

Dental implant

Dental implant has become an established therapy in dentistry in order to replace missing teeth in different clinical situations

- The success rate of about 83% after 16 years follow-up have reported
- Under care and attention of indications, anatomical and intra-individual limiting factors, insertion of dental implants seems to represent a **safe** treatment
- However, in the last decades increasing evidence raised on the presence of peri-implant inflammations representing one of the most frequent complications affecting both the surrounding soft and hard tissues, which can lead to implant loss
- Therefore, strategies for prevention and treatment of peri-implant disease should be integrated with rehabilitation concepts in dentistry

Definition and pathogenesis

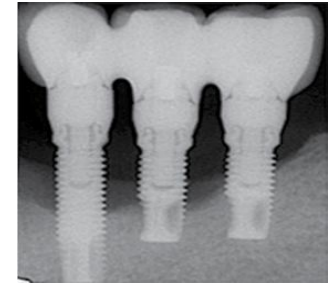
In analogy to gingivitis and periodontitis, affecting the periodontium of natural teeth, mucositis and peri-implantitis are an inflammation and destruction of soft and hard tissues surrounding dental implants

- **Mucositis** can be described as bacteria-induced, reversible inflammatory process of the peri-implant soft tissue with redness, swelling and bleeding on probing



Whereas **peri-implantitis** is a progressive and irreversible disease of implant surrounding hard and soft tissues and is accompanied with bone resorption, decreased osteointegration, increased pocket formation and purulence

- Type and shape of the implant, abutment and supra-structure prosthetic material can affect the peri-implant soft and hard tissues



Etiology and epidemiology

There are several reports on the prevalence of mucositis and peri-implantitis that differ between 5 - 63.4 %

- Based on the Six European workshop in Periodontology report, the incidence of mucositis is up to 80% and the peri-implantitis is between 28 - 56 %
- This underlines the fact that the bone remodeling processes often result in marginal bone loss during the first weeks after abutment connection, which can not be regarded as peri-implantitis
- This led to the recommendation to take a radiograph after insertion of the supra-structure

A spectrum of pathogenic germs can be detected such as ***Prevotella intermedia***, ***Prevotella nigrescens***, ***Streptococcus constellatus***, ***Aggregatibacter actinomycetemcomitans***, ***Porphyromonas gingivalis***, ***Treponema denticola*** and ***Tannerella forsythia***

- However, in contrast to periodontitis, peri-implantitis lesions can harbour bacteria that are not part of the typical periodontopathic bacteria such as ***Staphylococcus aureus***, which appear to play a predominant role for the development of a peri-implantitis and showed a high affinity to titanium

Risk factors and prevention

- Implant loss may occur in up to one year after insertion and called **early implant loss**
- While **delay implant loss** is considered when the time of implant loss is more than one year

The risk factors or circumstances for implant loss are:

- 1- Smoking with additional significantly higher risk of complications in the presence of apolipoprotein E4 genotype polymorphism
 - 2- Limited oral hygiene and lack of patient compliance (missing check up)
 - 3- Systemic diseases, such as diabetes mellitus, cardiovascular disease and immunosuppression
 - 4- Iatrogenic causes (cementitis; does not remove the excess of luting cement)
 - 5- Soft tissue defects or poor-quality of soft tissue at the area of implantation (lack of keratinised gingiva)
 - 6- History of one or more failures of implants
- Studies indicate smoking as the greatest identifiable and most often cited risk factor for peri-implant disease followed by a history of periodontitis
 - The presence of periodontitis or cigarette smoking increase the risk for peri-implantitis up to 4.7 fold

- The impact of keratinised gingiva around dental implants has been controversially discussed, but most studies emphasise the importance of an adequate zone of keratinised tissue surrounding implant

Additional factors can be nominated on the basis of implant loss

- 1- Overloading of the implant
- 2- Faults in material and techniques
- 3- Poor bone quality at the implant area
- 4- Systemic diseases and drug therapies, which inhibit bone modulations

Therapy

The treatment of peri-implant infections comprises conservative (non-surgical) and surgical approaches

- Depending on the severity of the implant disease (mucositis, moderate or severe peri-implantitis)
- A non-surgical therapy alone might be sufficient or a step-wise approach with a non-surgical followed by a surgical treatment may be necessary

Treatment of mucositis

- One of the main aim of peri-implant therapy is to detoxify the contaminated implant surface
- Mechanical implant cleaning with titanium or plastic-curettes, ultrasonic or air polishing
- Moreover, photodynamic therapy as well as antiseptic medication (chlorhexidine, hydrogen peroxide, sodium bicarbonate and povidone (iodine))

Peri-implantitis

Infectious disease that causes an inflammatory process in the soft and hard tissues surrounding an osteo-integrated implant, leading to loss of supporting bone

Risk factors for peri-implantitis

- Tobacco use
- Poorly controlled systemic conditions (e.g. diabetes mellitus, osteoporosis, post-irradiated jaws)
- History of periodontitis and noncompliance to treatment
- Poor oral hygiene
- Parafunctional habits (e.g. bruxism)
- Iatrogenic factors (e.g. lack of primary stability and premature loading during the healing period)

Signs

- Progressive increase in probing depth
- Suppurations and exudation from peri-implant space
- Bleeding on probing
- Clinical appearance of inflamed tissue (bleeding, swelling, colour change, suppuration, and plaque/calculus accumulation)
- Progressive loss of supporting bone on follow-up radiographs

Symptoms

- No severe pain
- May have dull pain, tenderness on brushing or palpation
- Bad taste, potentially noticeable if there are purulent exudates
- Increasing mobility in case of failed implant
- lymphadenopathy

Investigation

- Verify if iatrogenic factors are involved such as faulty restoration, impacted foreign material (residual cement), loose components ..etc
- Assess if inadequate biomechanical forces are applied by evaluating the occlusion for the presence of:
 - 1- Parafunction
 - 2- Occlusal overload
 - 3- Mobility of the restorative component (remove crown to assess whether implant is mobile), fractured restorative component, fractured implant
- Look for active periodontitis in other sites
- Assess the potential of other bone pathologies
- Perform an exploratory surgery

Diagnosis

Based on the **clinical** and **radiographic** evaluation, a diagnosis of peri-implantitis is determined

Differential diagnosis

Peri-implant mucositis

Treatment

The long-term goals are to stop the progression of the disease and maintain the implant site

- Depending of the aetiology of the problem, a specific treatment can be selected
- Appropriate management of peri-implantitis often requires referral to a periodontist

Aetiology: bacterial infection

- Control the acute bacterial infection and reduce the inflammation in the tissues through:
 - 1- Mechanical debridement
 - 2- Localised and/or systemic antimicrobial therapy
 - 3- Improved patient compliance with oral hygiene until a healthy peri-implant site is established
- At the re-evaluation, if the patient does not have a satisfactory response to the non-surgical therapy, surgery should be considered. It is important to assess for possible cement entrapment

1- Detoxify the implant surface by using mechanical devices (e.g., high pressure air powder abrasive, laser decontamination) and/or applying chemotherapeutic agents (e.g., supersaturated citric or tetracycline applied with cotton pellets or a brush)

2- Perform flap management with either or both resective and regenerative approaches, depending on the morphology and size of the bone destruction

3- Systemic antibiotics are suggested postoperatively

Aetiology: Biomechanical forces

Perform:

- An analysis of the fit of the prosthesis
- A verification of the number and position of the implants
- An occlusal evaluation

Prostheses design changes, replacing defective restorative components and correcting occlusal overload (through improvement of implant number and position, occlusal equilibration and occlusal splint for patient with parafunction) can arrest the progression of peri-implant tissue breakdown

Aetiology acting as a co-factors

Other etiologic factors may act as co-factors in the development of peri-implantitis. Nonetheless, treatment still consists of removing the bacterial infection or correcting the biomechanical forces

Possible co-factors

- Anatomical limitations: inadequate amount of bone in recipient site at the time of the implant placement
- Surgical trauma: overheating of bone during implant placement
- Compromised host response

Additional potential risk factors

- Treatment of active potential disease and improvement of oral hygiene
- Counseling the patient on tobacco cessation

Notes

- There is no consensus regarding the best regenerative material and no long-term data regarding success of regenerative treatment
- It is important for patients to understand that regenerations are neither predictable nor reliable on an integrated and restored implant. Patients must be involved in the decision to save or replace the implant
- Many techniques for implant detoxification have been used but there is not yet a defined standard protocol

Treatment of peri-implantitis

- Most of the strategies for peri-implantitis therapy are mainly based on the treatments used for teeth with periodontitis
- The bacterial colonisation of dental and implant surfaces follow similar principles
- Surgical treatments can be done using resective or regenerative approaches

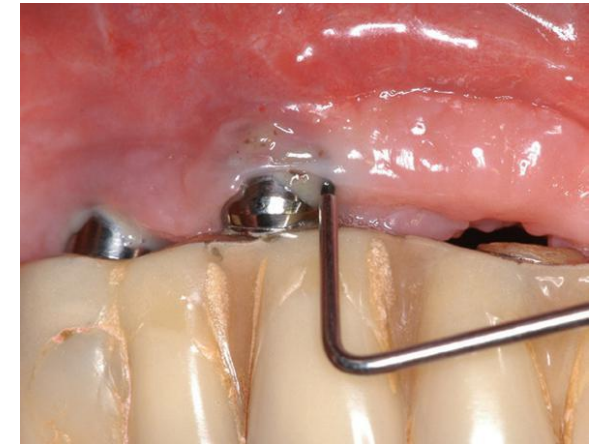
Conservative treatment

In addition to medication and manual treatment (with cures, ultrasonic and air polishing systems), innovative techniques such as laser-supported and photodynamic therapy methods are recently described as conservative therapeutic options

Manual treatment

Basic manual treatment can be provided by Teflon, plastic and titanium cures

- It is possible to reduce bleeding on probing scores by cleaning with piezoelectric scalers as well as with hand instruments
- No differences have been found between these methods concerning reduction of bleeding on probing, plaque index and probing depths after at least 6 months



- The air polishing systems are depending on the use of medium such as hydroxyapatite phosphate
- An abrasive air polishing medium can modify the surface of implants
- After air powder treatment cell attachment and cell viability still showed sufficient levels, but cell response decreased compared with sterile surface
- The extent of re-osteointegration of implant after air polishing therapy has been reported between 39 % and 46 % with increased clinical implant attachment and pocket depth reduction

Drug treatment

There are different modalities of treatment:

- Antiseptic rinses
- Application of systemic and locally delivered antibiotics in relation to pocket depth or different parameters such as tetracycline, doxycycline, amoxicillin, metronidazole, minocycline hydrochloride, ciprofloxacin, sulphonamides+ trimethoprim
- The effects of these antibiotics led to significantly reductions of pocket depths in a period between one to six months
- Some researchers noticed that the success rate of 58% when treating peri-implantitis with surgical debridement and the various combination of antibiotics
- The combination of metronidazole and amoxicillin on *P. gingivalis*, *Streptococcus sanguinis* and *Fusobacterium nucleatum* was found more effective than metronidazole alone

- Application of chlorhexidine resulted in the reduction of pocket depths, a higher implant adhesion and general weakening of inflammation
- **In conclusion**, local and systemic antibiotics are additional therapy but not a treatment option

Laser treatment

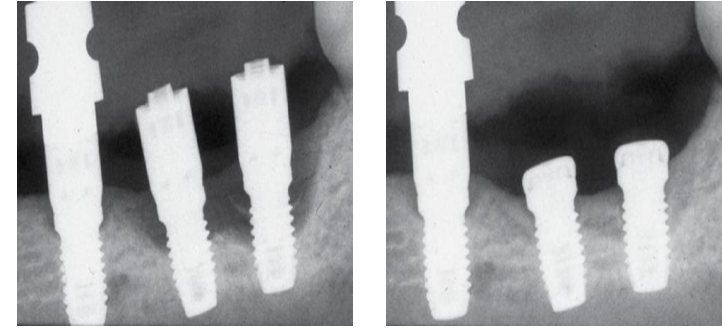
Laser is: (light amplification by stimulated emission of radiation)

- Lasers are used in the treatment of peri-implant diseases by means its bactericide mode of action such as co2 ,Diode, Er: YAG (erbium-doped: yttrium-aluminium-garnet) and Er, Cr, YSGG (erbium, chromium-doped: yttrium-scandium-gallium-garnet)
- Er.YAG and Er,Cr: YAG with a wavelength of 3 microns can reduce biofilms up to 90%
- In terms of bleeding at peri-implantitis, Er.YAG laser led to significantly better results compared to mechanical methods
- However, both methods showed no significant differences in changes of pocket depths, clinical attachment level, plaque index and gingival recession
- Although there is only few data in comparison to manual and surgical therapy, laser therapy as a treatment option has to be considered as an **adjunct**

Photodynamic treatment

It generates reactive oxygen species by multiplicity with help of a high single frequency light in combination with photosensitisers (toluidine blue)

- Photodynamic therapy generates **bactericide effects** against aerobic and anaerobic bacteria by a wave length 580 to 1400nm and toluidine blue-concentrations between 10 and 50ug/mL
- Photodynamic therapy, however; is still as an adjunctive therapy



Surgical treatment

It combines the concepts of the already mentioned non-surgical therapy with those of resective and/or regenerative procedures

Resective therapy

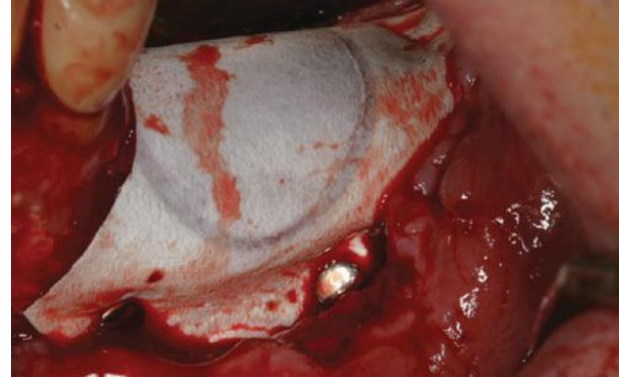
Resective surgery has been shown to be effective in reduction of BOP, probing depths and clinical signs of inflammation

- The basic principles include the elimination of the peri-implant osseous defect using ostectomy and osteoplasty as well as bacterial decontamination
- Smoothing and polishing of the supra-crestal implant surface may be applied
- According to some studies shown that in patients with active peri-implant disease, surgical pocket elimination and bone re-contouring in combination with plaque control before and after surgery represent an effective treatment
- Adjuvant implant surface decontamination with antimicrobial substances led to an initially less anaerobic bacterial contamination
- Although resective therapy is recommendable treatment option, it is not suitable in highly aesthetic sensitive areas

Regenerative approaches

In case of resective surgery it may result in re-osteo-integration in only minor superficial defects

- However, full regeneration and re-osteointegration are required for aesthetic and long-time survival points of views
- In animal models, it was possible to regenerate experimentally induced defects using various graft materials and/or resorbable membranes (GTR)
- The combination of membranes and bone graft materials were superior to those using membranes or bone graft alone
- Prevention of peri-implant disease is very important than treatment



In conclusion

This AKUT protocol as schematic treatment plan by Lang

Stage	Result	Therapy
	Pocket depth (PD) < 3mm, no plaque or bleeding	No therapy
A	PD < 3mm and /or bleeding on probing	Mechanically cleaning, polishing, oral hygiene instruction
B	PD 4-5 mm, radiologically no bone loss	Mechanically cleaning, polishing, oral hygiene instructions + local anti-infective therapy (e.g. CHX)
C	PD > 5mm, radiologically bone loss < 2mm	Mechanically cleaning, polishing, microbiological test, local and systemic anti-infective therapy
D	PD > 5mm, radiologically bone loss > 2mm	Resective or regenerative surgery

Treatment of failed implants

In the presence of extensive bone loss or implant mobility, the implant may be removed and alternative options to replace the missing tooth should be discussed (replacement of failed implant, fixed partial denture, removable partial denture, etc)