

A Patient Guide to
Peri-Implantitis
and How to Treat It



**The
Painful
Dental
Implant**

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Table of Contents

Foreword- The Painful Dental Implant	3
Peri- Implantitis- What Is It?	4
A Patient's Story	5
What is Peri-Implantitis?	7
Stages of Inflammation	8
Types of Peri-Implantitis	8
Peri-Implantitis- Why Does It Happen?	10
Dentist-Induced Peri-Implantitis	11
Patient-Induced Peri-Implantitis	20
Treatments: What Works; May Work; Or Does Not Work?	24
Peri-Implant Mucositis	29
Peri-Implantitis Type 1	30
Peri-Implantitis Type 2a	31
Peri-Implantitis Type 2b	34
Peri-Implantitis Type 3a	37
Peri-Implantitis Type 3b	40
Peri-Implantitis Type 4a	44
Peri-Implantitis Type 4b	46
Implant Infection	48
Implant Loss of Integration	50
What To Do Next?	53
Dentists Collaboration & Discussion	54
Surgical Management	55
Restorative Management	56
Glossary of Terms & Procedures	57
About Oral Surgeons & Periodontists	58
About restorative dentists	59
Computer-Assisted Planning	61
Dental Implant Removal	62
'Implant-Perfect' Methodology	64
About The Author- Dr. H. Ryan Kazemi	69

The Painful Dental Implant

Dental implants have truly revolutionized dentistry and how we treat millions of people with missing teeth. Since the debut of implants in the 1960's, we have made great advances in understanding the biology of dental implants. Implant materials and technology have also dramatically improved. Our current literature and studies suggest dental implant success rates well above 98% when implemented properly by skilled and well-trained clinicians following proper diagnostics and planning principles. The success of dental implants has made them today's standard-of-care for the replacement of missing teeth.

However, complications do sometimes happen! Complications such as peri-implantitis (inflammation around dental implants), infections, poor integration, and component-related issues despite better technology, healing biology, and mechanics, have been gradually increasing. We treat hundreds of patients every year with various dental implant complications. Fortunately, the majority of the complications with dental implants is completely preventable and can be avoided when trained surgeons and dentists work together as a team and follow an evidence-based protocol aligned with our "Implant-Perfect" methodology. Patients with dental implant complications often present with the "triple-less" syndrome: Less bone, less confidence, and less funds. Hence, they require special treatment considerations, not only dentally, but also emotionally.

This book, *The Painful Dental Implant*, is a valuable resource for both patients and dentists to understand peri-implantitis, the most common complication and cause of pain with dental implants. You will learn why peri-implantitis happens, why it may be on the rise, how to prevent it, and which treatments work. Additionally, you will learn how to choose the right team of dentists who can deliver remarkable results with less complications. If you are experiencing pain related to your dental implants or are currently considering dental implant treatment, this book is for you.

Dr. H. Ryan Kazemi

Peri-Implantitis: What is it?



Peri-implantitis is the destructive inflammatory process affecting the bone and gum tissues around dental implants. It is caused by similar bacteria involved in gum disease (periodontitis) that leads to bone loss around natural teeth.



Fig 1 Peri-implantitis in a patient with gum recession, inflammation, pain, and grayish appearance

A patient story:

Joan had to have her lower right tooth extracted because of a fracture and wanted it replaced as soon as possible. She saw her general dentist who performed the extraction with immediate placement of a single implant and restored it with a single crown. Soon after, Joan noticed increasing pain around her dental implant and receding gum tissue. She was reassured that it would gradually improve, but the gum recession and her pain continued to worsen over the next four months. She also became concerned about the grayish color from her gum tissue (Fig 1). Realizing her condition was worsening, she finally decided to seek a second opinion from

a specialist. When she came to see us, her gum tissue was noted to be inflamed and painful to touch. A CBCT (cone beam CT scan) was obtained to assess the condition of the implant, supporting bone, and source of her pain. It was immediately noted that the implant had been placed too far from its proper path with an excessive outward tilt (Fig 2). This, in turn, resulted in loss of bone and recession of her gum and subsequent exposure of the implant surface. Inadequate tissue support, plaque retention on the implant surface, and continued inflammation led to peri-implantitis and her symptoms of pain.



Fig 2 CBCT demonstrating excessive tilting of dental implant with loss of bone and soft tissue

What led to this problem:

- Poorly-placed implant by an inexperienced dentist
- No diagnostic CT imaging
- Poor planning
- Improper implant placement technique
- Failure to use a surgical guide for proper alignment
- Failure to recognize thin tissue biotype with high susceptibility to recession

“Over 95% of dental implant complications may be preventable”

How this could have been avoided:

- **Knowledge base** – Critical to selecting patient- and site-specific treatments
- **Proper diagnosis** – Use of CBCT to assess bone density and availability
- **Computer-assisted planning** – Precision planning for placement of dental implant
- **Team approach** – Treatment by a team of dentists: surgical placement of the implant by a trained surgeon and restoration by an experienced restorative dentist
- **Proper implant alignment** – Using a surgical guide to precisely position the implant within the confines of the bone and patient's bite
- **Establish adequate bone** – Necessary for implant support, integration, and longevity
- **Improve soft tissue quality** – Converting the thin gum tissue biotype to a thicker one around the implant

Treatment options and beyond:

Treatment options were discussed including implant removal and tissue grafting. However, based on Joan's type of peri-implantitis, the only viable and predictable treatment was to remove the implant, allow the gum tissue to regenerate naturally, and then plan for a new dental implant. This would first require restoration of the missing tissue by bone grafting and then delayed replacement with a new dental implant in its proper position.

The implant was removed using an atraumatic and non-invasive technique that required no gum incision or bone removal. The gum tissue was then allowed to heal for 3 months (Fig 3). Next, the bone was augmented to develop a proper foundation for a new dental implant. Through digital planning, a new dental implant was placed with accuracy and restored with a new crown.

Such complications have great physical and emotional effects on patients who have invested time and money in treatments that did not work. When considering a retreatment, it is important to recognize the patient's feelings, especially their



Fig 3 Cone beam CT scan 3 months after implant removal. There is inadequate bone but the gum tissue is now healed and the site is ready for bone graft. A dental implant is placed 4-6 months after the bone graft.

loss of confidence revealed by the often-asked question, “How will I know that this is not going to happen again?” Hence, it is critical to have an open and honest discussion before any further treatment is initiated. The team of dentists must gather and analyze all of the information about previous treatments and potential factors that may have led to

complications, and redesign a new and well-thought-out treatment plan.

Through good planning, communication, and teamwork, many patients can be retreated, successfully restoring their missing teeth and lost of confidence.

What is Peri-Implantitis?

Peri-implantitis is an inflammatory condition caused by plaque retention on or around dental implants. The surface of dental implants is made up of micro-pores and physical roughness designed for bone integration and healing. These micro-pores are particularly susceptible to plaque retention when there is inadequate bone and gum tissue coverage or when the tissue seal is lost around the implant. Plaque then adheres tightly to the implant surface making its removal practically impossible. This results in inflammation or infection that leads to bone and gum tissue loss and eventual implant failure.

“Inflammation or infection leads to bone and gum tissue loss and eventual implant failure”

Stages of inflammation

Peri-implantitis often begins as mild inflammation near the gum tissue and can advance to more severe forms of inflammation or infection if left untreated.

1. **Peri-implant mucositis:** This is an early form of inflammation that may be treatable. Early warning signs are mild discomfort, redness, mild swelling of gums and mild bleeding when probed by dentist. If undetected and untreated, it often advances to peri-implantitis.
2. **Peri-implantitis:** The inflammation has now progressed with increasing pain, gum tissue redness, possible bleeding, and swelling. There are four types of peri-implantitis, depending on its severity and degree of bone and gum tissue loss over the implant, which are discussed further below.
3. **Infection:** Unresolved peri-implantitis can transform into an infection, characterized by increased pain and swelling, significant loss of bone, possible pus drainage, and eventual implant mobility.
4. **Complete bone loss:** With further progression and destruction of supporting bone, the implant will exhibit

signs of increased pain and either implant mobility or complete exfoliation.

If untreated at the very early stage, peri-implantitis can progress to complete bone loss, infection, and implant failure.

Types of Peri-Implantitis

The classic form of peri-implantitis is an inflammatory condition that progresses in a circular fashion around the implant and exhibits bone loss in a similar pattern leading to a crater-like defect all the way around the implant. This is in contrast to periodontal disease around natural teeth that often develops on one side and progresses either vertically creating a local pocket or horizontally causing recession. It can also develop on all sides causing bone loss on every surface of the tooth.

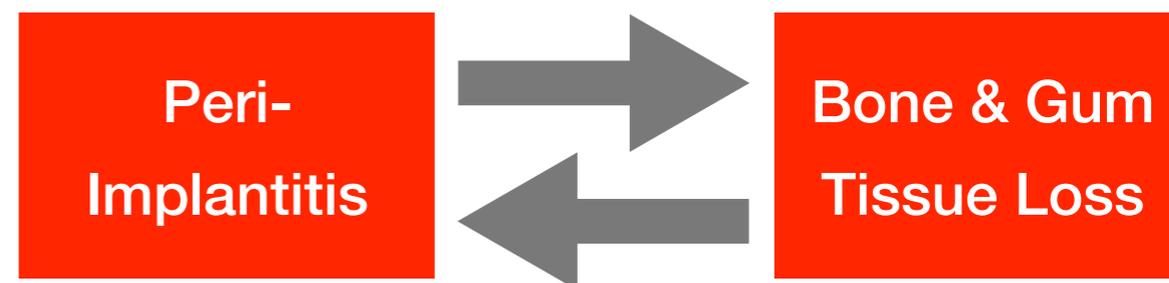
Our observation, however, indicated that not all implant-related inflammatory conditions meet the classic definition of peri-implantitis. There are several variations based on causative factors and the degree of bone and gum tissue loss.

To help better understand these variations, we categorized peri-implantitis into four types:

1. **Peri-Implantitis Type 1:** Inflammation of the gum tissue with no loss of bone or gum tissue. The gum tissue may appear red, is painful to touch, and may bleed during brushing or flossing.
2. **Peri-Implantitis Type 2:** Inflammation, along with loss of bone on one side of the implant, with normal gum tissue level. Depending on the amount of the bone loss, it can be further categorized as:
 - **Type 2a:** Bone loss 1-4 mm
 - **Type 2b:** Bone loss greater than 4 mm
3. **Peri-Implantitis Type 3:** Advancement of inflammation with loss of bone on one side of the implant and receding gum tissue.
 - **Type 3a:** Bone loss 1-4 mm
 - **Type 3b:** Bone loss greater than 4 mm
4. **Peri-Implantitis Type 4:** Severe inflammation with bone loss on more than one side or all around the implant.
 - **Type 4a:** Normal gum tissue level
 - **Type 4b:** Loss of gum tissue

During our evaluation, we also noted that peri-implantitis can be either the cause or the result of bone and gum tissue loss.

In some circumstances, peri-implantitis led to loss of bone and gum tissue while in others it was the lack of bone and soft tissue that led to peri-implantitis. In this regard, the diagnosis and treatment plan must fit the specific scenario in order to be effective.



In chapter 3, we'll explore each type of peri-implantitis and possible treatment options. However, let's first take a look at why peri-implantitis happens and how it can be prevented.

Peri-Implantitis: Why Does It Happen?



In over 90% of cases, peri-implantitis is caused by poor diagnosis, poor planning, improper treatments, improper implant position, and inexperience of treating dentists.

Treatments for peri-implantitis have been largely ineffective and disappointing. Therefore, it is best to prevent peri-implantitis by eliminating factors that cause it. Factors that contribute to peri-implantitis may be divided into three categories: **dentist-induced, patient-related, and the unknowns**. In our experience, over 80% of peri-implantitis cases were iatrogenic and attributable to dentist-induced causes while about 15% were linked to patient-related factors. About 5% of cases seem to have occurred with no known causes. Since practically all of the dentist-induced and most of the patient-related factors are controllable, one can conclude that about 95% of all peri-implantitis cases may be completely preventable.

Dentist-Induced Peri-Implantitis

Let's first define what we mean by 'dentist'. It refers to anyone with a dental degree who may be a general dentist, prosthodontist, endodontist, implantologist, or a trained dental implant surgeon which includes oral surgeons and periodontists. Hence, dentist-induced peri-implantitis is not limited to any particular type of dentist. Additionally, being an oral surgeon or a periodontist does not necessarily reflect

proficiency in implant surgery. A number of surgeons in both specialties focus on other types of treatments and do not perform dental implant surgery primarily in their practice.

A large percentage of patients with peri-implantitis can be linked to improper treatment and techniques by the treating dentists. Implant dentistry requires precision work-up, comprehensive diagnostics and planning, full understanding of

Key factors in preventing dental implant complications

1. Choosing the right team of dentists consisting of a surgeon and restorative dentist working as a team
2. Comprehensive examination and diagnostics consisting of full mouth series of X-rays, cone beam CT scan, study models, photos, and video
3. Collaborative treatment planning & proper staging
4. Following evidence-based and biologically-driven materials and techniques

its healing biology, and close collaboration between a skilled team including a surgeon and a restorative dentist. Most cases of peri-implantitis can be prevented when such principles are followed. However, due to ongoing trends of general practitioners performing surgical procedures without proper training, there is an overall increase in the incidence of dental implant complications. A recent report published by the American Dental Association (ADA) concluded that implant survival and success rates in general dental practices was lower than those reported in studies conducted in academic and specialty settings (1).

Let's take a look at the key contributing dentist-induced factors in peri-implantitis:

1. Placement of implant in insufficient bone

Placement of a dental implant where there is insufficient bone is a failure in diagnosis and planning, resulting not only in implant surface exposure and peri-implantitis, but also aesthetic and functional complications (Fig 4). This can be easily prevented by proper pre-surgical diagnostic imaging using CBCT and bone augmentation to develop the necessary dimension for implant placement. At least 1.5 - 2.0 mm of bone width surrounding the implant is required for long-term stability and support.

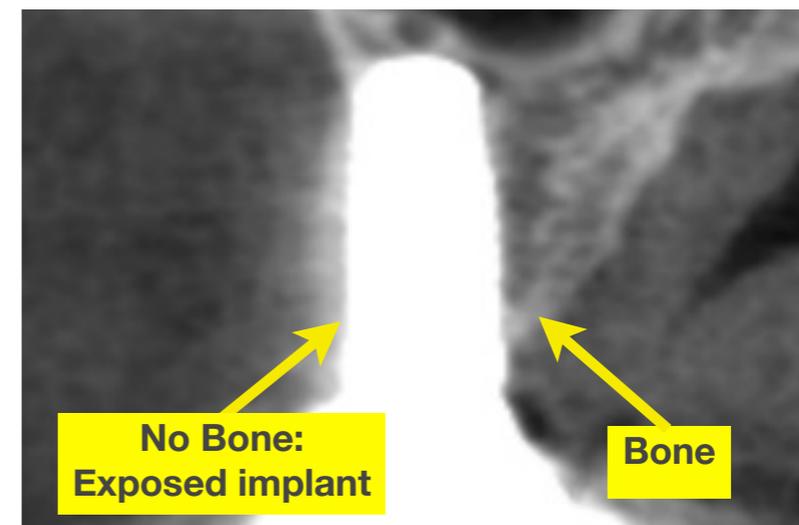


Fig 4 Implant is shown in a cross section of a CT scan: The selected implant was too wide and placed in insufficient bone resulting in exposed implant surface.

2. Poor positioning or alignment of the implant

A dental implant aligned poorly outside the confines of the bone will have insufficient bone coverage and result in tissue recession and exposed implant surface (Fig 5, 6, 7). Plaque adherence to the implants rough surface causes inflammation leading to pain, swelling, and infection. This can be avoided by making sure there is adequate bone for implant support, use of a surgical guide during implant placement, understanding of bite relationships, use of computer-assisted planning, and precise implant alignment during placement.



Fig 5 A poorly aligned dental implant positioned too far out resulting in gum recession and inflammation

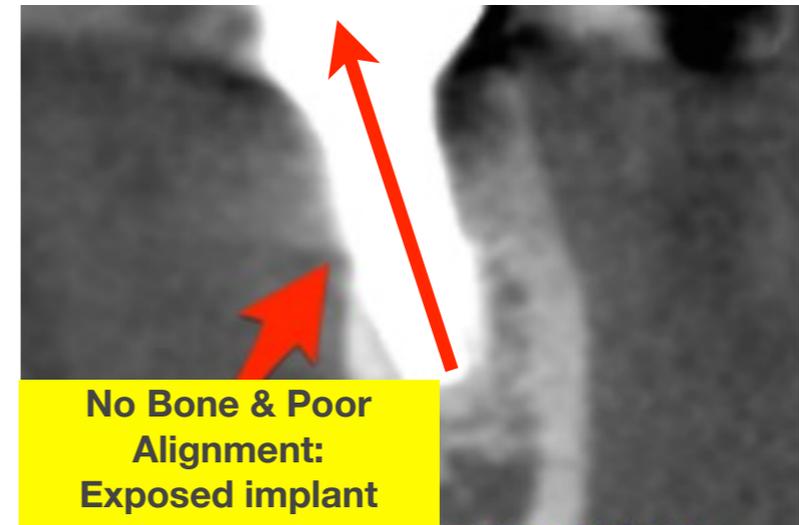


Fig 7 Shown in a cross section of a CT scan, this implant was placed off axis and misaligned with underlying bone which resulted in implant surface exposure and bone loss



Fig 6 Two implants placed not deeply enough within bone; The surface of the implant is now exposed and causing inflammation

3. Placement of the wrong implant size

Dental implants come in various lengths and diameters. The surgeon must select an appropriate implant size based on its location, type of bone, available bone, type of restoration, and



proximity of vital structures such as nerves and sinus areas. A minimum 1.5 to 2.0 mm of bone coverage over an implant is required for proper coverage, integration, and gum tissue attachment. Therefore, if there is 7 mm width of bone, a maximum 4 mm diameter implant may be selected allowing a minimum of 1.5 mm of bone coverage on each side. If the implant selected is too wide, there will be insufficient bone and exposure of the implant surface which can easily harbor plaque and bacteria. The clinician must use CBCT to accurately measure the available width and height of bone and select the appropriate implant dimension that provides proper support, proper coverage with healthy bone and gum tissue, and proper aesthetic results.

4. Poor surgical implant placement technique

Traumatic surgical technique and poor management of bone and gum tissue during implant placement can easily cause irreversible tissue damage and loss of tissue vitality. Tissue damage can lead to gum and bone recession resulting in implant surface exposure and inflammation. Some examples of traumatic surgical techniques are excessive speed of the surgical drill and bone “burning” during site preparation, tearing of the gum tissue flap, and excessive forces during implant placement that can fracture the bone. Proper tissue management requires in-depth surgical skills and a thorough understanding of tissue biology and healing that are only mastered by trained surgeons. Also, poor implant handling and contamination during placement can cause infection.

5. Immediate implant placement in sites with periodontal disease or existing infection

Immediate implant placement refers to the placement of a dental implant at the time a tooth is extracted. There are basic guidelines for immediate implant placement that must be followed to achieve optimal results. One of those guidelines is

absence of active infection from gum disease or abscess affecting the tooth being extracted and the site of the immediate implant placement. The bacterial contamination of a periodontally involved or infected tooth can make placement of an immediate implant a high risk for developing inflammation, peri-implantitis, infection, and ultimate failure (Fig 8a-c). In such circumstances, it is best to extract the tooth, clean the site, perform a site graft if appropriate, allow the site to heal, and place the implants at a later time.



Figs 8 a-c A tooth with existing infection and bone loss. Extraction and immediate placement of a dental implant has high risks of developing inflammation, peri-implantitis, and complications and should be avoided.

6. Placement of an implant adjacent to teeth with existing periodontal disease, infection, or abscess related to the pulp

Dental implants placed adjacent to teeth with active periodontal disease, infection, or abscess related to the pulp (known as lesion of endodontic origin) have increased risk of developing inflammation, peri-implantitis, and infection (Fig 9, 10a-b). Prior to implant placement, the restorative dentist

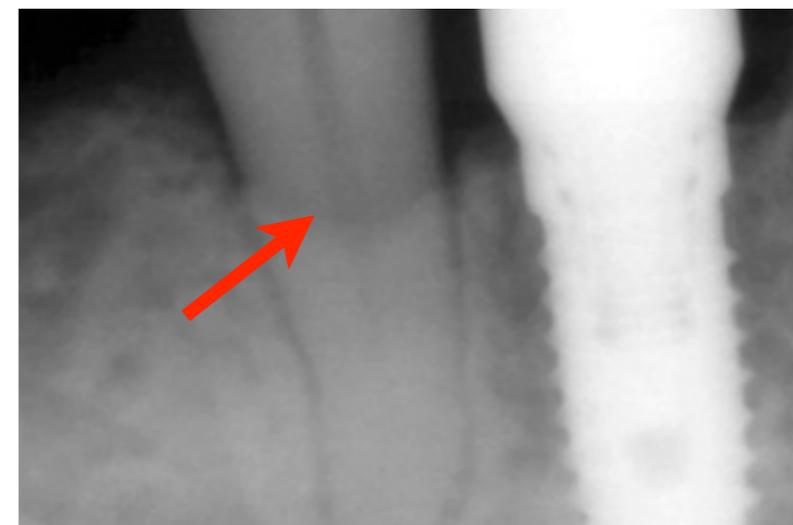


Fig 9 Dental implant was placed next to an untreated tooth with existing periodontal disease. The implant subsequently developed peri-implantitis and infection and had to be removed.

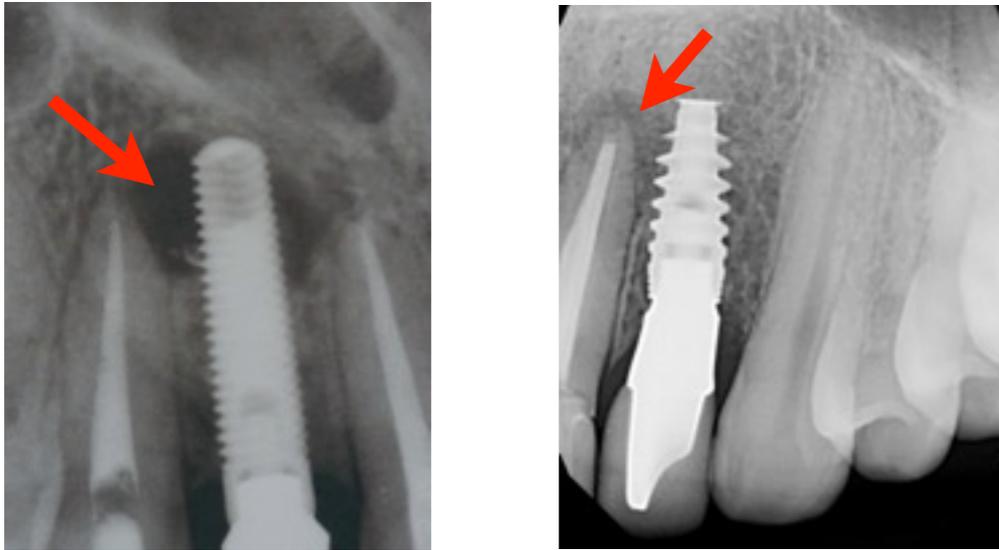


Fig 10a, 10b Dental implants placed adjacent to teeth with existing endodontic (pulp-related) infection have high risk of contamination and failure.

must perform a comprehensive clinical and radiographic examination to assess restorative, periodontal and endodontic health of all the teeth. Any existing periodontal disease should be treated by a periodontist to restore bone and gum tissue health. Any suspicious lesion or abscess related to the pulp of the tooth should also be evaluated and treated by an endodontist prior to implant placement. And any tooth with significant infection, breakdown, or non-restorable condition should be extracted by the oral surgeon before implant placement.

7. Immediate placement of implants in sites with lack of sufficient bone

Another key guideline for immediate implant placement is whether there is adequate amount of bone present following tooth extraction. **A basic rule is No Bone, No Implant!** Immediate placement of implants where there is already missing bone, even if grafted at the time, increases risks (Fig 11). Extraction sites with missing bone should first be grafted, allowed to heal, and then the surgeon can proceed with implant placement at a later time.

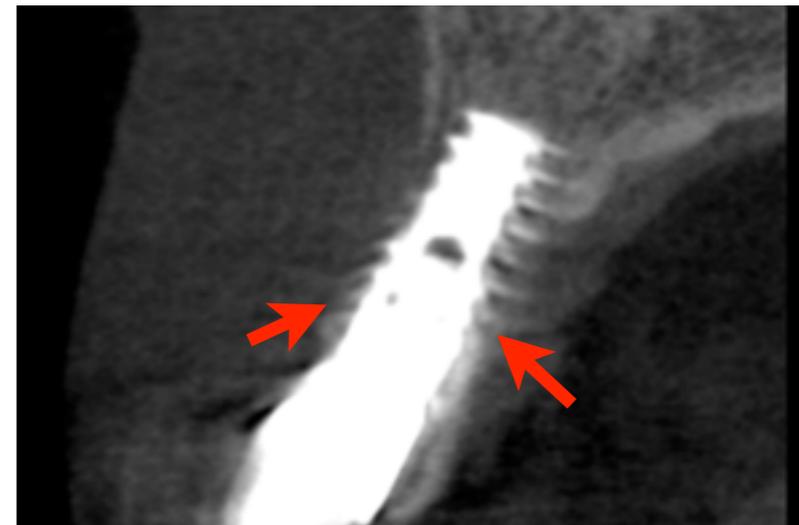


Fig 11 This implant was placed immediately at the time of tooth extraction with inadequate amount of bone. There is a significant amount of missing bone on both sides of the implant.

8. Poor fitting of components or crown

Implant dentistry is precision dentistry. If the abutment (the component that is attached to the implant and supports the crown) or a crown is not fully seated or is ill-fitted, the resulting gap becomes a plaque retention site (Fig 12). With plaque and the inability to clean it, inflammation and peri-implantitis develop. This can be easily prevented by proper restorative techniques, high-quality laboratory work, and verification following placement.

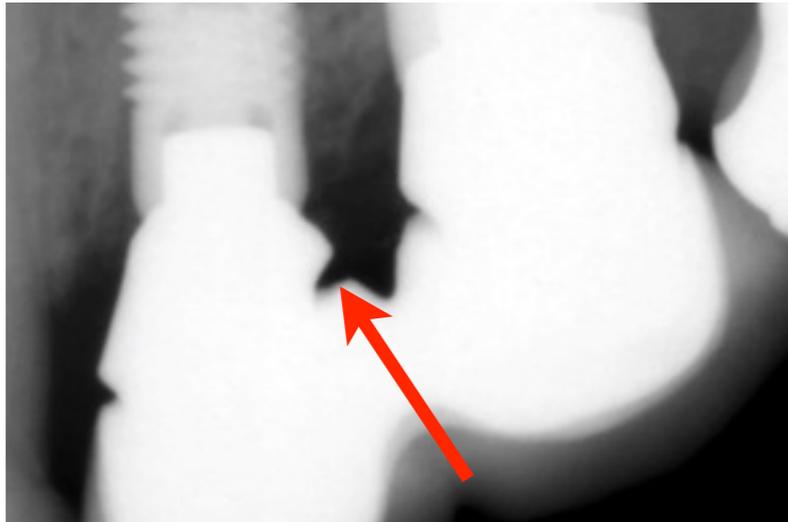


Fig 12 The crowns are not fitted well resulting in a gap between implant abutment and the crown. This gap can harbor plaque and cause inflammation leading to peri-implantitis.

9. Patient with thin tissue biotype

Patients with a thin type of gum and bone tissue are more prone to recession and implant exposure (Fig 13a). This is in contrast to thick gum tissue biotypes that are tougher and more resilient to recession (Fig 13b). Through precise examination and diagnostics, the dentist and surgeon must recognize the type of existing gum tissue. For thin tissue biotypes, the surgeon should perform either bone grafting or soft tissue grafting to convert the thin tissue to a thicker one which is more resilient and stable over time. The team must also select the right size implant and platform configuration to support the bone and soft tissue for long-term success.



Fig 13a Thin gum tissue biotype



Fig 13b Thick gum tissue biotype

10. Plaque retention around poorly-positioned implant or poorly-shaped crown

Poor implant position or crown shape can make it difficult for the patient and hygienist to access the area for effective cleaning (Fig 14). This results in plaque retention leading to inflammation and peri-implantitis. This can be prevented by proper workup, development of proper tissue form by grafting techniques, precise implant positioning, and customized abutments and crowns that mimic natural teeth. This is another reason why close collaboration between a skilled restorative dentist and oral surgeon is paramount to success and implant longevity.



Fig 14 Poorly designed and under-contour crowns cause plaque entrapment and inflammation which can lead to peri-implantitis

11. Residual cement material after placement of the final crown

Residual cement material is perhaps one of the most common causes of peri-implantitis. In one study by Wilson, excess dental cement was associated with signs of peri-implant disease in the majority (81%) of the cases (14).

The final crown or prosthesis may be retained on the final abutment supported by the implants using either cement or screws. If cemented, it is vital that the dentist uses proper

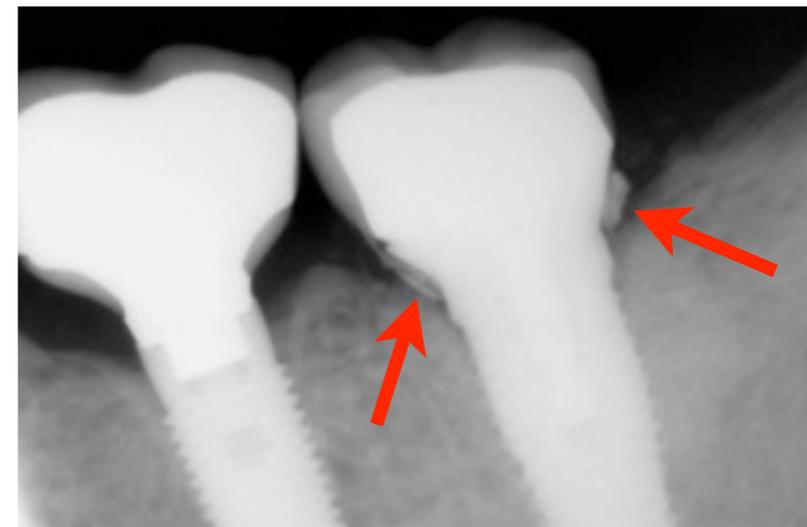


Fig 15 Residual cement around crowns induces inflammation and lead to peri-implantitis and bone loss. When cemented, the dentist should use proper technique and verification with an X-ray.

cementation technique and removes all residual cement from under the gum tissue. Cements are very toxic and cause damage to gum and bone tissues leading to peri-implantitis and bone loss (Fig 15). Many clinicians now use screw-retained crowns to avoid this common complication associated with cementation.

12. Occlusal overload

Excessive bite forces in presence of peri-implant inflammation, have been reported to cause peri-implant bone loss (11). The literature suggests that the occlusal forces and inflammation should be diagnosed and controlled to prevent peri-implantitis.

The dentist must diagnose patient's occlusal (bite) scheme and detect signs of possible overload. These include excessive enamel wear, loss of vertical dimension (over-closed mouth), periodontal disease, fractured teeth, and fractured restorations. The restorative dentist must control the occlusal overload to the implant by careful design of the restoration and its relationship to the opposing teeth or by recommending bite splints such as a night guard.

13. Inadequate zone of attached gingiva

Natural teeth and dental implants both require a healthy zone of attached gingiva (gum tissue) for long term periodontal or peri-implant health. Attached gingiva forms a tight cuff around the neck of the teeth or implants and helps to protect the underlying bone from plaque or trauma from chewing or brushing. Increased width of keratinized mucosa around implants is associated with lower mean alveolar bone loss and improved indices of soft tissue health (12).

Patients may present with either a thin or no zone of attached gingiva. It is the responsibility of the dentist to diagnose this condition and request the team surgeon to perform the appropriate gingival graft procedure to increase the width of attached gingiva. Dentist's failure to either diagnose or make appropriate recommendations to correct this condition can lead to peri-implantitis and gradual bone loss.

Top 10 Contributing Factors to Dentist-Related Peri-Implantitis

1. Dental implant placement by inexperienced dentists who engage in surgical procedures without proper training.
2. Poor diagnosis and treatment planning.
3. Lack of team approach (surgeon and restorative dentist)
4. Restorative dentists who depend on their surgeon to provide implant abutment and restorative components.
5. Use of stock abutments instead of recommended customized abutments.
6. Ill-fitting abutments and crowns fabricated by low-cost laboratories that lack precision and quality.
7. Placing dental implants without surgical guides.
8. Failure to recognize and treat existing infection or inflammatory diseases before implant placement.
9. Poor understanding of dental implant biology and healing.
10. Failure to follow restorative-based treatment planning and implementation.

Patient-Related Peri-implantitis

In our review, about 15% of peri-implantitis cases can be attributed to patient-related factors including personal habits and health reasons.

1. Poor oral hygiene and home care

Dental implants are equally prone to inflammatory effects of plaque or calculus as natural teeth. Poor home care and oral hygiene lead to plaque and calculus formation and eventual peri-implantitis. Proper home care is critical to maintaining healthy tissue around teeth and implants. Following the completion of treatment, your dentist should review oral hygiene instructions specific to your needs to help you keep your teeth and implants clean. There a number of cleaning tools and techniques to help you be more effective with your home hygiene. These include brushes, regular floss, super

Patients can increase their dental implant longevity and success by adhering to home and professional care instructions and maintaining optimal oral and general health

floss, Christmas tree-shaped brushes, rubber tips, electric toothbrushes with either pulsating or irrigating actions, and a number of antiseptic mouth rinses. Ask your dentist for two or three hygiene techniques to keep it simple and easy to do.

2. Irregular professional cleaning

Professional dental care is equally important in maintaining your teeth health. Patients with dental implants are recommended to see their dentist for a checkup and cleaning at least once every three to four months. Your dentist and hygienist will monitor the effectiveness of your home care, perform professional cleaning, and detect early signs of inflammation before it leads to a bigger problem. Cleaning around dental implants requires different instruments and techniques than natural teeth, so make sure your dentist is familiar with them.

Patients with dental implants should see a dentist for checkup and cleaning at least once every three to four months

3. Smoking

There is a statistically significant difference in the failure rates of dental implants between smokers and nonsmokers. Smokers have a higher incidence of failure and complications following dental implantation and implant-related surgical procedures (15).

Smoking directly inhibits the mouth's natural defense against bacteria and inflammation. Smokers have a higher incidence of teeth caries, periodontal disease, and dental implant complications. Smoking causes poor implant healing, poor integration, gum and bone loss, peri-implantitis, and infections. Patients are recommended to cease smoking and use nicotine patches as needed both during peri-operative time and after the implants have been restored.

4. Untreated periodontal disease

Adjacent teeth with untreated periodontal disease can adversely affect dental implants and promote inflammation that can lead to peri-implantitis and infection. Patients should seek treatment for periodontal disease before placement of implants to minimize contamination and risks of failure. Such patients should then see their dentist every three to four months for a complete checkup and cleaning.

5. History of periodontal disease

Patients with a history of periodontal disease may potentially have a higher risk of peri-implantitis. This should be discussed before treatment and considered during the treatment planning phase. Close monitoring, frequent examination, and cleaning are critical in early recognition of inflammation and effective treatment.

6. Adjacent teeth with infection or abscess

Teeth adjacent to planned implant sites should be checked for any signs of abscess or lesions related to a necrotic pulp. Such teeth should be evaluated and treated by an endodontist before implants are placed as any existing infection can contaminate the implant and cause failure.

7. Systemic diseases affecting healing process

Some medical conditions affecting the body's healing process or immune system can have adverse effects on dentition, whether natural teeth or implants. These include uncontrolled diabetes, immune deficiency disorders, chemotherapy, and radiation therapy. Some medications can decrease salivary flow and promote dry mouth which can enhance inflammation of gums. Before implant placement, the oral surgeon must

consult with the patient's physician and take necessary precautions to assure optimal healing and success of the implants. The patient's compliance with following their physician's recommendations is equally important in minimizing complications.

8. Patient's healing physiology

Another factor that affects healing is the patient's physiology. Some patients simply heal better and faster than others. It is well recognized that stress and poor nutrition have a direct adverse effect on the healing process, and this may partly explain variations in our results. However, for many, there is no obvious underlying cause. Past medical and surgical history and knowledge of the healing process from previous procedures help us to better understand an individual's healing physiology so we can consider it in our planning.

Unknown Factors



In a small number of patients with peri-implantitis, there seems to be no obvious etiology or cause. Despite appropriate diagnosis, implant placement methodology, expertise of a specialist, and the right materials and techniques, peri-implantitis has been reported in some patients. The reasons are not completely understood, but it may be related to bacterial contamination during the placement of the implant, which can then lead to peri-implantitis. Rinsing with chlorhexidine (peridex) before and after placement of implants may help to prevent this. The patient's healing physiology and undiagnosed health conditions, as discussed, may also be a factor in such cases.

Treatment: What works? What May Work? What Doesn't Work?



Implant dentistry is highly successful, and a predictable treatment when performed properly by a trained and skilled team of dentists. On the other hand, the treatment of peri-implantitis has been very limited and largely disappointing. Most attempted treatments for peri-implantitis of implant infection fail. We'll now take a look at what we think works, what may work, and what treatment do not work and should be avoided.

While the causes of peri-implantitis can be identified in most cases, effective treatment options are less obvious. From early days of dental implants, clinicians have tried a number of different treatments, with mostly disappointing results. This is perhaps due to the difficulty in decontamination of the implant surface from plaque's toxins and the unpredictability in re-establishment of bone and soft tissue healing on that same surface.

Several methods of treating peri-implantitis have been described in the literature. Most of these methods focus on removal of the contaminating agent from the implant surface, but they remain highly unpredictable and their long-term success is unknown. These treatments include:

- Administration of systemic antibiotics alone
- Mechanical debridement with or without systemic antibiotic treatment (8)
- Mechanical debridement with or without localized drug delivery and chlorhexidine oral rinses (9)
- Mechanical debridement combined with LASER decontamination (6)

- Surgical debridement, and more recently...
- Surgical debridement with guided bone regeneration (GBR) for reparation of bony and soft-tissue defects (10)

Because nonsurgical treatment approaches have been ineffective in management of peri-implantitis, additional surgical interventions have been used including:

- Mechanical/ultrasonic debridement with localized drug delivery; i.e., antimicrobial minocycline spheres (Arestin®)
- Laser treatment with and without flap access
- Open flap debridement
- Open flap debridement with guided bone regeneration

Froum et al. reported an encouraging results in 51 cases of peri-implantitis using a regenerative approach including surface decontamination, use of enamel matrix derivative, a combination of platelet-derived growth factor with bovine bone or mineralized freeze-dried bone, and coverage with a collagen membrane or a subepithelial connective tissue graft. He demonstrated 3 mm gain of bone level over a period of 3

to 7.5 years. However, there was no histology to determine the nature of the newly formed tissue (13)

There is limited literature and research on effective treatment of peri-implantitis. Most articles are case reports on a specific technique that was attempted on a patient with variable results. There are very few studies on large patient samples that can provide us with meaningful treatment options or results. Hence, the outcome of treatments such as bone graft, tissue graft, or decontamination techniques (i.e. Laser, surgical decontamination, antibacterial) performed on the failing implants are largely unknown and should be approached cautiously. Even, if a treatment has appeared to work initially, its long-term prognosis and outcome remains questionable.

Before investing more time and money on such treatments, it is critical for the treating dentists to obtain all necessary diagnostic information, manage contributing factors, select treatments with the best long-term results, and provide patients with realistic expectations.

With such limited literature and inconsistent results from reported procedures, we decided to analyze what we have learned about the treatment of failing implants for patients with this frustrating problem. We first reviewed patients that we have seen with peri-implantitis, bone loss, and infection and identified contributing factors, when possible. We then looked at what treatments have been done on those patients and their clinical outcomes. Finally, we reviewed the literature and case reports to learn about the experience of other clinicians on different treatment modalities.

Before investing more time and money on treatments, it is critical for the treating dentists to obtain all necessary diagnostic information, manage contributing factors, select treatments with the best long-term results, and provide patients with realistic expectations.

And here is what we learned:

1. There was no consensus on which treatment modalities are consistently effective in managing failing dental implants with peri-implantitis.
2. The current classifications on different types of peri-implantitis, for the most part, are descriptive of the extent of the disease, but never have been validated regarding treatment efforts. There is also no universal or standard classification that clinicians can use for early detection and intervention. (2)
3. There were no prospective studies on the efficacy of various treatment options on failing implants.
4. Non-surgical treatment of peri-implantitis is highly unpredictable (3, 4, 5).
5. Beneficial effects of laser therapy on peri-implantitis have been shown, but its efficacy for long-term success is unknown (6,7).
6. Most procedures showed disappointing results and unpredictable outcomes.

In any disease process, treatment selection should be based on proper diagnosis, biological factors, and the probability of a long-term cure. This principle along with our observations led us to the recommendations in this chapter. First, we created a classification for various types of peri-implantitis and degree of bone and soft tissue loss. Then for each type, we listed what we know works, what we think might work, and what does not work and should be avoided.

Regardless of the type of complication, a patient with a painful dental implant should first see a specialist with expertise in management of dental implant complications as soon as possible.

There are two dental specialties that are formally trained in surgical principles of implant dentistry: oral surgeons and periodontists. However, they may not necessarily be experienced in managing dental implant complications. Therefore, patients should ask the oral surgeon or periodontist if they have specific experience in managing dental implant complications and whether they use current methods and techniques in their treatments.

When seeking the right specialist, patients should inquire:

1. Availability of CBCT (cone beam CT scan) imaging for proper diagnosis.
2. Whether the surgeon uses special tools and techniques for atraumatic removal of dental implants.
3. Experience and skill in bone and soft tissue regeneration.
4. Utilization of Platelet Derived Growth Factor (PDGF) or other biologic agents for enhancement of healing.
5. Experience in managing dental implant complications and the type of patients they have treated.
6. Evidence-based treatments that provide the best outcome with long-term results.

Before engaging in any treatment, patients should consult with a surgeon and a restorative dentist. The team dentists should obtain detailed past dental and medical history, perform a careful clinical examination, and obtain all necessary diagnostic information including CT scan (CBCT), dental X-rays, photos, and models. Equally important is discussion of patients' emotional state and what they expect from treatment.

Treatment options include both surgical and non-surgical methods. The team should consider all historical and existing factors along with diagnostic studies to design a treatment plan that best meets the patient's needs and goals. In some circumstances, it may also be helpful to obtain information on the initial treatments rendered by the original clinicians.

With good data and full understanding of the circumstances that led to peri-implantitis, the team can now make recommendations on optimal treatment.

Let's take a look at treatment options for each type of peri-implantitis and other inflammatory-related complications: what works, what may work, and what absolutely does not work and should be avoided!

If you are experiencing...

- Mildly painful gum tissues
- Mild swelling of gums
- Mild bleeding of gums
- No bone or gum tissue loss

You have >> Peri-Implant Mucositis

This is the mildest form of inflammatory condition affecting dental implants with mild pain and redness of the gum tissue (Fig 16).

What treatment works:

- Professional cleaning by your dentist every 3-4 months
- Better home care with effective brushing and flossing
- Use of other plaque control tools such as super floss, soft-picks, rubber tip stimulator, and proxabrush
- Application of chlorhexidine (peridex) to the gum tissue around the implant and its crown

- Identify and correct possible contributing factors such as fit of the components, crown shape and contours, and accessibility for effective plaque removal.



Fig 16 Peri-implant mucositis in a patient with upper incisor dental implant. The area appears red and more swollen.

With early intervention and elimination of contributing factors, most cases of peri-implant mucositis can be effectively controlled and treated.

If you are experiencing...

- Moderate to significant painful gum tissue
- Moderate bleeding from gums
- Increasing red and swollen gums
- No bone or gum tissue loss

You have >> Peri-Implantitis Type 1

This is a more advanced form of peri-implant mucositis characterized by increased pain, bleeding, and swelling around the gum tissues (Fig 17).

What treatment works:

- Deep cleaning by your dentist
- Better home care with effective brushing and flossing
- Use of other plaque control tools such as super floss, soft-picks, rubber tip stimulator, and proxabrush
- Application of chlorhexidine (peridex) to the gum tissue and around the implant and its crown

- Debridement along with antibiotics, either in the form of pills or localized drug delivery; i.e., antimicrobial minocycline spheres (Arestin®)
- Identify and correct possible causes as soon as possible: proper access for plaque removal, ill-fitting crown, residual cement, smoking, etc.



Fig 17 Peri-implantitis type 1 is characterized by increased redness, bleeding and swelling of gum tissue, but no loss of bone or soft tissue



video

Hygiene Instructions for Dental Implants

If you are experiencing...

- Pain, redness, or bleeding of gum tissue
- 1-4 mm of bone loss on one surface of the implant
- No loss of gum tissue
- Possible gray color of implant surface visible through the gum tissue

You have >> Peri-Implantitis Type 2a

In this type, bone is partially missing on one surface, but the gum tissue remains at a normal level. It is similar to peri-implantitis type 1, except that now there is loss of bone and possible grayish appearance of gum tissue in thin tissue biotypes (Fig 18).

What treatments work:

- See a surgeon for a consultation. Your dentist alone cannot address this problem.
- Antibiotic therapy to control inflammation or infection
- Removal of dental implant using atraumatic technique

- Immediate bone graft to restore missing bone if appropriate based on the quality and health of the surrounding tissues and type of bony defect
- If bone graft is not appropriate at the time of implant removal, then reevaluate in 3 months with CBCT (cone beam CT scan) and determine the best bone grafting approach for the type of bony defect
- Application of platelet derived growth factor to implant removal site to enhance tissue recovery and healing
- Replace with a new dental implant in 4-6 months using **“Implant-Perfect”** methodology (see the glossary section)



Fig 18 Peri-implantitis type 2a occurs when there is 1-4 mm loss of bone on the implant, but the gum tissue remains intact. The gum tissue may appear darker as the color of the implant becomes visible due to lack of bone coverage.

What treatments MAY work:

If the width of the exposed implant surface is 1-3 mm AND there is minimal inflammation, AND there is no evidence of infection AND the gum tissue is relatively thick and healthy, THEN...

- The crown may be removed, and a cover screw placed on the implant— Allow 6-8 weeks for gum tissue healing
- If the gum tissue is very thin or poor quality, the surgeon can attempt to improve its quality by a connective tissue gingival graft. This will help achieve a better result after bone grafting. In this case, allow 3 months of gum graft healing before bone grafting.
- The surgeon reflects the gum tissue and uncovers the exposed part of the implant
- The exposed implant surface is then detoxified using anti-bacterial agents or laser
- Bone grafting is attempted over the exposed implant surface
- Bone grafting may be complemented with growth factors from rhBMP2 or PDGF for enhanced healing

- A slow-resorbing or non-resorbing occlusive membrane is placed over the bone graft
- The implant and grafted bone is covered with soft tissue completely and allowed to heal for at least 6 months
- The implant should be re-evaluated using CBCT and clinical examination to assess the degree of bone regeneration over the implant and attachment level
- If successful, uncover the implant platform, place healing abutment, and prepare for a new crown

NOTE: THE SURGICAL RESULTS MAY VARY. THERE IS NO EVIDENCE-BASED SUPPORT FOR THIS TREATMENT AND LONG-TERM SUCCESS MAY RANGE FROM NONE TO 50% DEPENDING ON BIOLOGICAL FACTORS AND THE PATIENT'S HEALING POTENTIAL. THE SURGEON AND PATIENT MUST CONSIDER THE TIME, COST, AND BENEFIT / RISK OF SUCH TREATMENTS BEFORE PROCEEDING.

The prognosis of this treatment may decrease if:

- The width of the exposed implant surface is greater than 3mm
- There is significant inflammation
- There is active infection
- The gum tissue is relatively thin and in poor health
- In this case, it may be best to follow the implant removal process

- Laser-assisted peri-implantitis procedure (LAPIP) treatment alone (This may help to detoxify the surface but regaining new attachment is not predictable)
- Bone graft or gum tissue grafting in significantly misaligned implants

What treatments DON'T work:

The following treatments are not evidence-based and do not work:

- Watching it and hoping it improves
- Antibiotic treatment alone
- Deep cleaning alone
- Application of antibacterial agents in the gum sulcus alone (This may help with controlling inflammation or infection temporarily, but will not create a new attachment)

If you are experiencing...

- Pain, redness, or bleeding of gum tissue
- Greater than 4 mm of bone loss on one surface of the implant
- No loss of gum tissue
- Possible gray color of implant surface showing through the gum tissue

You have >> Peri-Implantitis Type 2b

In this type, bone is largely or completely missing on one surface but the gum tissue seems normal. Similar to Type 2a, the gum tissue seems at a normal level with deep inflammation, but there is almost no bone on one surface of the implant (Fig 19).

What treatments work:

- See a surgeon for consultation. Your dentist alone cannot address this problem.
- Antibiotic therapy to control inflammation or infection
- Removal of dental implant using atraumatic technique

- Immediate bone graft to restore missing bone, if appropriate, based on the quality and health of the surrounding tissues and type of bony defect
- If bone graft is not appropriate at the time of implant removal, then reevaluate in 3 months with CBCT (cone beam



Fig 19 Peri-implantitis type 2b occurs when there is a significant loss of bone (> 4 mm) on the implant, but gum tissue level remains intact. The gum tissue may appear darker due to lack of bone coverage on the implant surface

CT scan) and determine the best bone grafting approach for the type of bony defect

- Application of platelet derived growth factor to implant removal site to enhance tissue recovery and healing
- Replace with a new dental implant in 4-6 months using **“Implant-Perfect”** methodology (see the glossary section)

What treatments **MAY** work:

If the width of the exposed implant surface is 1-3 mm AND there is minimal inflammation, AND there is no evidence of infection AND the gum tissue is relatively thick and healthy, THEN...

- The crown may be removed, and a cover screw placed on the implant—Allow 6-8 weeks for gum tissue healing
- If the gum tissue is very thin or poor quality, the surgeon can attempt to improve its quality by a connective tissue gingival graft. This will help achieve a better result after bone grafting. In this case, allow 3 months of gum graft healing before bone grafting
- The surgeon reflects the gum tissue and uncovers the exposed part of the implant

- The exposed implant surface is then detoxified using antibacterial agents or laser
- Bone grafting is attempted over the exposed implant surface
- Bone graft material is placed
- Bone graft may be complemented with growth factors from rhBMP2 or PDGF for enhanced healing
- A slow-resorbing or non-resorbing occlusive membrane is placed over the bone graft
- The implant and grafted bone is covered with soft tissue completely and allowed to heal for at least 6 months
- The implant should be re-evaluated using CBCT and clinical examination to assess the degree of bone regeneration over the implant
- If successful, uncover the implant platform, place the healing abutment, and prepare for a new crown

NOTES:

1. THE SURGICAL RESULTS MAY VARY. THERE IS NO EVIDENCE-BASED SUPPORT FOR THIS TREATMENT AND LONG-TERM SUCCESS MAY RANGE FROM NONE TO 50%

DEPENDING ON BIOLOGICAL FACTORS AND THE PATIENT'S HEALING POTENTIAL. THE SURGEON AND PATIENT MUST CONSIDER THE TIME, COST, AND BENEFIT / RISK OF SUCH TREATMENTS BEFORE PROCEEDING.

2. THE PROGNOSIS OF THIS TREATMENT IN PERI-IMPLANTITIS TYPE 2B MAY BE LESS THAN PERI-IMPLANTITIS TYPE 2A.

The prognosis of this treatment may decrease if:

- The width of the exposed implant surface is greater than 3mm
- There is significant inflammation
- There is active infection
- The gum tissue is relatively thin and in poor health
- In this case, it is best to follow the implant removal process

What treatments DON'T work:

The following treatments are not evidence-based and do not work:

- Watching it and hoping it improves
- Antibiotic treatment alone
- Deep cleaning alone
- Application of antibacterial agents in the gum sulcus alone (This may help with controlling inflammation or infection temporarily, but will not create new attachment)
- Laser-assisted peri-implantitis procedure (LAPIP) alone (This may help to detoxify the surface but regaining new attachment is not predictable)
- Bone graft or gum tissue grafting in significantly misaligned implants

If you are experiencing...

- Pain, redness, or bleeding of gum tissue
- 1-4 mm of bone loss on one surface of the implant
- Receding gum tissue
- Dark gray appearance of implant surface

You have >> Peri-implantitis type-3a

In this type, there is loss of both bone and gum tissue. The implant, its abutment, or both is now partially visible as the gum tissue has receded exposing the implant surface. Depending on the level of inflammation, there may be associated pain or bleeding (Fig 20).

What treatments work:

- See a surgeon for a consultation. Your dentist alone cannot address this problem
- Antibiotic therapy to control inflammation or infection
- Removal of dental implant using atraumatic technique
- Due to loss of gum tissue, following removal of the dental implant it is best to allow the site to heal for 2-3 months and

regenerate the missing soft tissue first before any bone grafting. The regenerated soft tissue will improve the success of bone grafting at a later time.

- Application of platelet derived growth factor to implant removal site to enhance tissue recovery and healing
- The site is reevaluated in 3 months with CBCT (cone beam CT scan) and the best bone grafting approach is determined



Fig 20 Peri-implantitis type 3a in a patient with loss of bone and receding gum tissue and grayish appearance of the margin

- Bone is augmented using an appropriate approach based on the type of bone deficiency (horizontal, vertical, or combination)
- Replace with a new dental implant in 4-6 months using ***“Implant-Perfect”*** methodology (see the glossary section)

What treatments MAY work:

In peri-implantitis type 3a, the loss of soft tissue is often due to significant misalignment of the implant toward the facial or buccal aspect of the site. This is easily diagnosed by clinical and CBCT evaluation of the implant. In this case, any attempts at bone or gum tissue graft do not work and often fail. Additionally, the restoration of such implants are challenging and often aesthetically unacceptable. Therefore, it is best to remove the implant and follow the treatment sequence for implant removal.

In circumstances where the implant is well-aligned, then the following treatment may work. If the width of the exposed implant surface is 1-3 mm AND there is minimal inflammation AND there is no evidence of infection, AND the gum tissue is relatively thick and healthy, THEN...

- The crown may be removed, and the cover screw placed on the implant—Allow 6-8 weeks for gum tissue healing
- If the gum tissue is very thin or poor quality, the surgeon can attempt to improve its quality by a connective tissue gingival graft. This will help achieve a better result after bone grafting. In this case, allow 3 months of gum graft healing before bone grafting
- The surgeon reflects the gum tissue and uncovers the exposed part of the implant
- The exposed implant surface is then detoxified using antibacterial agents or laser
- Bone grafting is attempted over the exposed implant surface
- Bone graft material is placed
- Bone graft may be complemented with growth factors from rhBMP2 or PDGF for enhanced healing
- A slow-resorbing or non-resorbing occlusive membrane is placed over the bone graft
- The implant and grafted bone is covered with soft tissue completely and allowed to heal for at least 6 months

- The implant should be evaluated using CBCT and clinical examination to assess the degree of bone regeneration over the implant
- If successful, uncover the implant platform, place the healing abutment, and prepare for a new crown

NOTE: THE SURGICAL RESULTS MAY VARY. THERE IS NO EVIDENCE -BASED SUPPORT FOR THIS TREATMENT AND LONG-TERM SUCCESS MAY RANGE FROM NONE TO 50% DEPENDING ON BIOLOGICAL FACTORS AND THE PATIENT'S HEALING POTENTIAL. THE SURGEON AND PATIENT MUST CONSIDER THE TIME, COST, AND BENEFIT / RISK OF SUCH TREATMENTS BEFORE PROCEEDING.

The prognosis of this treatment may decrease if:

- The width of the exposed implant surface is greater than 3 mm
- There is significant inflammation
- There is active infection
- The gum tissue is relatively thin and in poor health

In this case, it is best to follow the implant removal process.

What treatments DON'T work:

The following treatments are not evidence-based and do not work:

- Watching it and hoping it improves
- Antibiotic treatment alone
- Deep cleaning alone
- Application of antibacterial agents in the gum sulcus alone (This may help with controlling inflammation or infection temporarily, but will not create a new attachment)
- Laser-assisted peri-implantitis procedure (LAPIP) alone (This may help to detoxify the surface but regaining new attachment is not predictable)
- Bone graft or gum tissue grafting in significantly misaligned implants

If you are experiencing...

- Pain, redness, or bleeding of gum tissue
- Greater than 4 mm of vertical bone loss on one surface of the implant
- Receding gum tissue

You have >> Peri-implantitis type-3b

Similar to type 3a, there is loss of both bone and gum tissue, but it is more extensive. The implant surface now has significant loss of bone and exposed surface, and there is likely more advanced gum recession (Fig 21, 22).

What treatments work:

- See a surgeon for a consultation. Your dentist alone cannot address this problem
- Antibiotic therapy to control inflammation or infection
- Removal of dental implant
- Due to loss of gum tissue, following removal of the dental implant it is best to allow the site to heal for 2-3 months and regenerate the missing soft tissue first before any bone

grafting. The regenerated soft tissue will improve success of bone grafting at a later time.

- Application of platelet derived growth factor to implant removal site to enhance tissue recovery and healing
- The site is reevaluated in 3 months with CBCT (cone beam CT scan) and the best bone grafting approach is determined



Fig 21 Peri-implantitis type 3b occurs when there is greater than 4 mm of missing bone on one surface and receding gum tissue



Fig 22 Peri-implantitis type 3b in this patient with obvious loss of bone and receding gum tissue.

- Bone is augmented using an appropriate approach based on the type of bone deficiency (horizontal, vertical, or combination)
- Replace with a new dental implant in 4-6 months using **"Implant-Perfect"** methodology (see the glossary section)

What treatments **MAY** work:

Similar to peri-implantitis type 3a, in type 3b the loss of soft tissue is often due to significant misalignment of the implant toward the facial or buccal aspect of the site. This is easily diagnosed by clinical and CBCT evaluation of the implant. In this case, any attempts at bone or gum tissue graft do not work and often fail. Therefore, it is best to remove the implant and follow the treatment sequence for implant removal.

In circumstances where the implant is well-aligned, then the following treatment may work. If the width of the exposed implant surface is 1-3 mm AND there is minimal inflammation AND there is no evidence of infection, AND the gum tissue is relatively thick and healthy, THEN...

- The crown may be removed and the cover screw placed on the implant—Allow 6-8 weeks for gum tissue healing
- If the gum tissue is very thin or poor quality, the surgeon can attempt to improve its quality by a connective tissue gingival graft. This will help achieve a better result after bone grafting. In this case, allow 3 months of gum graft healing before bone grafting
- The surgeon reflects the gum tissue and uncovers the exposed part of the implant

- The exposed implant surface is then detoxified using antibacterial agents or laser
- Bone grafting is attempted over the exposed implant surface
- Bone graft material is placed
- Bone graft may be complemented with growth factors from rhBMP2 or PDGF for enhanced healing
- A slow-resorbing or non-resorbing occlusive membrane is placed over the bone graft
- The implant and grafted bone is covered with soft tissue completely and allowed to heal for at least 6 months
- The implant should be evaluated using CBCT and clinical examination to assess the degree of bone regeneration over the implant
- If successful, uncover the implant platform, place the healing abutment, and prepare for a new crown

NOTES:

1. THE SURGICAL RESULTS MAY VARY. THERE IS NO EVIDENCE-BASED SUPPORT FOR THIS TREATMENT AND LONG-TERM SUCCESS MAY RANGE FROM NONE TO 50% DEPENDING ON BIOLOGICAL FACTORS AND THE PATIENT'S HEALING POTENTIAL. THE SURGEON AND PATIENT MUST CONSIDER THE TIME, COST, AND BENEFIT / RISK OF SUCH TREATMENTS BEFORE PROCEEDING.

2. THE PROGNOSIS FOR TREATMENT IN PERI-IMPLANTITIS TYPE 3B MAY BE LESS THAN PERI-IMPLANTITIS TYPE 3A.

The prognosis of this treatment may decrease if:

- The width of the exposed implant surface is greater than 3 mm
- There is significant inflammation
- There is active infection
- The gum tissue is relatively thin and in poor health

- In this case, it is best to follow the implant removal process

What treatments DON'T work:

The following treatments are not evidence-based and do not work:

- Watching it and hoping it improves
- Antibiotic treatment
- Deep cleaning
- Application of antibacterial agents in the gum sulcus alone (This may help with controlling inflammation or infection temporarily, but will not create new attachment)
- Laser-assisted peri-implantitis procedure (LAPIP) alone (This may help to detoxify the surface but regaining new attachment is not predictable)
- Bone graft or gum tissue grafting in significantly misaligned implants

If you are experiencing...

- Pain, redness, or bleeding of gum tissue
- Loss of bone all around the implant or on more than 2 surfaces
- No loss of gum tissue

You have >> Peri-implantitis type-4a

In this type, there is a loss of bone all around the implant in a crater-like fashion, but the gum tissue level remains unchanged. It appears as a dark area surrounding the implant on a routine dental X-ray (Fig 23).

What treatments work:

- See a surgeon for a consultation. Your dentist alone cannot address this problem
- Antibiotic therapy to control inflammation or infection
- Removal of dental implant using atraumatic technique
- Complete removal of all inflammatory or granulation tissue

- Immediate bone graft to restore missing bone, if appropriate, based on the quality and health of the surrounding tissues and type of the bony defect
- If bone graft is not appropriate at the time of implant removal, then reevaluate in 3 months with CBCT (cone beam CT scan) and determine the best bone grafting approach for the type of bony defect
- Application of platelet derived growth factor to implant removal site to enhance tissue recovery and healing

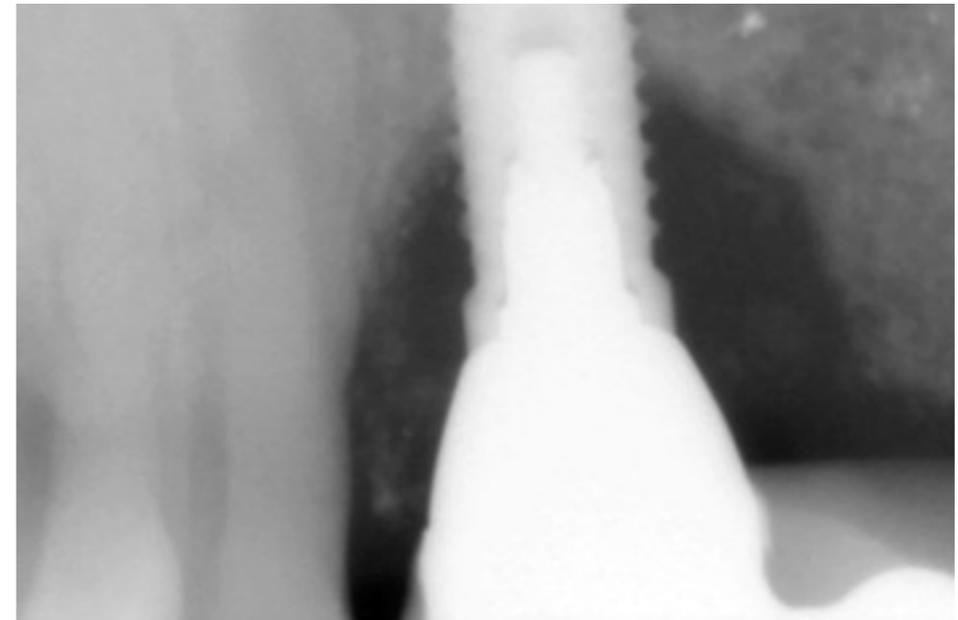


Fig 23 Peri-implantitis type 4a with crater-like loss of bone around the implant, but no gum tissue loss

The site is reevaluated in 3 months with CBCT (cone beam CT scan) and the best bone grafting approach is determined

- Bone is augmented using an appropriate approach based on the type of bone deficiency (horizontal, vertical, or combination)
- Replace with a new dental implant in 4-6 months using ***“Implant-Perfect”*** methodology (see the glossary section)

What treatments MAY work:

Bone grafting to regenerate attached tissue has been attempted and reported in the literature. However, long-term success of such procedures is unknown. Each individual case should be evaluated by the treating surgeon. The likely prognosis and pros and cons of the bone grafting option should also be thoroughly discussed with patient.

Laser-assisted peri-implantitis procedure (LAPIP) has been described in the literature with some success, however, its long-term prognosis and longevity of the implants remain unknown.

What treatments DON'T work:

The following treatments are not evidence-based and do not work:

- Watching it and hoping it improves
- Antibiotic treatment
- Deep cleaning
- Application of antibacterial agents in the gum sulcus alone
- Bone graft or gum tissue grafting in significantly misaligned implants

If you are experiencing...

- Pain, redness, or bleeding of gum tissue
- Loss of bone all around the implant or on more than 2 surfaces
- Receding gum tissue

You have >> Peri-implantitis type-4b

In this type, as in type 4a, there is a loss of bone all around the implant in a crater-like fashion, but now there is also receding gum tissue and the implant surface is visible all around (Fig 24, 25, 26).

What treatments work:

- See a surgeon for a consultation. Your dentist alone cannot address this problem
- Antibiotic therapy to control inflammation or infection
- Removal of dental implant using atraumatic technique
- Complete removal of all inflammatory or granulation tissue
- Immediate bone graft to restore missing bone, if appropriate, based on the quality and health of the surrounding tissues

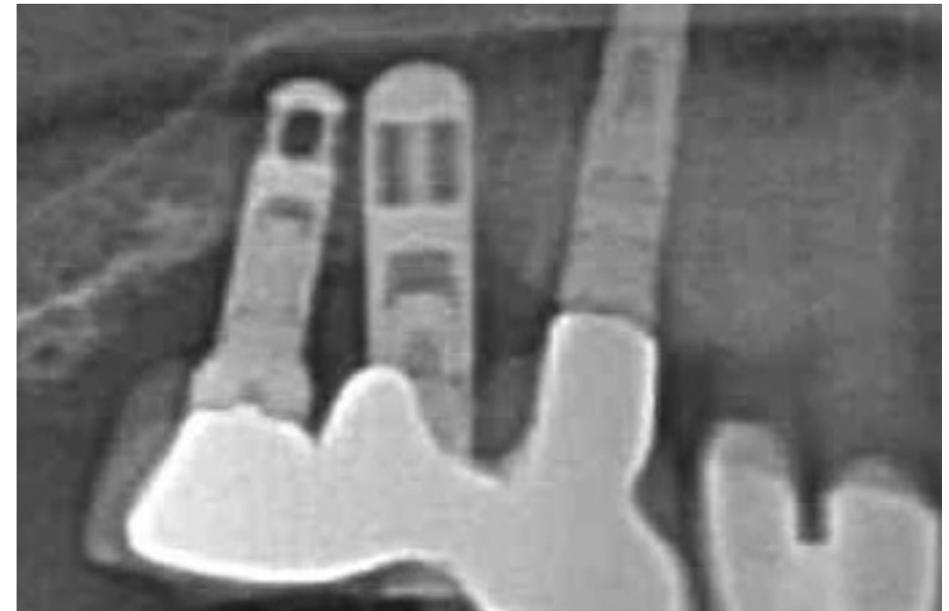


Fig 24-25 Peri-implantitis type 4b with infection characterized by crater-like bone defect around the implants and pus drainage indicating active infection



Fig 26 Peri-implantitis type 4b with the loss of bone and gum tissue resulting in exposure of implant surface

and type of the bony defect

- If bone graft is not appropriate at the time of implant removal, then reevaluate in 3 months with CBCT (cone beam CT scan) and determine the best bone grafting approach for the type of the bony defect
- Application of platelet derived growth factor to implant removal site to enhance tissue recovery and healing
- The site is reevaluated in 3 months with CBCT (cone beam CT scan) and the best bone grafting approach is determined

- Bone is augmented using an appropriate approach based on the type of bone deficiency (horizontal, vertical, or combination)
- Replace with a new dental implant in 4-6 months using “Implant-Perfect” methodology (see the glossary section)

What treatments **MAY** work:

There are no treatments available to regain bone and soft tissue attachment in peri-implantitis type 4b.

What treatments **DON'T** work:

The following treatments are not evidence-based and do not work:

- Watching it and hoping it improves
- Antibiotic treatment
- Deep cleaning
- Application of antibacterial agents in the gum sulcus
- Laser-assisted peri-implantitis procedure (LAPIP)
- Bone graft or gum tissue grafting in significantly misaligned implants

If you are experiencing...

- Pain, redness, and swelling of gum tissue or face
- Drainage of pus (purulence) from the gum tissue
- Note: infection can occur with or without the presence of actual draining pus
- Bone or gum tissue loss

You have >> Implant infection

Implant infection can happen in all peri-implantitis types. It is characterized by swelling, pain, and possible drainage of pus (Fig 25, 26).

What treatments work:

- See an oral surgeon for a consultation. Your dentist alone cannot address this problem
- Start antibiotics immediately
- Removal of dental implant as soon as possible
- Augment immediately with bone graft if there is adequate tissue health to support it and there is no pus. Graft will help to reserve or augment missing bone. If there is pus, then the



Fig 25-26 Infection around a dental implant can present with pain, swelling, pus, and evidence of bone loss

site should only be cleaned and irrigated and grafted 2-3 months later

- Immediate application of platelet derived growth factor to enhance healing
- Replace with a new implant in 4-6 months using “Implant-Perfect” methodology

What treatments MAY work:

If the infection is very minor and there is adequate bone support, it may respond to antibiotic treatment and surgical decontamination along with bone grafting once infection has resolved. If the infection and bone loss are more severe, then the prognosis diminishes greatly. Each individual case should be evaluated by the treating surgeon. The likely prognosis and pros and cons of treatments such as bone grafting should also be thoroughly discussed with patient.

What treatments DON'T work:

The following treatments are not evidence-based and do not work:

- Watching it and hoping it improves
- Antibiotic treatment alone
- Deep cleaning
- Application of antibacterial agents in the gum sulcus
- Laser-assisted peri-implantitis procedure (LAPIP)
- Bone graft or gum tissue grafting in significantly misaligned implants

If you are experiencing...

- Pain, redness, or bleeding of gum tissue
- Looseness (mobility) of the implant
- Possible bone loss

You have >> **Implant integration loss**

Inflammation or infection can lead to loss of bone integration and looseness of the implant. The crown will be loose due to movement of the implant. Poor implant integration can also happen in the absence of inflammation or infection (Fig 27).

What treatments work:

- See an oral surgeon for a consultation. Your dentist alone cannot address this problem
- Remove dental implant as soon as possible
- Graft the site if appropriate to preserve or augment bone (Note: if there is a loss of gum tissue, then allow 3 months before grafting)
- Immediate application of platelet derived growth factor to enhance healing

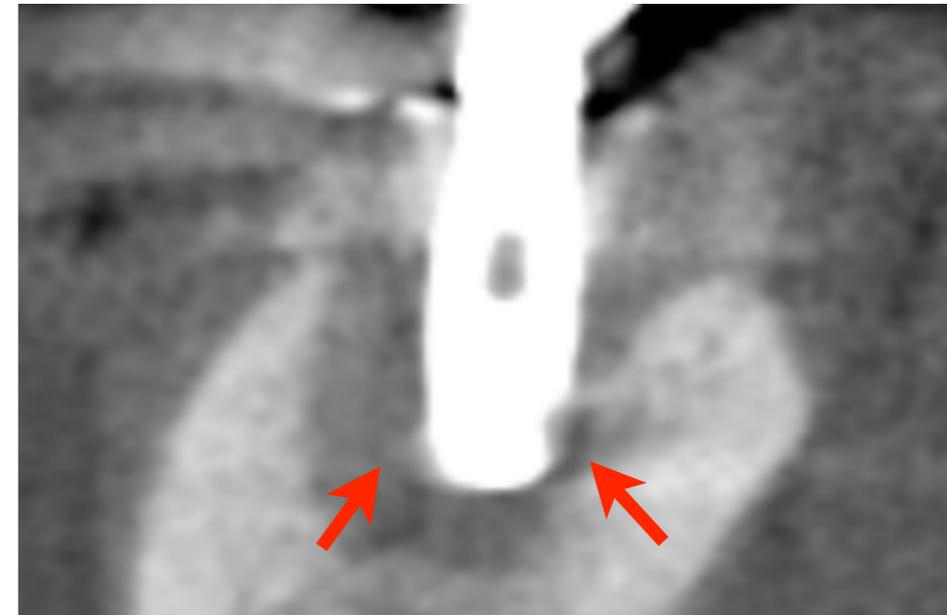


Fig 27 Chronic infection leading to complete loss of implant integration demonstrated by bone loss all the way around the implant

- Replace with a new implant in 4-6 months using “Implant-Perfect” methodology

What treatments MAY work:

There are no treatments available for this condition. The implant, once it loses integration, has failed and must be removed.

What treatments DON'T work:

The following treatments are not evidence-based and do not work:

- Watching it and hoping it improves
- Antibiotic treatment alone
- Deep cleaning
- Application of antibacterial agents in the gum sulcus
- Laser-assisted peri-implantitis procedure (LAPIP)
- Bone graft and/or gum tissue grafting in significantly misaligned implants

About treatments that DON'T work:

The only predictable treatment for peri-implantitis types 2-4, implants with infection, and implants that have not integrated, is implant removal, restoration of the missing tissue, and replacement with a new implant. The key word is 'predictable'. Several treatments including grafting and laser have been described in the literature with some degree of reported success. However, the authors have acknowledged that the long-term results are questionable and they do not work in every situation.

Future prospective studies and trials may help clinicians form a better criteria for case selection which can improve treatment predictability. Until then, the best approach remains prevention of peri-implantitis by following strict guidelines well established in implant dentistry.

Implant Peri-implantitis Type and Conditions

Signs	Peri-implant Mucositis	Type 1	Type 2a	Type 2b	Type 3a	Type 3b	Type 4a	Type 4b	Infection	Non-integration
Pain										
Bleeding										
Gum Recession										
Bone Loss			1-4 mm 1-surface	> 4 mm 1-surface	1-4 mm 1-surface	> 4 mm 1-surface	 All around	 All around		
Pus										
Mobility										
Grayish Color Changes										

What to Do Next?



Dental implant complications should be immediately assessed and treated by a team of dentists with expertise. Any delay in treatment can result in further structural damage to the bone and gum tissue and increased pain and swelling.

Dental implant complications, while rare, are frustrating and disappointing not only for you as a patient, but also for the dentists involved in the treatment. However, problems should be addressed as soon as possible to avoid further complications, pain, infections, or negative effects on one's health. In this section, we'll discuss your next steps in managing the implant complication and the journey to recovery and restoration of normal health.

Dentists Collaboration & Discussion

If you were initially treated by a team of dentists, including an oral surgeon or periodontist and a restorative dentist, seek treatment options from the same team. The treating team of dentists should collaborate, assess diagnostic X-rays or CBCT, and discuss biological, aesthetic, and functional implications of the troubled dental implant.

If you were treated by a general dentist for both surgery and restorative work, immediately seek a consultation with a board-certified oral and maxillofacial surgeon or periodontist experienced in managing complications and tissue regeneration techniques.

The specialist should contact the general dentist and obtain the following information:

- Date of implant placement
- Treatment scenario—Immediate or delayed implant? Site grafting? Immediate or delayed restorations?
- Type of implant placed
- History of treatment, both prior to and after implant placement
- Any other treatment performed
- Pre-operative and post-operative X-rays

As necessary, new diagnostic information should be obtained by the team of dentists. This includes:

- Conventional X-rays
- CBCT (Cone Beam CT Scan)
- Photos
- Study models

Following thorough collaboration, the team of dentists should design a “rescue plan” and step-by-step treatment strategy

for how to resolve the complication, restore possible missing bone or soft tissue, and replace the dental implant.

Rescue and Replacement Plan

During a group meeting with the surgeon, the restorative dentist, and the patient, all treatment options are proposed and the prognosis for each option is discussed. It is important to ask questions about ideal treatment options, expected results, limitations, who will provide each treatment, the order in which they are provided, length of treatment time, and cost.

The cost for rescue and retreatment may vary depending on the nature of the complication, contributing factors, and individual practice rules. Inquire with the original dentist or team about how they manage cost issues.

Transitional Prosthesis

Whether the implant is planned for removal or treatment, typically, the existing restorations must be removed. Therefore, the restorative dentist will obtain necessary impressions to

fabricate a transitional prosthesis to be used in the interim until a new implant and restoration is placed.

Surgical Management

Surgical management of implant complications should only be done by experienced surgeons with skills in implant removal, tissue regeneration, and proper implant placement. The surgeon must be completely aligned with the restorative dentist during the entire length of the treatment. Procedures performed by the surgeon include:

- Implant removal
- Bone grafting
- Soft tissue grafting
- Other tissue regeneration techniques
- Surgical diagnostic work-up
- Placement of new dental implants

Restorative Management

The restorative aspect of treatment should be provided by an experienced general dentist or a prosthodontist. They need to fully understand the team approach and collaborate with the team surgeon. The restorative dentist will provide the following procedures:

- Restorative treatment plan
- Aesthetic and functional analysis
- Fabrication of a transitional prosthesis
- Provisionalization of dental implant
- Final implant-supported restorations
- Other necessary dental care

Emotional Impact

During my 18 years of managing patients with implant complications, I have come to appreciate its emotional effect on patients. After all, each patient started with a positive attitude, hope, and the promise of successful results. Therefore, when implant complications happen, patients must deal with their feelings of disappointment, frustration, and

distrust. They have invested much time and money only to find themselves exposed to more time and expense. There is no easy way through this, but it can be managed.

First, it is important for the team of dentists to acknowledge the emotional effect, empathize, and offer their support during the retreatment.

Second, there must be a very transparent conversation between the dentists and the patient about what is possible and appropriate expectations.

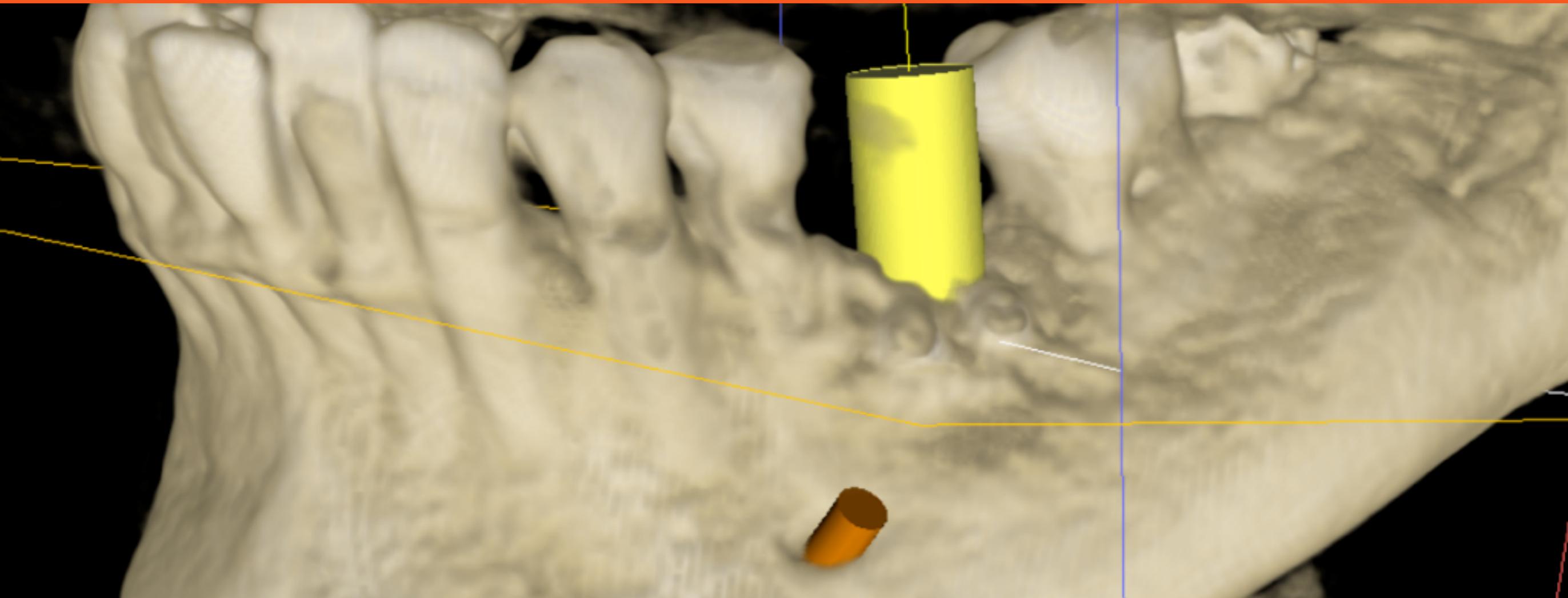
Third, the patient must come to a state of acceptance and get reignited with positive thoughts about a successful outcome.

Finally, the procedures need to be done with great care and attention to detail by the selected experts with continued patient reassurance of treatment progress.

What to Expect After Surgery

Using advanced instruments and techniques, removal of dental implant can be a minimally invasive procedure with little or no pain and swelling after the procedure. If bone grafting is required, patients generally experience some discomfort and localized swelling for about 5-7 days. If there is existing infection, a 7-10 day regimen of antibiotics are recommended.

Glossary of Terms & Procedures



To make better and more engaged decisions about treatment, it is vitally important for patients to understand the terminology, type of specialists, and common procedures related to dental implant treatments.

About Oral Surgeons

Oral surgeons receive a minimum of four years of post-doctoral training in accredited residency programs. They receive hospital-based training in oral and facial surgical procedures and anesthesia, in addition to extensive medical training to care for medically-compromised patients.

With extensive surgical expertise, oral surgeons are the specialist of choice for the placement of dental implants and related bone grafting procedures. Additionally, oral surgeons specialize in:

- Extraction of teeth (wisdom teeth and others)
- Oral biopsies
- Corrective jaw surgery (orthognathic surgery)
- Oral and facial infections
- Oral and facial trauma
- IV sedation/anesthesia

About Periodontists

Periodontists receive 2–3 years of post-graduate training for treatment of gum disease, various gingival procedures (functional and cosmetic), and dental implants for teeth replacement. Periodontists often work along with general dentists or prosthodontists for long term periodontal care of patients (bone and gum tissue surrounding teeth). They provide both preventive periodontal care as well as both surgical and non-surgical management of periodontal disease. While some procedures are performed by both periodontists and oral surgeons, they often work in collaboration on patients with complex needs requiring their expertise. Additionally, periodontists specialize in:

- Surgical and non-surgical treatment of gum disease
- Preventive periodontal procedures
- Treatment of gum recession via grafting procedures
- Cosmetic gingival procedures
- Minor bone grafting procedures for implants

About Restorative Dentists

The first type of restorative dentist is a prosthodontist who has received three additional years of postdoctoral training in dentistry, gaining advanced skills in both cosmetic and restorative procedures. Some may also perform common periodontal or oral surgery procedures, but most focus on treatment of patients with complex cosmetic and restorative needs. In a patient with multidisciplinary needs (e.g., a patient who needs crowns, implants, root canal treatment, and gum surgery), a prosthodontist will act as both the restorative dentist and the coordinator of the overall treatment and team of dentists.

The second type of restorative dentist is a general practitioner. A general dentist has graduated from a 4-year dental school with no additional formal post-doctorate residency. Some may have completed a 1-year general practice residency program following dental school, providing them additional clinical experience and expertise.

About 'Implantologists'

Some dentists market themselves as implantologists signifying their specific interest in implant dentistry. However, It's important to know that 'implantology' is not a recognized specialty by American Dental Association and does not reflect formal training in an accredited residency program like those in oral surgery or periodontics. Any dentist can self-prescribe this label with no specific requirements.

About 'Mini-Residency' Programs in Implant Dentistry

Some clinicians may have completed a 'mini-residency' program in the field of implant dentistry. Most mini-residencies are weekend programs given over six to eight sessions and consist of lectures and some hands-on classes on lab models. While such programs provide participants a greater insight and knowledge base in implant dentistry, they do not provide the necessary training as given during formal residencies that take three to four years to complete. When seeking the right

dentist for implant therapy, patients should inquire about the clinician's proficiency and experience.

CBCT (Cone Beam CT Scan)

CBCT (Cone Beam CT Scan) is an in-office dental scan imaging machine that provides an accurate 3-dimensional view of the jawbone and surrounding structures (Fig 28 a-b). CBCT is used for precision planning of dental implant placement and related bone grafting with maximal safety. It allows computer-assisted planning and fabrication of accurate surgical guides for precision placement of dental implants. Although, at the time this book was written, it is not



considered a standard-of-care to use CBCT for dental implant planning, in our opinion it should be used in **every** patient as its benefits significantly outweigh its low cost and minor additional radiation. CBCT allows proper diagnosis and planning allowing the surgeon to augment bone when necessary and place the implants in proper position. Many cases of peri-implantitis can be effectively prevented by this approach.

“CBCT should be used in EVERY patient undergoing dental implant” therapy”

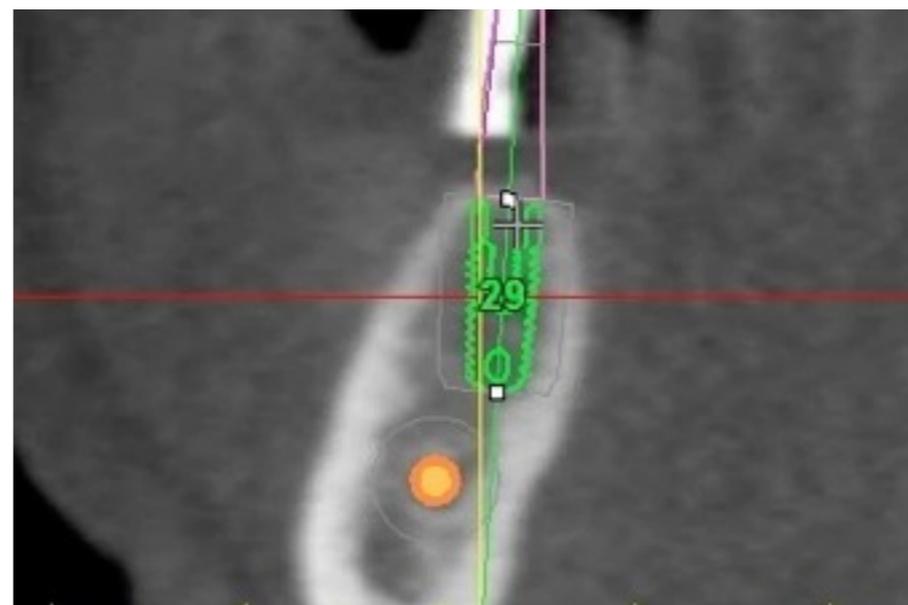
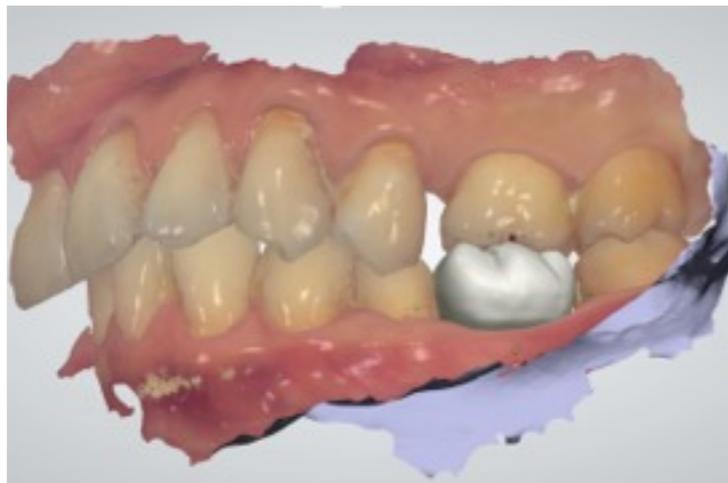


Fig 28 a-b CBCT images showing precise dimensions of the jaw bone and vital structures important during treatment planning

Computer-Assisted Planning

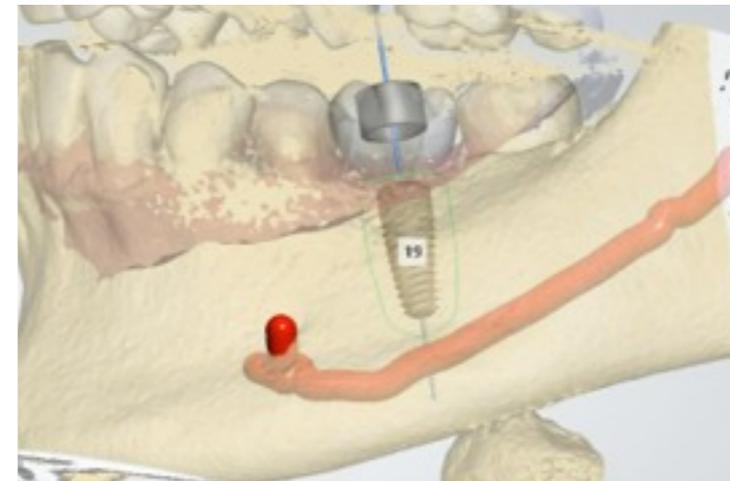
Through a complete digital work-up and computer-assisted planning, dental implants can be placed safely and with great precision in orientation and position. Here is the process:

1. A cone beam CT scan (CBCT) is obtained for 3-dimensional image of the jaw bone and related structures.
2. A digital impression of patient's teeth and gum tissue is obtained using an intra-oral scan.



3. The CBCT and the digital intra-oral scan are then combined to represent the relationship of the jaw bone to teeth and gum tissue.

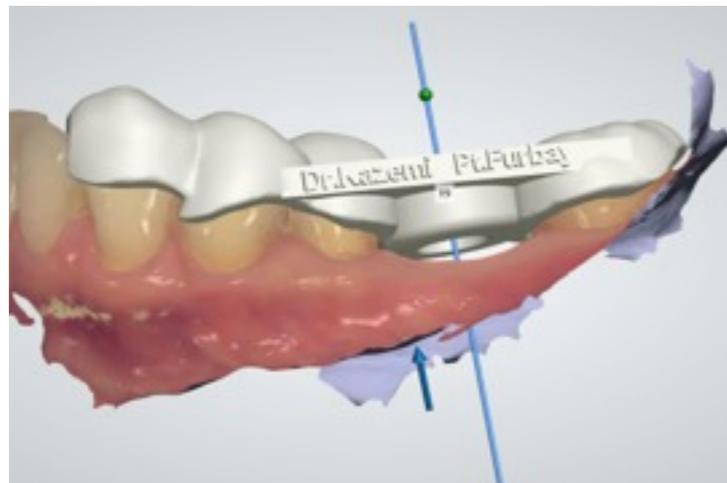
4. The planned restorations are then drawn digitally into the 3-dimensional model. This is essentially the digital prototype of the final prosthesis.
5. Digital dental implants are then placed and adjusted until they are perfectly positioned within the confines of the restoration and the supporting bone. The implant diameter and the length are precisely selected to assure an optimal and safe position in relation to surrounding nerves, sinuses, and adjacent teeth.



video

Digital Implant Dentistry

6. Using the final digital work-up, a CAD / CAM surgical guide is fabricated. The surgeon uses this surgical guide to position the implant precisely and according to the 3-dimensional work-up.

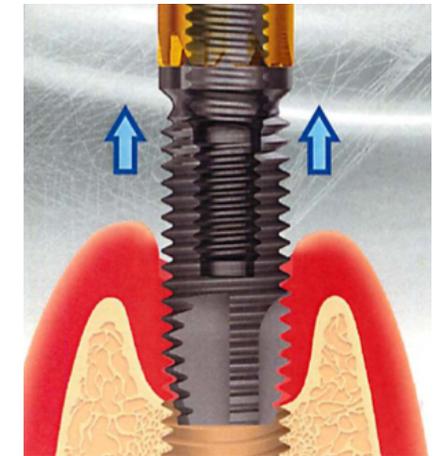


Dental Implant Removal

Complications that require removal of dental implants include fractures, poor position, peri-implantitis, non-integration, and infection.

Using special implant removal instruments and technique, failed dental implants can now be removed easily and quickly with NO bone removal. This new technique makes removal of such

implants easier and less invasive in comparison to the traditional technique of cutting the bone around an implant using trough burs. Using specialized dental implant removal instruments, the procedure takes less than 10 minutes with minimal patient discomfort. Once the implant is removed, the site is cleaned and inspected and, if necessary, grafted for future implant replacement. In some circumstances, an immediate replacement with a new dental implant may be done.



video

Atraumatic Removal of Failed Dental Implants

Bone Grafting

Bone grafting allows preservation or augmentation of deficient bone where the implant has been removed to allow future replacement with a new implant. In some circumstances, bone

grafting can be done at the time of implant removal, while in other cases, it is done in at a later time. There are several different types of bone grafting materials based on the type of defect and augmentation needs.

Soft Tissue Grafting

Soft tissue grafting refers to using own gum tissue or a banked tissue such as Alloderm to improve the amount and quality of gum tissue surrounding dental implants and teeth. Gum tissue graft may be obtained from the roof of the mouth or pre-packaged from other sources. The most common form of gum tissue graft is a connective tissue graft obtained from the roof of the mouth.

Surgical Guide

Surgical guides are customized plastic jigs that allow the surgeon to place the implants with absolute precision and in accordance with the diagnostic work-up. Surgical guides may be made either from 3-dimensional CT scans (CBCT) using CAD-CAM technology, or using conventional impressions and models. Either way, surgical guides should be used in every implant placement surgery to assure the accuracy and safety of the procedure.



Transitional Prosthesis

Transitional prostheses are temporary teeth that allow patients to function and smile until their implants are placed and restored with final teeth. There are two variations. The first is a removable transitional prosthesis, which includes flippers or Essix appliances. The second is a fixed transitional prosthesis using a bonding material on adjacent teeth for support. The appropriate type of prosthesis is selected by the restorative dentist.



'Implant-Perfect' Methodology

Precision placement of dental implants and fabrication of teeth that mimic natural teeth require thorough planning and skillful execution of each stage of treatment. Our "Implant-Perfect" methodology has been the cornerstone of our high degree of dental implant success and client satisfaction.

1. Diagnostics & Imaging

- **Evaluation by the implant surgeon** to assess teeth to be extracted, quantity and quality of planned implant sites, bone and soft tissue grafting needs, and dental implant placement.
 - A CBCT is obtained for precise assessment of available bone and to determine the relationship of important vital structures such as nerves and sinus cavities.
 - A separate intra-oral scan captures a precise digital impression of existing teeth.
 - CBCT and intra-oral scan are combined for a complete digital imagery of existing bone and teeth. Then, using computer-assisted planning, virtual

restorations and dental implants are placed, providing information on every aspect of the planned treatment.

- **Evaluation by the restorative dentist** to assess aesthetic needs, bite requirements, transitional or provisional restorations needs, and final restorations.

2. Surgeon-Dentist Collaborative Planning

- The surgeon and the restorative dentist discuss all diagnostics information, surgical and restorative aspects of the treatment, and collaborate on appropriate steps to achieve the goals.
- The digital computer-assisted plan is now reviewed for accuracy by both doctors and approved before initiating treatment.

3. Provisionalization / Transitional Prosthesis

- The restorative dentist delivers a transitional (interim) or a provisional (temporary) prosthesis, which provides patients with a short-term solution for their smile and eating needs. They also provide further diagnostic information for the treating surgeon and dentist.

4. Implant Site Development

- If necessary, the surgeon augments the proposed implant sites to develop the necessary bone and soft tissue support for the planned dental implants and teeth.
- The surgeon uses the 3-dimensional digital computer workup to plan exactly how much and where the grafting is necessary.
- Adequate bone and soft tissue are required for proper dental implant alignment and positioning, adequate coverage for integration and stability, and fabrication of implant-supported teeth that mimic the form, aesthetics, and function of natural dentition.

5. Dental Implant Placement

- The surgeon uses the digital information from CBCT and intra-oral scan to design and fabricate a CAD/CAM surgical guide which provides precise alignment and positioning for the planned dental implants.
- The surgeon selects the dental implants with appropriate diameter and length to support the planned restorations in a safe, precise, and proper position.

- The surgeon places the selected dental implants using the surgical guide and advises the restorative dentist on the appropriate time frame before restoration.
- The surgeon monitors the healing of dental implants and approves when they are ready for implant provisionalization or final restoration according to the original plan.

6. Dental Implant Provisionalization

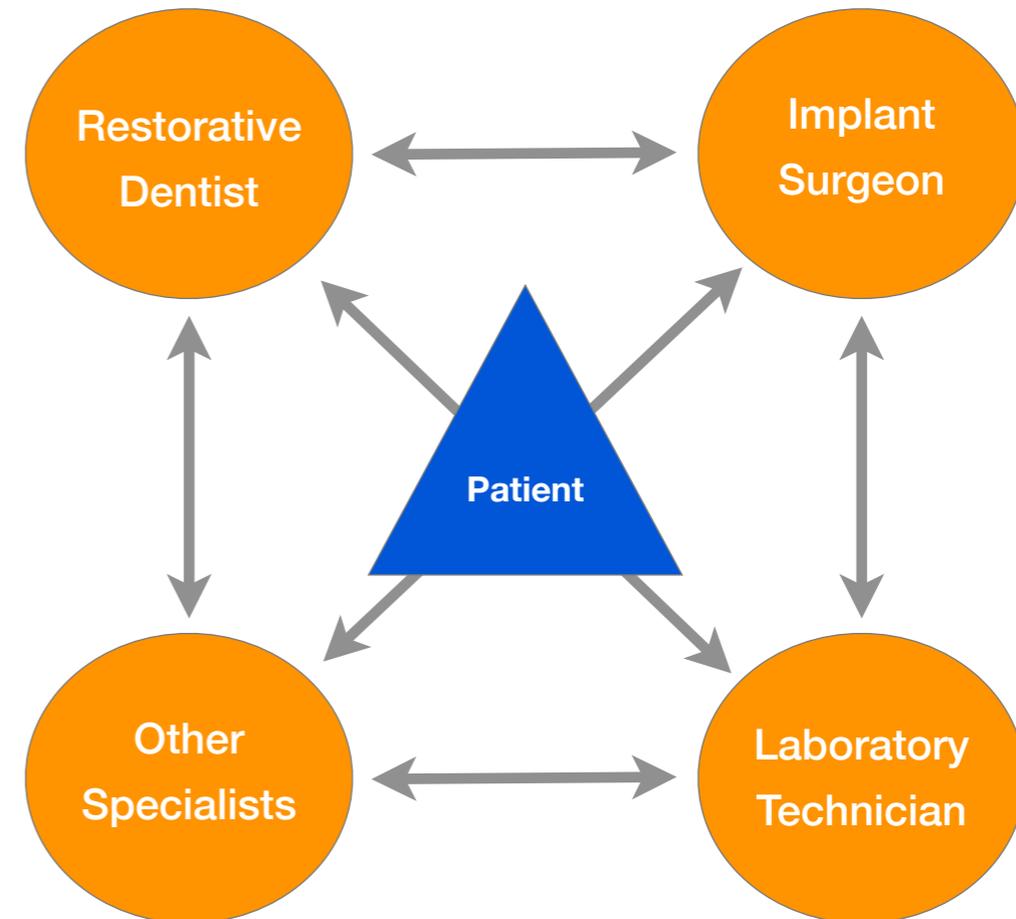
- For upper front dental implants and when appropriate in other areas, the restorative dentist provisionalizes the dental implants. These are temporary restorations supported by the dental implants.
- Provisionalization restorations are important in designing the gum tissue form for optimal aesthetics and easy access for cleaning. They also help to develop and design a proper bite (i.e. occlusion) vital in long-term success. Dental implants should be provisionalized for at least three months before replacement with the final prosthesis.
- There are circumstances where provisionalization is not necessary, and the restorative dentist can proceed right to the final restorations.

7. Final Implant Restoration

- The restorative dentist captures the implant orientation, position, and its surrounding soft tissue using either intra-oral scan as a digital impression or using conventional impression techniques.
- The impressions are submitted to a laboratory for fabrication of the final restorations, which are then returned to the restorative dentist for placement.
- Close collaboration between a quality laboratory and the restorative dentist is paramount in achieving remarkable results.

Team Approach to Implant Dentistry

Team approach refers to the collaborative effort between the restorative dentist, implant surgeon, master laboratory technician, and other dental specialists as appropriate working together to realize patient's goals and objectives. In this regard, no individual dentist alone can master all the principles in implant dentistry and patients's are advised to be cautious with 'do-it-all' dental practitioners.



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About The Author



Dr. H. Ryan Kazemi is an oral and maxillofacial surgeon certified by the American Board of Oral and Maxillofacial Surgeons. He received his dental degree from the University of Pennsylvania, School of Dental Medicine in 1990. Following a one-year internship at the Albert Einstein Medical Center in Philadelphia, he pursued surgical training at The Washington Hospital Center in Washington, D.C., where he received his certificate in Oral and Maxillofacial Surgery.

Dr. Kazemi has practiced in Bethesda, Maryland, since 1997, providing a full spectrum of oral and maxillofacial surgery procedures with emphasis on extractions, dental implants, bone grafting, and management of dental implant complications.

Dr. Kazemi is a diplomat of the American Board of Oral and Maxillofacial Surgeons, and an active member of the American Association of Oral and Maxillofacial Surgeons, American College of Oral and Maxillofacial Surgery, Academy of Osseointegration, American Dental Association, and Entrepreneur Organization.

He has served as the founder and president of several dental and implant study clubs in the Washington, D.C. area. Dr. Kazemi has published and lectured extensively on dental implants, bone grafting, and practice management.

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