Implant planning affects periimplant diseases

A time shift link

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_Implants are becoming increasingly popular with low-cost offers promoting this development. The number of customers preferring implants to customary restorations is expanding. The variety of client demands, individual settings, treatment options and risks related to inflammation and bone damage following implant treatment advocate evident, comprehensible and durable solutions.

Safeguarding implant treatment commences with careful tooth removal, pre-implant treatment and implant planning respecting four key issues:

1. Early decision making to ensure implant bone support with limited number of implant placements.
2. Sound tooth removal to protect bone loss by intraalveolar root dissection.
3. Accuracy of implant diagnosis and implant placement by 3-D visualization (DVT) of implant surgical access.
4. Minimal surgical involvement with short and low diameter implants while restricting augmentation to prosthetic relevant settings.

_Planning

Early Decision Making

Early implant decision making comprises anatomical, functional and economic issues:

a) Anatomy: Treated severe periodontitis usually displays clinical stability with further drawbacks around implant supported bone at buccal plates or interapproximal sites by inflammation (Figs. 1 & 2).[1]

b) Function: Following untreated periodontal diseases or tooth removal, shifting of single tooth initiates due to myofunctional imbalance. By loss of front-canine equilibration, a group side shift emerges with further bite reduction as result of age and misusage.[2]

c) Dues: Periodontal therapy of severely compromised teeth with bone loss > 50 % often results in a later date implant treatment that doubles dental efforts and bills. Economic issues should downregulate this strategy.

d) Oral comfort: Stability, oral hygiene and esthetics become fostered by timely implant placement and optimized implant prosthetics.

Fig. 1_Severe periodontitis, residual inflammation and bacteremia. Poor hygienic capability, comfort and esthetics with furcation caries.
Fig. 2_Drawn-out expectation period in advanced periodontal disease at # 15, 16 with horizontal alveloar bone resorption at assigned implant site (see Fig. 14).


Fig. 1

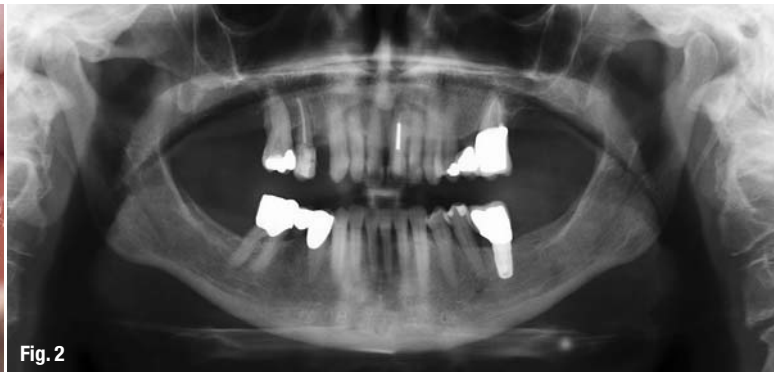
Fig. 2

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Fig. 3


Fig. 4

Fig. 3_Surgical access to deep intrabony periodontal pockets securing the residual dentition and safeguarding inflammation prior to implant placement following completion of non-surgical periodontal therapy.

Fig. 4_Microsurgical revision using a vascular pedicle flap to maintain interdental papillae and augment resting periodontal pockets with autogenous bone. Usage of Osteora (antiinflammatory) or Emdogain, if applicable.

Fig. 5_Relaxation appliance in the maxilla with a frontal plateau to decompensate age and use related bite reduction prior to final implant planning.

Fig. 6_Temporary relief from damage resulting from use (wear) and habits by restoring a front-canine equilibration.

Fig. 7_Vertical release of 1 mm achieving premolar and molar relief to promote bone healing following treatment of periodontal compromised sites prior to implant surgery.

Clinical practice emphasizes a time-tested planning with (i) removal of severely compromised teeth, (ii) periodontal therapy securing the residual dentition, supplemented by (iii) microsurgical revision of deep intrabony pockets prior to implant placement to safeguard inflammation (Figs. 3 & 4). Implant planning resides tentatively. A final quotation will be drawn after completion of functional relief and 3-D digital evaluation of the implant bone anatomy.

Functional decompensation

Fully and partially edentulous patients frequently reveal a bite reduction by usage (wear) with loss of front-canine equilibration and a resulting left and right grouped pemolar and molar side shift.[3] Dysfunction and habits (pressing, grinding etc.) promote further damage. In severe periodontitis, group side shift accelerates disease progression, impedes post therapy healing and weakens alveloar bone assigned for later implant placement. Early implant planning includes following key issues:

1. Inspection of the oral cavity comprises evaluation of the mastication muscels (M. temporalis, M. masseter) and the temporomandibular joints (M. pterygoideus medialis und lateralis) with focus of tension, induration and pain pressure.
2. Osteopathic examination of craniocaudal dysfunctions: initiated by body statics (inclined position), (mis-)posture, walk (activity) etc. should exclude somatic sources. If applicable supportive therapy. If applicable, manual osteopathic treatment to improve physiologic function, i.e. body alignment, symmetry and support homeostasis that has been altered by somatic dysfunctions.[4]
3. Carefull reduction of prominent protrusive contacts (front) and sliding bars during laterotrusion on the operating side.
4. Placement of a relaxation appliance in the maxilla (overbite and deep bite in the mandible) for functional decompensation with a frontal plateau allowing a front-canine equilibration and temporary relief in molars by vertical release of 1 mm (Figs. 5–7).


Fig. 5


Fig. 6


Fig. 7

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Fig. 8

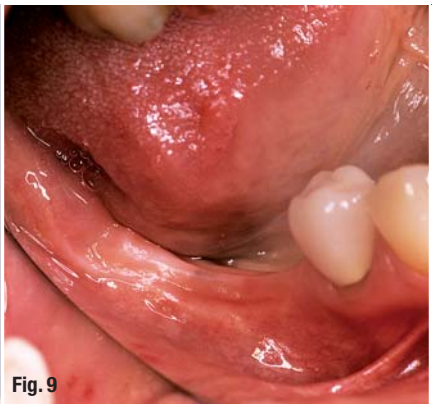


Fig. 9

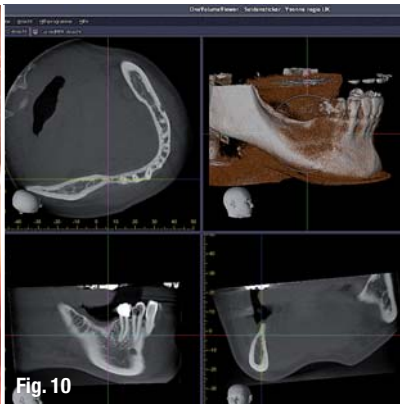


Fig. 10

Fig. 8_Intraoral appliances are manufactured as strew splints in a dimension of 1.5 mm with extension to the first molars (complete dental arch).

Fig. 9_Advanced horizontal alveolar bone atrophy in the mandible with small ridge, vestibular sloping plateau, proximity to n. alveolaris and small keratinized gingiva.

Fig. 10_Securing implant planning (implant length, positioning, diameter and surgery) by DVT review (Cranium Bonn, Germany, 2014).

The primary objective is the decompensation of use-related dysfunctions to achieve relief, vascularization and mineralization of the alveolar bone prior to implant placement. Subsequent realization of the issues 1–4 ensures dispenses of the habitual use patterns after 4 to 6 weeks wearing. Due to hygiene and stabilization, the intraoral appliances are manufactured as strew splints in a dimension of 1.5 mm with extension limited to the first molars (Fig. 8).

_Digital imaging 3-D

Digitization means information and safeness. The generation of a DVT in early implant planning harbors three vantages:

- Commitment: The expenses of 120–180 EUR depending to extent, area of analysis and institute display a motivational factor ensuring consent with the treatment plan. Young patients and IT employees ask for the benefit of 3-D imaging during the first or second visit of implant planning to safeguard and minimize surgical implant placement.
- Anatomy: Additional information about vicinity to N. alveolaris, extent of sinus maxillaris and anatomical septa, characteristics and mineralization of implant bone (following tooth removal) and implant positioning related to adjacent teeth (Figs. 9 & 10). However, inclined DVT readings result in measurement errors up to 1 mm.[5, 6]
- Precision: The benefit of a time-intense 3-D implant evaluation is a more precise, controlled and risk-reduced planning, and eases surgical implant placement. These advantages should be utilized by all dental health care providers, even those with long-term clinical expertise.

If you are not a DVT owner, oral surgeons (specialists) and diagnostic radiology clinics are appropriate contact addresses. Regard: For the intended 3-D image, always allocate the exact DVT area, details and viewer suitable for your PC software. The expenses both of the DVT and the digital analysis and evaluation are subjects to private cash.

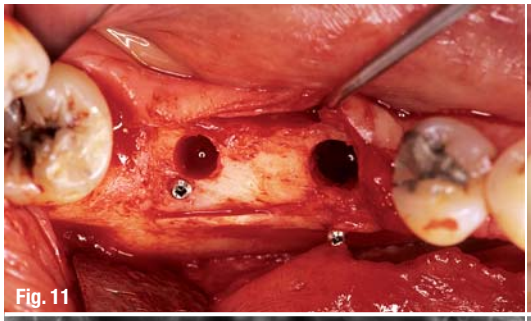


Fig. 11


Fig. 12

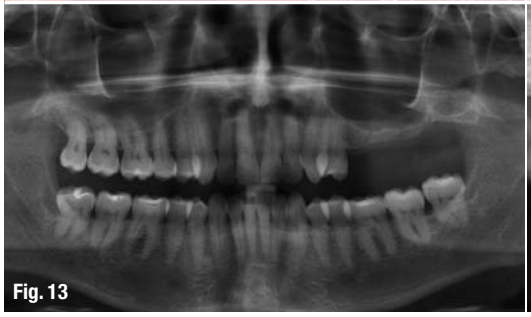


Fig. 13


Fig. 14

Fig. 11_Interimplant distances of 7 mm at front and premolar sites with 11 mm in molars to safeguard vascularization and periimplant damage, assigned from prosthodontics. Surgery: Dr G. Kochhan.

Fig. 12_Inadequate implant bone support with vestibular bony defect following tooth loss due to traumatic crossbite relationship in the left upper maxilla.

Fig. 13_Initial setting (OPG) with combined vertical and lateral alveolar bone defect. Augmentation using sinus floor elevation (vertical) und BoneShield technique (lateral) with separate implant placement # 25, 26, 27.

Fig. 14_Vertical implant bone defect # 16 as result of long-term periodontal damage (see Fig. 2). Prevention of sinus elevation by 3-D analysis with implant placement close to sinus.

Interimplant distance

If an implant is placed adjacent to a tooth, the interdental papilla remains. If two implants are inserted side by side, the supracrestal biological width and the papilla as result disappear, independent of the implant type used.[7] The effects of implants with platform switching, concave abutments, micromachined neck or implant abutment micro-movements onto the stability of crestal bone and soft tissues are limited to subclinical notice.[8,9] The interimplant distances primarily follow prosthetic requirements of the residual dentition.[10] From anatomy, the present rules occur:

1. Minimal distance between single-rooted teeth incl. premolars: 7 mm.
2. In molars interimplant distances of at least 11 mm (Fig. 11).

For appropriate implant placement according to prosthetics, the local bone anatomy is often inadequate, especially in patients with cross-bite or long-term periodontal damage etc. (Figs. 12–14). If the clinical setting implicates deficient implant bone support, 3-D digital imaging of alveolar bone including individualized implant positioning with diameter-reduced implants is allocated. Note: Prior to surgery, calculate additional efforts, extent and expenses of alternative augmentation, bone grafting or allogeneic bone grafts including pedicle flap surgery and infection due to soft tissue advancements.

_Implant placement

Perfusion

Maintenance of vascularized implant bone is indispensable to avoid further periimplant damage as result of spongious bone tissue injury during implant surgery (early implant failures). Within implant insertion, bleeding of cortical bone following drilling is a necessary requirement for uneventful healing and integration of the implant into surrounding tissues (Fig. 15).[11] The following step by step procedure has been proven effective:

a) Utilization of keen pilot und multi-use tapping drills (renew early, otherwise high drilling forces and danger of deviation from drilling axis occur).
b) Intermitted implant bed preparation under permanent cooling with 0.9 % saline.
c) Prior to implant placement, wait until implant bed has been replenished with blood.
d) Wetting of implant surface with blood prior to implant insertion.
e) Limited rotation speed < 800 r.p.m during implant bed preparation, hand implant placement with torque key, max. 10–30 Ncm, if applicable (Fig. 16).

A slight subcrestal position of the implant is advisable as drilling endpoint.[12] To ensure healing, a primary fixation of the implant is mandatory for all implant types (cylindrical, root-formed etc.), bone quality and anatomical localization. The authors strongly discourage from further „screwing" to avoid ongoing tissue injury of the implant-bone-interface.[13]

Periimplant tissue (volumen)

Due to alveolar bone defects resulting from tooth removal, periodontitis or dysfunction, the conditions of periimplant keratinized gingiva around implants are not adequate.[14] Safeguarding implant planning and surgery, the additional dues of soft tissue surgery to enlarge periimplant gingiva should be implemented into the quotation:

Enlargement:

Initially, implant planning (not to forget cast models) and implant placement. During implant in-

Fig. 15_Promotion of perfusion and healing by micro-invasive implant surgery with implant abutment insertion into vascularized blood-supplied alveolar bone.
Fig. 16_Micro-invasive implant surgery to protect alveolar bone avoiding machined insertion and implant fixation with torque wrench.

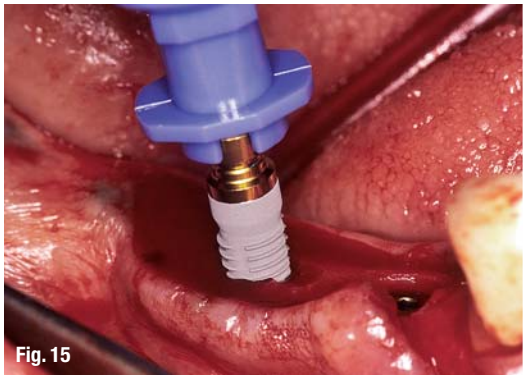


Fig. 15

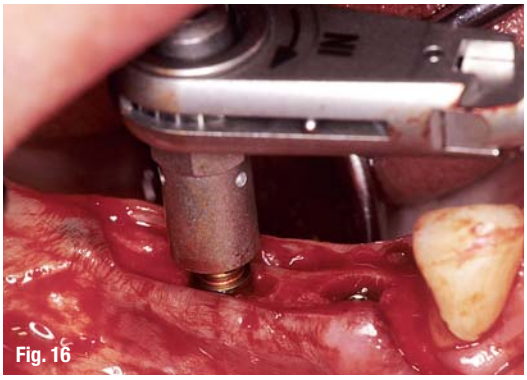


Fig. 16

sertion into local bone, enlargement of periimplant gingiva with a ridge incision 1–2 mm orally is usually adequate. In lateral augmentation in the maxilla, periimplant enlargement is frequently mandatory as result of flap advancement to cover the defect. During healing and prior to implant exposure, vestibuloplastic surgery with free autogenous gingival graft from palate at implant site in a separate visit (Figs. 17–19). In individual cases and edentulism in the mandible, periimplant enlargement with Edlan Mejchar-Vestibuloplastic surgery to create attached mucosa by a pedicle flap with adequate esthetics prior to implant placement. Also, to achieve soft tissue protection following implant insertion (Figs. 20–22).

Thickening:

To safeguard implant placement and protect against periimplant diseases, an adequate periimplant width is more needed than soft tissue thickness. Following thickening by free autogenous soft tissue grafts from the palate or roll flap, loss of periimplant dimension is anticipated due to shrinkage and further scar formation. Periimplant thickening is limited to individual patients with esthetic needs in the upper front of the maxilla. Shortcomings following healing, scar formation, normal biologic resorption and failing of long-term stability are usually compensated by individual prosthetic abutments and ceramic crowns with a wide periimplant shoulder.

Short and diameter-reduced implants

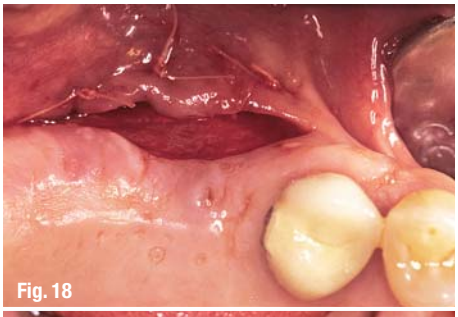
The usage of short implants < 9 mm demands minimalization of surgery. Implant placement and healing are customer-friendly. However, micro-incision surgery requires additional efforts by 3-D imaging (DVT) during planning and sensitiveness in clinical realization. Evidence-based clinical data for short and diameter-reduced implants are inconsistent and industry-driven. Biomechanical research underestimates the functional adaptive capacity of implant bone.[15, 16] In clinical practice, horizontal alveolar bone loss is the most frequent demand:

Mandible:

1. Advanced alveolar bone loss in premolars and molars (numerous; Figs. 23–29).
2. Proximity to N. alveolaris.

Fig. 17_Sinus elevation # 26 with implant placement prior to periimplant enlargement.
Fig. 18_Periimplant soft tissue extension with apical fixation prior to free gingival grafting during implant healing.
Fig. 19_Free gingival graft in situ prior to suturing.
Fig. 20_Unstable periimplant gingiva with poor hygiene capability, persistent inflammation # 34 and chronic sensitivity.
Fig. 21_Plastic pedicle flap surgery (Edlan-Mejchar) to remodel free into attached periimplant mucosa. Lack of buccal implant bone with oversized implant diameter.
Fig. 22_Unobtrusive healing for eigth weeks posttherapy with functional relief by enlargement and periimplant stabilization.


Fig. 17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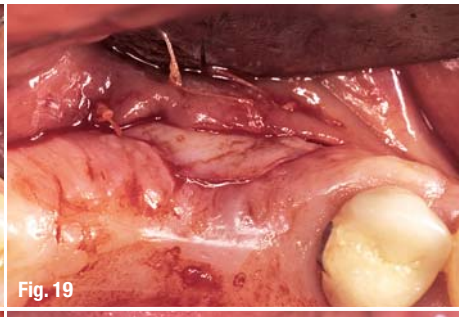
Fig. 19


Fig. 20


Fig. 21


Fig. 22

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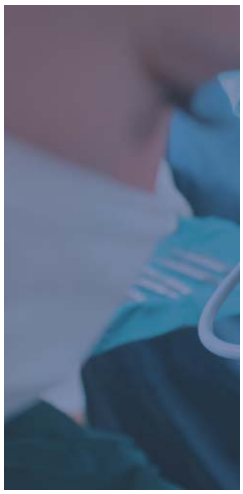

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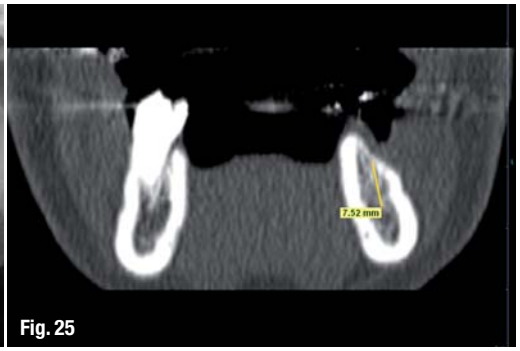
Fig. 23


Fig. 24



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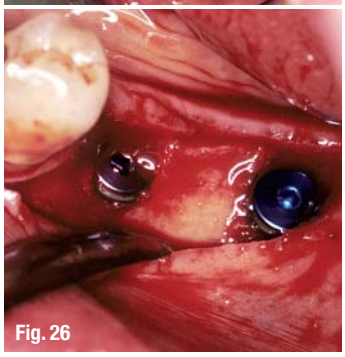
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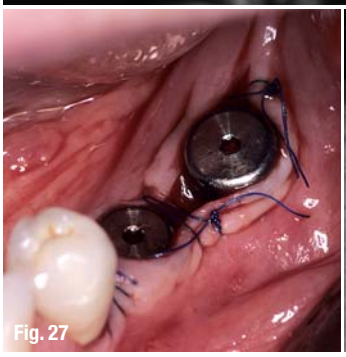
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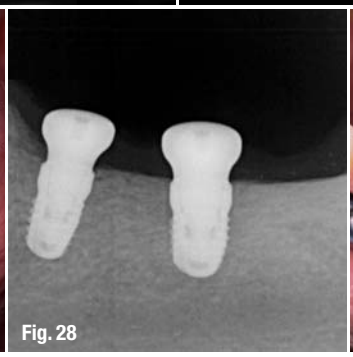
Fig. 28


Fig. 29

Fig. 23_Indication for short and diameter-reduced implants in the mandible with unilateral tooth loss and low vertical alveolar bone height.
Fig. 24_Initial OPG (pre-therapy) with demineralization and lateral alveolar bone atrophy # 35, 36.
Fig. 25_Securing the implant planning and surgery by 3-D visualization with reduced implant length of 7 mm. Ridge resorption and vicinity to n. alveolaris (Radiology: Fürther Freiheit, Germany, 2014).
Fig. 26_Intrasurgical setting following placement of short implant abutments (7 mm) with diameter of 4.3 und 5.0 mm.
Fig. 27_Vertical enlargement of resorption-related thin periimplant gingiva by 1 mmm oral horizontal ridge incision during surgical implant exposure.
Fig. 28_Unobtrusive X-ray following surgical implant exposure with prevention of N. alveolaris avoiding augmentation.
Fig. 29_Single implant crown restoration (unlocked) with implanto-prosthetic relationship of 1:1.
Fig. 30_Long-cone implanto-prosthetic abutments undergo no self-cleaning frequently initiating periimplant sensitivity.

Maxilla:
1. Close anatomical relationship to sinus maxillaris.
2. Atrophied or edentulous maxilla following long-term appliance of removable dentures.

Horizontal alveolar bone defects, as result i.e. of longstanding periodontitis, are compensated surgically during implant placement to avoid extended implanto-prosthetic abutments susceptible for recurrent soft tissue infection (Fig. 30). Fixed implanto-prosthetic restorations of the partially endentulous mandible are achieved with axially screwed, uncemented and unlocked crowns to improve hygiene and avoid further damage by cementing and periimplantitis. Integration in clinical practice is successful with focus on tissue biology and both renunciation from mechanical dentistry and interlocking theories. Diameter-reduced (< 4 mm), small implants (minis) allowing transgingival healing. According to their material properties (fracture) and restricted implanto-prosthetic indications and compatibility, Minis are limited to individual applications in multi-morbid subjects with edentulous mandible, enhanced risk for surgery i.e. advanced diabetes mellitus or hematopoietic diseases and handicaps for oral hygiene.[17]

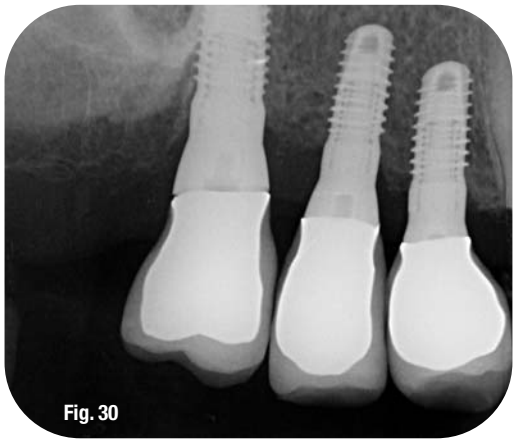
Fig. 30

_Augmentation and revision

Except for sinus floor grafting, the number of augmentative implant surgery is declining and confined to reconstruction following trauma and tumor by vertical distraction or individual prosthetic or esthetic settings.[18] The indications for surgical augmentation during implant placement include:
a) Tooth loss in cross-bite settings.
b) Lateral alveolar bone defects (premolars and molars).
c) Modelling of periimplant bone in esthetically demanding situations at incisors and canines (emergence profile).

The authors have recently reported about the use and implementation of autogenous bone and spongious bone chips and their synthetical alternatives in implant surgery in detail.[19]

The regressive developments of implant augmentation in clinical practice implicate direct recommendations for surgical revision of periimplant defects. The following procedure is advisable.[20] (Tab. 1):

Mucositis:
– Defect depths ≤ 3 mm: Oral hygiene and implant cleaning (hygienist).

– Defect depths ≤4–5 mm: Additionally 0.2 % CHX, Er:YAG decontamination, if applicable (dentist).
– Defect depths ≥ 6 mm: Periimplant plus periodontal cleaning, systemic antibiotics: amoxicilline 500 mg 20 T and Clont 400 mg 20 T, t.i.d for 7 days.

Together with decompensation by occlusal appliances (mentioned above), safeguarding by front-canine equilibration and removal of implanto-prosthetic restoration, the clinical situation often improves. The procedure can be easily repeated. The recommendation to removably screwfix implant restorations axially (only premolars and molars) is becoming a strong relevance in the treatment of periimplant damage.

Periimplantitis:
Advanced periimplant damage with circumferential angular bone loss encompasses
– Defect depths ≥ 8 mm: Explantation, surgical revision (if applicable).

In these clinical settings, implant removal with repeated insertion, augmentation (where appropriate) and prosthetic restoration following healing is advocated, if the client approves the treatment. In periimplant damage, the benefit of rapid implant bone healing following insertion of short and diameter-reduced implants becomes obvious. In individual, strategically important implant sites, i.e. canine implant area in edentulism, revision is emphazised with the following surgical protocol (Tab. 2):[21]
– Removal of implanto-prosthetic restoration, if screw-fixed.
– Horizontal ridge incision with a mucoperiostal flap and mesial vertical extension.
– Curettage of implant bone defect.
– Irrigation with 0.2% CHX, supplemented by Er.YAG-decontamination.
– Stimulation of bleeding plus autogenous bone grafts for defect fill and reconstruction, defect coverage with rotated pedicle soft tissue flap.
– Close, tension-free wound closure, no functional loading.
– Systemic antibiotics.

_Summary

The prevention of periimplant diseases is based on a comprehensive analysis, evaluation and planning prior to implant placement. Securing the residual dentition from periodontal disease, on time removal of compromised teeth and functional decompensation with focus on front-canine equilibration are the key issues during implant planning. Prior to surgery, DVT diagnostic evaluation is required if proximity to anatomical structures is anticipated, and short and diameter-reduced implants are advocated to determine interimplant distances and safeguard implant treatment. Implant placement succeeds with minimal mechanical loading of implant bone and implementation of perfusion during surgery. Periimplant enlargement is scheduled during implant healing, either by free gingival graft or pedicle flap. Premolar and molar implant restorations are screw-fixed axially to ease handling in case of periimplant damage. The concerted action of eliminating inflammation, stabilizing function while minimizing surgery secures implant success, prevents periimplant diseases and promotes the reputation of dental health care providers in the community._

Author's note: I appreciate the encouragement and support of Dr Gerhard Kochhan, Düsseldorf, in periimplant cooperation.
Editorial note: A list of references is available from the publisher.

Periimplant Therapy

Step	Defect (PD in mm)	Treatment
A	≤ 3 mm	Oral Hygiene + IMP Cleaning
B	≤ 4–5 mm	CHX 0.2 %, Er:YAG
C	≥ 6 mm	Systemic Antibiotics
D	≥ 8 mm	Implant Removal/Regenerative Therapy

Surgical Reentry

1. Removal of suprastructure (screw-fixed).
2. Horizontal alveolar ridge incision with vertical mucoperiostal flap reflection.
3. Intrabony defect curettage.
4. 0,2% CHX irrigation, Er:YAG-decontamination.
5. Stimulation of spongious bleeding plus autogenous bone grafts for defect fill and reconstruction.
6. Close, tension-free defect closure, no functional implant loading.
7. Systemic antibiotics.

Table 1_Key treatment issues to combat periimplant damage, to a large extent being prevented by early and carefull implant planning.
Table 2_Surgical revision of advanced periimplant bony defects is limited to single clinical settings due to the time and extent of surgery and additional patient expenses.

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