	Maxilla 217/55 Mandible 1296/79
Controlled diabetes 9%	1053/93

•Bone loss

Mean marginal bone loss during the first year	Mean marginal bone loss per year in subsequent years
0.9mm (range from 0.4 to 1.6)	0.1mm (range from 0 to 0.2mm)

•Peri-implant soft tissue complication

	Number of implants studied/lost
Mean incidence	
Fenestration/dehiscence 7%	3156/223
Gingival inflammation/proliferation 6%	17,565/1,060
Fistulas 1%	11,735/117

•Method of assessing peri-implant health

The relationship between implant loss/bone loss and the factors conventionally used to evaluate the periodontal status of natural teeth is not clear so far.

•Mechanical complications

	Number	placed/affected
Mean incidence		
Overdenture loss of retention/adjustment 30%		376/113 prostheses
Esthetic veneer fracture (resin) 22%		663/144 prostheses
Overdenture relines 19%		595/114 prostheses
Overdenture clip/attachment fracture 17%		468/80 prostheses
Esthetic veneer fracture (porcelain) 14%		258/36 prostheses
Overdenture fracture 12%		570/69 prostheses
Opposing prosthesis fracture 12%		168/20 prostheses

•Esthetic/ phonetic complications

Esthetic complications occurred with a mean incidence of 10% (47 of 293 crowns) and of 730 prostheses 51 (7%) caused phonetic problems.

•Most common implant complication

	Number	placed/affected
Mean incidence		
Overdenture clip/attachment loosening 30%		376/113 prostheses
Implant loss in maxilla from radiation therapy 25%		217/55 implants
Hemorrhage-related complications 24%		379/92 patients

•Complications incidence comparison of prostheses

complications	Mean incidence	Number of prostheses studied/affected by
Conventional fixed partial dentures 27%		3272/886
Resin bonded prostheses 26%		7029/1823
Conventional single crowns 11%		1476/157
Post and cores 10%		2784/279
All-ceramic crowns 8%		4277/357

Palmer RM, Palmer PJ, Newton JT. Dealing with esthetic demands in the anterior maxilla. Periodontol 2000 2003;33:105-118. (33 Refs)

Purpose: To discuss considerations when restoring the edentulous anterior maxilla.

Materials and Methods: Review and authors' opinion.

Findings and Conclusions: The anterior maxilla, from 1st premolar to 1st premolar, is often described as the esthetic zone. Esthetics is subjective. A patient's expectation is either specific for his/her own mouth or based on a perceived ideal.

Assessment and Diagnosis- Study models, radiographs and the lip and facial tissue presentation are useful for diagnosing and planning an esthetic case. The teeth and gingival exposure when a patient smiles and laughs, and the frontal and lateral view of a patient should be assessed clinically. The health, dimensions and contours of the soft tissue are also assessed clinically. From study casts, the M-D and B-L dimensions can be measured and a diagnostic wax-up can be completed. Dimensions of an edentulous site can be confirmed on radiographs, and the extent of hard tissue is also ascertained. A diagnostic removable prosthesis can be used to permit the patient to "try" the appearance, allow for easy modifications and be used as a provisional restoration; however, some patients dislike a removable prosthesis and, at times, the esthetics may be easier to achieve on a removable prosthesis than for a fixed implant prosthesis.

Compromised Case- Esthetic cases, from a single tooth restoration to a longer span, may require compromise. With single tooth restorations, alterations may need to be made on the adjacent dentition to achieve a desired esthetic outcome. This may be due to a deficiency in soft tissue and bone vertically and/or horizontally. The amount and extent of bone loss can be affected by the duration of tooth loss or trauma. The Periodontal condition may present an esthetic challenge due to recession, loss of papillae, large interdental spaces, bone loss, tooth position and mobility. Endodontic lesions and prior apical surgery may contribute to a compromised area in the esthetic zone. Cleft lip and palate individuals often have missing or malformed lateral incisors, ridge deficiencies or failed fixed prosthesis which are managed with extractions and result in a larger edentulous area.

Treatment Strategies- Treatment strategies for the compromised case can be addressed either surgically or prosthetically. Guided bone regeneration may be completed, although the patient should be aware that the deficiency may not be completely resolved. Teeth may be extracted to allow for more esthetic results. Conventional or implant supported removable partial dentures and fixed partial dentures can also provide adequate esthetics, provided the bone and remaining teeth are sound. Pink porcelain is another option used to disguise the lack of gingiva. For some cases, a transitional tooth supported bridge may be indicated as a "trial" prosthesis with the benefit of minimizing loading forces on the edentulous ridge. Disadvantages to this type of restoration may be cost in time as well as money, and the retained teeth may be the most suitable location for implant placement. Other alternatives include temporary implants with a fixed provisional restoration, immediate implants with an immediate bridge or a removable provisional denture.

Implant Placement- If minimal bone resorption has occurred in an edentulous area, the placement of the implant 3 mm apical to the level of the CEJ of adjacent teeth has been recommended for an esthetic emergence profile of the restoration. With vertical bone loss, the top of the implant is placed at the level of the crest or just coronal to it depending on the implant design. For a compromised ridge, the implant is positioned more palatally. For a removable prosthesis, the implant can be placed at the site which provides the most stability and the best amount of bone as long as adequate space is provided for the attachment apparatus. For a fixed prosthesis, the implant site is chosen to minimize both cantilever forces and esthetic compromises. The implants should be placed at the location of the teeth which they are replacing. Labial angulation with the long axis either through the cingulum area or the incisal tip can result in acceptable although not optimal esthetic results. A balance between a patient's expectations and what the clinician is capable of achieving must be reached through dialogue and careful planning.

Kim Y, Oh TJ, Misch CE, Wang HL. Occlusal considerations in implant therapy: clinical guidelines with biomechanical rationale. Clin Oral Impl Res 2005; 16: 26-35. (94 Refs)

Purpose: To discuss the importance of implant occlusion for implant longevity and to provide clinical guidelines of optimal implant occlusion based on the currently available literature. In addition, possible solutions managing complications related to implant occlusion are proposed.

Materials and Methods: literature review.

Findings and Conclusions:

Differences between teeth and implants:

	Tooth	Implant	Discussion
Connection	PDL	Osseointegration, functional ankylosis	
Proprioception	Periodontal mechanoreceptors	Osseoperception	The presence or absence of the PDL functions makes a remarkable difference in detecting early phase of occlusal force between teeth and implants. The detection threshold of minimal pressure was significantly higher on implants (8.75 times >) than on natural teeth. Thus it can be speculated that osseointegrated implants without periodontal receptors would be more susceptible to occlusal overloading because the load sharing ability, adaptation to occlusal force, and mechanoperception are significantly reduced in dental implants.
Tactile sensitivity	High	Low	
Axial mobility	25-100µm	3-5 µm	The tooth mobility from PDL can provide adaptability to jaw skeletal deformation or torsion in natural teeth. However, dental implants do not possess those advantages due to lack of PDL.
Movement phases	Two phases: Primary: non-	One phase: linear and elastic	The movement of a natural tooth begins with the initial phase of

	linear and complex Secondary: linear and elastic		periodontal compliance, followed by the secondary movement phase occurring with the engagement of the alveolar bone. In contrast, a loaded implant initially deflects in a linear and elastic pattern, and the movement is dependent on elastic deformation of the bone.
Movement patterns	Primary: immediate movement Secondary: gradual movement	Gradual movement	
Fulcrum to lateral force	Apical third of root	Crestal bone	There is concentration of greater forces at the crest of surrounding bone of dental implants without any rotation of implants. Richter also reported a transverse load and clenching at centric contacts resulted in the highest stress in the crestal bone.
Load-bearing characteristics	Shock absorbing function Stress distribution	Stress concentration at crestal bone	
Signs of overloading	PDL thickening, mobility, wear facets, fremitus, pain	Screw loosening or fracture, abutment or prosthesis fracture, bone loss, implant fracture	

Possible overloading factors of implant occlusion:

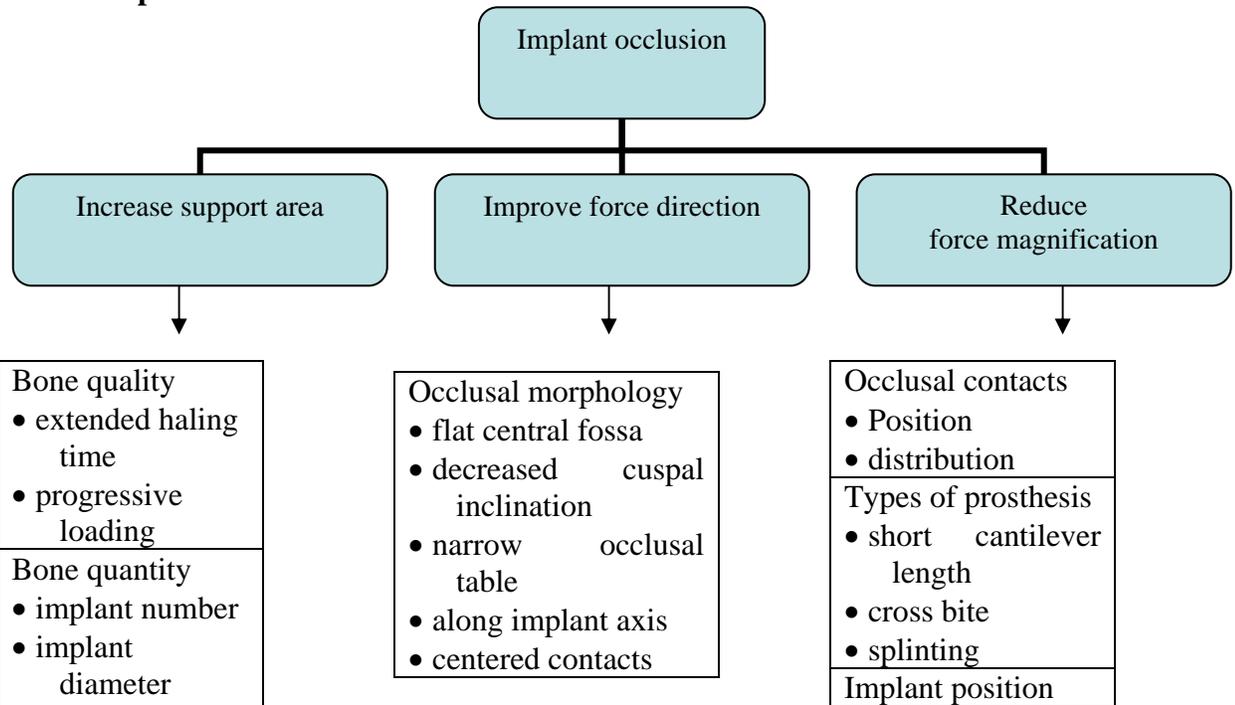
Factors	discussion
<p>Overextended cantilever</p> <ul style="list-style-type: none"> • > 15 mm in the mandible • > 10-12 mm in the maxilla 	<p>When a biting force was applied to the distal cantilever, the highest axial forces and bending moments were recorded on the distal implants, which were more pronounced in the prosthesis supported by only three implants as compared with prostheses with five or six implants. Shackleton et al. indicated that a shorter cantilever length is more favorable for the success of mandibular fixed implants supported prosthesis. On the other hand, <10-12 mm cantilever was recommended in the maxilla due to unfavorable bone quality and unfavorable force direction compared with mandible.</p>

<p>Parafunctional habits/ heavy bite force</p>	<p>Overload from parafunctional habits seemed to be the most probable cause of implant loss and marginal bone loss after loading. Heavy occlusal force and undesirable distribution of occlusal contacts may be factors of overloading, thus possibly leading to higher susceptibility to implant bone loss, implant fractures/loss, and prosthesis failures.</p>
<p>Excessive premature contacts</p> <ul style="list-style-type: none"> • >180 μm in monkey studies • >100 μm in human studies 	<p>Studies have suggested a critical height of premature occlusal contacts on implant prostheses for crestal bone loss.</p>
<p>Large occlusal table</p>	<p>Typically 30-40% reduction of occlusal table in a molar region has been suggested, but any dimension larger than the implant diameter can create cantilever effects and eventual bending moments in single-implant prosthesis. A narrow occlusal table reduces the chance of offset loading and increased axial loading, which eventually can decrease the bending moment. Misch described that a narrow occlusal table also improves oral hygiene and reduces risks of porcelain fracture. He also described the utilization of cross-bite occlusion to avoid buccal cantilever and increase axial loading in cases of palatal placement of maxillary molar implants.</p>
<p>Steep cusp inclination</p>	<p>The reduction of cusp inclination can decrease the resultant bending moment with a lever-arm reduction and improvement of axial loading force. A flat area around centric contacts can direct the occlusal force in an apical direction. Studies indicate that the cusp inclination affected the magnitude of forces transmitted to implant prosthesis. A reduced cusp inclination, shallow occlusal anatomy, and wide grooves and fossae could be beneficial for implant prosthesis.</p>
<p>Poor bone quality/ density</p>	<p>Bone quality has been considered the most critical factor for implant success at both surgical and functional stages and it is therefore suggested that occlusal overload in poor-quality bone can be a clinical concern for implant longevity. The combination of poor bone quality and overload was considered to be the leading cause for the late implant failure. Misch proposed that progressive bone loading can permit development time for load-bearing bone at bone-to-implant interface and provide bone with adaptability to loading via a gradual increase of loading. These findings suggest that extended healing time and carefully monitored loading may be needed in poor quality bone.</p>
<p>Inadequate numbers of implants</p>	

Basic principles of implant occlusion may include:

1. Bilateral stability in centric occlusion: this also provides stability of the masticatory system and a proper force distribution.
2. Evenly distributed occlusal contacts and force.
3. No interferences between retruded position and centric position.
4. Wide freedom in centric occlusion (1-1.5 mm): can accomplish more favorable vertical lines of force and thus minimize premature contacts during function. A 1.5 mm of flat fossa area for side freedom in centric in the prosthesis has been recommended for this purpose.
5. Anterior guidance whenever possible: Gibbs et al. found that anterior or canine guidance decreased chewing force compared with posterior guidance.
6. Smooth, even, lateral excursive movements without working/non-working interferences.

Objectives of implant occlusion:



Occlusal guidelines for clinical applications:

Clinical situation	Occlusal principles
Full-arch fixed prosthesis	<ul style="list-style-type: none"> • Bilateral balanced occlusion (BBO) with opposing CD • Group function or mutually protected occlusion with shallow anterior guidance when opposing natural dentition • No working and balancing contact on cantilever • Infraocclusion in cantilever segment (100 µm) • Freedom in centric (1-1.5 mm)
Overdenture	<ul style="list-style-type: none"> • BBO using lingualized occlusion • Monoplane occlusion on a severely resorbed ridge
Posterior fixed	<ul style="list-style-type: none"> • Anterior guidance with natural dentition

prosthesis	<ul style="list-style-type: none"> • Group function occlusion with compromised canines • Centered contacts, narrow occlusal tables, flat cusps, minimized cantilever • Cross bite posterior occlusion when necessary • Natural tooth connection with rigid attachment when compromised support
Single implant prosthesis	<ul style="list-style-type: none"> • Anterior or lateral guidance with natural dentition • Light contact at heavy bite and no contact at light bite • Centered contacts (1-1.5 mm flat area) • No offset contacts • Increased proximal contact
Poor quality of bone/grafted bone	<ul style="list-style-type: none"> • Longer healing time • Progressive loading by staging diet and occlusal contacts/materials

1. The amount of stress and the quality of the bone are related to implant longevity
2. Occlusal overloading, possibly resulting from large cantilevers, excessive premature contacts, parafunctional activities, improper occlusal designs, and/or osseointegrated full fixed prostheses in both jaws, can be a limiting factor for implant longevity
3. Even distribution of occlusal contacts avoiding occlusal interferences and increasing number of implants may significantly reduce occlusal overload on implants and implant prosthesis
4. Poor quality bone may be more vulnerable to occlusal overloading, which can be reduced by extended healing time and carefully monitored loading.