International Journal of Enhanced Research in Medicines & Dental Care (IJERMDC),
ISSN: 2349-1590, Vol. 13 Issue 10, October 2026

Prosthetic Complications in Dental Implant Therapy: Etiology, Prevention and Management — A Narrative Review

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ABSTRACT

Background: Implant-supported fixed and removable prostheses demonstrate favorable survival, but biological, technical and mechanical complications continue to influence maintenance, patient satisfaction and treatment outcomes.

Objective: To review the causes, clinical presentation, prevention and management of complications described in the supplied source document. Methods: A narrative synthesis of the supplied 64-page Word document was undertaken; its reference list was retained as the citation source.

Results: The source identifies peri-implant disease, framework and veneering fractures, screw loosening and fracture, implant fracture, decementation, overdenture attachment wear and esthetic complications. Management ranges from occlusal adjustment, component replacement and conservative screw retrieval to framework reconstruction and implant replacement.

Conclusion: Prosthetically driven planning, passive fit, controlled occlusion, manufacturer-recommended torque and maintenance are central to reducing complications. This is a narrative account rather than a systematic review.

Keywords: Dental implants; prosthetic complications; screw loosening; abutment screw fracture; peri-implantitis; overdenture; framework fracture.

INTRODUCTION

Missing teeth can either be replaced by fixed or by removable implant-supported prostheses. The clinical decision between the two differing types of restorations is based on anatomic, esthetic, and economic factors, and most importantly the wishes of the patient.

High survival rates and low complication rates of the prostheses are an important prerequisite for the general success of treatment, as failures of the prosthesis may result in failures of the entire implant rehabilitation.

One of the most important strategies to reduce the risk of failure is a comprehensive pretreatment diagnostic work-up followed by the decision to fabricate either a fixed or a removable implant prosthesis.

According to the prosthetic plan the number of implants should be defined, as well as their ideal three-dimensional prosthetic positions in the mesio-distal, bucco-oral, and vertical dimensions.1

Numerous systematic reviews have been conducted on the survival and complication rates of FPDs supported by implants. Good survival rates of up to 10 years have been reported for both single-unit and multiple-unit implant-supported FPDs. With substantial evidence available, fixed implant-supported prostheses are fully acknowledged as a reliable treatment option for the replacement of single or multiple missing teeth nowadays.

However, the survival rates generally refer to the prosthesis that continued its clinical service during definite follow-up period and this does not necessarily render them free of complications. 2

In a systematic review conducted by Salvi and Brägger as part of the proceedings of the 4th International Team for Implantology Consensus Conference, prosthetic risk factors were defined as either technical or mechanical risks.

Therefore, based on this statement, the prosthetic complications can be considered as technical or mechanical complications.

The technical complications represent those relevant to laboratory-fabricated parts such as fracture and chipping of the veneering materials, whereas mechanical complications represent complications relevant to the prefabricated parts, such as implant fracture or abutment failures.2

CLASSIFICATION OF COMPLICATIONS

Implant-supported single crowns and multiple implant-supported bridges may suffer from various mechanical, biological, or technical complications.

Poor patient selection is one of the important factors that adversely contribute toward failures in implant dentistry.
There are 3 types of complications:

Prosthetic complications comprise of Technical and Mechanical complications

BIOLOGICAL COMPLICATIONS

Biological failures include bacterial infections, microbial plaque buildup, progressive bone loss, and sensory disruptions. Biological complications are subcategorized into early biological failures and late implant failures, where the early failures are attributed to the failure of placing the surgical implant under proper aseptic measures 3,4,5 and the late complications are typically peri-implantitis and infections bred by bacterial plaque.6,7

Peri-implant disease is defined as the inflammatory pathological change that takes place in the soft and hard tissues surrounding an osseointegrated implant [Figures 2 and 3].8 When an implant is successfully osseointegrated, the peri-implant disease that occurs is the consequence of disparity between the host defense and increasing bacterial load.9

It usually takes about 5 years for the peri-implant disease to progress and exhibit clinical signs and symptoms.10,11,12 The incidence of peri-implantitis and implant loss could be greater if the studies with longer follow-up periods are evaluated.13
In a healthy environment around the implant, the tissues play a pivotal role in preventing the spread of agents that can be pathognomonic, and if the biological barrier is breached, it could lead to bacterial contamination around the bone resulting in hasty destruction of the tissues surrounding the implant.

The peri-implant disease is also related to unequal occlusal load distribution, which may lead to loosening of the superstructure, infection of the surrounding area, eventually culminating into the inflammatory process. 14Predisposing systemic conditions include uncontrolled diabetes mellitus, osteoporosis, smoking, long-standing treatment with steroids, uncontrolled periodontitis, radiation therapy, and chemotherapeutics.15

The peri-implant disease treatment strategies have been explored and employed to prevent failure of the implant treatment.
They include nonsurgical mechanical debridement, local antimicrobial delivery in periodontitis and peri-implantitis, and surgical debridement with bone grafting. 16

Implant removal is warranted if there is more than 60% of bone loss following peri-implantitis, and there is evidence of mobility.17

Clinical and radiographic symptoms of peri-implantitis
Attachment loss/bone loss of 2.5 mm
Vertical destruction of crestal bone on radiographs
Possible swelling and hyperplasia of the peri-implant tissues
Pain (unusual) if present, depicts acute infection

TECHNICAL COMPLICATIONS

The frequency of occurrences of technical complications is greater in implant-supported FPDs as compared to the implant-supported removable prosthesis.

Fracture of the framework Whenever there is a rigid connection between the osseointegrated implant and the fixed subsequent framework, the strains are inevitably induced in every component of the framework.

Hence, the challenge remains for a prosthodontist to deliver a tolerable prosthesis that does not jeopardize the endurance of the treatment.21,22 Therefore, passive fit of the framework has been advocated as a requirement for successful long-term osseointegration of the implant with the surrounding bone.23-25

The problem of fracture of framework is reportedly exaggerated in partially edentulous jaws, because the implant-abutment interface and abutment retention screw are exposed to higher lateral bending loads, tipping, and elongation as compared to bilaterally splinted implants in a completely edentulous jaw. 26-28

The length of the cast bar or framework span is directly proportional to the construction-related distortion, 29 which could get worsened by nonparallel placement of dental implants.

To correct the gross misfit of the abutment–superstructure relationship, cutting the framework or bar and then joining the sections by welding or soldering is recommended, but both techniques may further impair the original fit.30

Since the corrective methods usually lead to a misfit, in order to avoid the need for such corrections, it is recommended that effort must be made to improve the original/initial fit of the cast frameworks. 31

Factors that influence the accuracy of the initial fit of the framework include the impression material, 32,33 impression technique,31-33 and positional stability 33,34 of the transfer posts. Refined approaches and detailed and accurate prosthodontic procedures are still a requisite to achieve a passive fit with an implant-supported superstructure. 35

Fracture of veneering porcelain Metal-ceramic restorations are the most common types of restorations in clinical dentistry.36,37

With the passage of time, esthetic demands of the patients have risen and thus driven the clinicians to focus on all-ceramic restorations. Zirconia restorations are promising, and the material is even being used to fabricate implant abutments for cement-retained restorations or for direct veneering for screw-retained prosthesis.38 Fracture of the veneering ceramic is another common complication associated with single-implant restorations. 39,40,41

Sadid-Zadeh et al. 28 concluded that of a total of 5052 ceramic and porcelain fused to metal restorations, 172 failed due to chipping off, which makes it 3.4% of the complications associated, at a mean follow-up of 5 years.

The incidence of the fracture of the veneering ceramic can be reduced by following the clinical recommendations, that is, by reducing the occlusal table, preventing heavy occlusal contacts, keeping shallow cuspal heights and by providing adequate thickness of the overlying ceramic.39

MECHANICAL COMPLICATIONS

An open tray impression taken using addition cured silicone. Poor implant angulation can be judged which could lead to a mechanical failure Mechanical complications are usually a sequel to biomechanical overloading.

Factors contributing to the biomechanical overloading are poor implant position/angulation (cuspal inclination, implant inclination, horizontal offset of the implant and apical offset of the implant) insufficient posterior support (i.e., missing posterior teeth) and inadequate available bone or the presence of excessive forces due to the parafunctional habits, that is, bruxism.

Forces resulting from either functional or parafunctional occlusal contact of the natural teeth will result in either a physiologic adaptation of the tissues of the attachment apparatus or, if beyond the adaptive capacity of the host, may result in the lesion of occlusal traumatism. Since osseointegrated implants have no periodontal ligament, occlusal traumatism cannot exist.

Instead, adverse forces generated by occlusal activity may result in mechanical complications of the implant components, i.e. screw loosening, screw fracture or fixture fracture.

Overloading of the implants usually causes loosening or fracture of the implant component. Goodacre et al. stated that screw loosening or fracture prevailed more with the prosthetic screws as opposed to the abutment screws. 41

Implants restored with single crowns have shown more screw loosening as compared to multiple implants with multiple restored units,42 and mandibular molar implant restorations are more affected by screw loosening as compared to the maxillary ones.

In another study, the incidences of loosening of the abutment screw or the abutment were found to be 59.6% in a follow-up of 15 years.43

In a systemic review by Pjetursson et al.,44 the yearly rate of abutment or screw loosening ranged from 0.62% to 2.29% that converts into a 5-year complication rate ranging from 3.1% to 10.8%. In another follow-up study of Branemark single-tooth implants, screw loosening was reported to be the most frequent complication.45

To ease the incidence of screw loosening, it is advised to maximize the joint clamping forces while curtailing joint separating forces. 46

Joint separating forces include excursive contacts, cantilevered contacts, interproximal contacts, off-axis centric contacts, and nonpassive frameworks. In an article by Sadid- Zadeh et al.39, it was suggested to torque the abutment or the screw retained crown, with twice the force recommended by the manufacturer at an interval of 5 min between each rotation.

Over the course of years, many manufacturers have revised the conventional implant components to reduce the incidents of screw loosening.47,48

There are two major causes of implant fracture: biomechanical overloading and peri-implant vertical bone loss.49

The risk of implant fracture increases multifold when the vertical bone loss is severe enough to concur with the apical limit of the screw.50-52 Implant fractures are also attributable to flaws in the designs and manufacturing of implant itself.53,54

Unnoticed and recurrent screw loosening is a risk factor for dental implant fracture, which indicates change in the prosthesis design. 55

The most frequently encountered fracture is of the hexagonal head away from the main body of the screw.

[When a screw is loose, it is more disposed to excessive sideward load. Fracture of the implant abutment screw can be a grim setback as the remaining fragment inside the implant jeopardizes the efficient functioning of the implant. 56

When patients wear an implant-supported prosthesis (fixed or removable), there is a decrease in the occlusal forces which ranges from 200 to 300 N. 57,58 59

The failure of implant abutments occurs when the lateral forces exceed 370 N for the abutments having the joint depth of at least 2.1 mm and 530 N with a joint depth of at least 5.5 mm.60-62

Implants with a smaller diameter of 4 and 3.75 mm are inclined to fractures more easily than those with the greater diameter.53,54,63

It has been reported that an implant having a diameter of 5 mm is three times stronger than the one with the diameter of 3.75 mm, while an implant of 6 mm diameter is 6 times stronger than a 3.75 mm implant.64

The risk factors associated with implant components are Abutment screw fracture and loosening can be reduced if certain strategies are followed.

These include careful treatment planning, understanding of the occlusal scheme, tightening the implant to the recommended torque, and routine follow-up appointments.

Cement failure is another consequence of biomechanical overload, typically affects the prosthesis attachment and may be treated by recementation procedure.

With the advancements in material science, particularly for luting agents, the incidence of decementation has reduced significantly. 40

However, careful treatment planning and clinical criteria must be followed to avoid such incidences.39
A variety of implant and abutment designs and materials have been introduced to overcome perceived and real limitations found clinically.

The mechanical integrity of these components is determined by the dimension, type of connection, type of material, and type of restoration.42,43

The general categorization of abutments includes titanium versus zirconium and internal conus versus internal sliding fit or external hex connections.

When internal connection abutments were compared with external connection abutments by systematic review, the abutment did not influence implant survival or complication rates, but internal conus connections showed less marginal bone loss.44

Regarding the materials, no differences regarding the survival or failure of ceramic or metal abutments were observed in a review of single-tooth implants. 45

However, complications emerge in clinical practice.

PROSTHETIC COMPLICATIONS AND RISK FACTORS

Prosthetic complications occur in dental implant therapies of all types, including single and multiple implants restored using fixed and removable prostheses.

The cause and-effect relationship of the complications has not been fully considered, and dynamics in the implant and component treatment result in a complex restoration that can experience mechanical complications with a tendency to become a cause of failure to the component selection, design, or manufacture.

The most commonly reported implant mechanical complications include adjustment of overdentures because of loss of retention, relines, or clip/attachment fracture 65-68; veneer fracture in fixed prostheses 69,70 ; overdenture fracture 71,72; acrylic resin fracture in hybrid prostheses; 73,74screw loosening and screw 75,76 and metal framework fracture. 77,78Many of these complications are related to poor planning, poor case selection, or even poor implementation of the treatment plan.

Screw loosening or fracture is more common with prosthetic screws compared with abutment screws, 77 and this is the most common component complication.

Screw complications are also more common in single-tooth implant restorations compared with multiple units. 79
Consistently, one of the most frequently reported complications is loosening of both the abutment screw and the prosthetic screw, with an incidence of 5.6% after 5 years, and it could be as high as 59.6% within 15 years. 80,81

The outcome is affected by design of the implant connection, with implants with external connections having a higher incidence, with a mean of 18.3% after 5 years, 82-85 whereas screw loosening associated with internal connection was 2.7% after 4.5 years. 80 86-89

It has always been proposed that abutment and prosthetic screws must be tightened with a torque instrument to achieve the required clamping force derived from the recommended torque. Occlusion and cantilevers are considered important risk factors in the outcome of the implant restoration.

Fracture of implants is a terminal failure for implant therapy and is associated with several factors, including material, implant diameter and length, presence of a cantilever, and bruxism.90 Bruxism may significantly reduce implant survival.

The presence of a cantilever in implant prostheses is associated with increased incidence of complications such as veneer fracture and screw loosening. 91

These two factors of increased force and magnification of imposed force should be paramount concerns in treatment planning. Encountering bruxism or increased loading should encourage the use of larger diameter and additional implants as well as the absolute avoidance of cantilevers. 92 Placement of implants using short implants or tilted implants can avoid the requirement of distal cantilevers in many implant prostheses.

Retrieval of the fractured screw depends on whether the screw is loose within the implant or abutment or tightly bound within the screw threads.

Many methods have been proposed to remove a fractured screw, including a dental instrument (explorer,hand scaler, ultrasonic scalers) rotated counterclockwise as well as a fork remover in a drill running in reverse.

If the head of the screw has been stripped and a driver cannot grasp the screw, drilling a horizontal groove cut into the screw head has been advocated to engage the instrument with a flat-head driver or instrument.

There are also many companies that provide screw-retrieval kits; no matter the solution, extra attention must be paid when drilling so as to not damage the internal bore threads, because then the implant might need to be removed.

The prefabricated titanium-bonding base (Ti Base) is used to create a hybrid abutment or a screw-retained implant crown. Although this system offers several advantages, including low component cost, chair-side manufacture, titanium-titanium implant connection, and ability to lute extraorally, there are reports of fracture and Ti Base debonding.

These complications may be caused by the small surface area and cross-sectional area of these components. However, clinical data are lacking. Management of the Ti Base debonding consists of using an abutment with a more robust base to support the restoration, including a cast-to abutment system or a CAD/CAM custom abutment.

MANAGEMENT OF PROSTHETIC COMPLICATIONS

Complications involving implant-supported or implant-retained prostheses are common occurrences in dental implant therapy.

These complications can range from being minimal and easily managed to catastrophic requiring complex management and even complete replacement of the implant prosthesis. Prosthetic implant complications for various types and prosthetic designs can be categorized as the following: prosthetic material wear and fracture, loss of retention of overdenture prosthesis, fracture or loss of overdenture attachments, fracture of prosthetic framework, prosthetic screw loosening or fracture, and esthetic complications.

Prosthetic Material Wear and Fracture
This complication can occur in all types of implant reconstructions but occurs in fullarch metal-acrylic resin complete implant fixed prostheses in particular.

Bozini and colleagues documented in a meta-analysis that wear and fracture of the veneer material in full-arch metal-acrylic resin complete implant fixed prostheses was the most frequent complication.

Sadid-Zadeh and colleagues 80 in a literature review reported an incidence of 3.4% for the fracture of the veneer ceramic and metal-ceramic restorations after 5 years. 81,85,93

Their investigation showed a higher incidence of the complication for posterior implants (3.1%) than for anterior implants (1.7%).

It also revealed a higher incidence in external connection implants (5.4%) compared with internal connection implants (2.9%) after 4.7 years.

The incidence of veneering material fracture increases to 12.4% in multiunit fixed implant-supported prostheses after 5 years. 89,94,95

Priest and colleagues documented the need for replacement of denture teeth caused by wear or fracture as the most common prosthetic complication for mandibular full-arch implant-supported prostheses.

In addition, they observed that cantilevered frameworks had a high risk of fracture when opposed by fixed prostheses. In contrast, no fractures occurred for any of the frameworks opposed by complete dentures or removable implant prostheses.78 For such prostheses, replacement of denture teeth and gingival-colored resin while maintaining the supporting metal substructure is a common practice.

This protocol is normally implemented to repair fractures or as a reconstruction protocol to address advanced wear of denture teeth and lack of occlusal functionality of prostheses. In metal-ceramic–layered and full-ceramic–layered full-arch reconstructions, fracture or chipping of the overlying ceramic may occur. The management of such complications may range from minor polishing adjustment of the restoration in cases of minor chipping to complete stripping and replacement of the overlying ceramic in cases of major fractures that significantly affect the esthetics and the functionality of the prosthesis.

Protocols such as bonding milled ceramic restoration to existing restorations in a ceramic veneer–like fashion have been used.97 Moreover, protocols to bond composite resin to repair fractured and chipped ceramic have been reported, although the predictability of this protocol remains questionable. 98

Veneering ceramic chipping and fracture can also occur in single-unit and multiunit partial-arch and short-span fixed implant restorations with rare occurrences of complete fracture of the entire restorative core. 77,99

In cases of major fracture that involves the core restorative material or fracture of the connector area of an implant-supported prosthesis, a complete remake of the prosthesis is normally indicated example of a catastrophic fracture of an anterior implant crown; the fracture was immediately managed by the fabrication of interim restoration using a prefabricated polycarbonate provisional crown form that was relined with composite resin–based provisional material with a full ceramic or metal-ceramic crown as the definitive restoration.

In fixed implant-supported prostheses, a common place for fracture is the connector area between pontics and retainers or between pontics.

Studies using finite element analysis showed that this is the area of highest stress concentration, especially in cases with minimal interocclusal space and short connectors.70

This finding reiterates the importance of restorative space in the construction of a robust implant prosthesis.
Proper implant planning, design of the prosthesis, managing occlusal stress, choosing proper prosthetic materials, and number of implants are important factors in minimizing complications and material fracture in dental implant therapy

Causes: This is more frequently reported than screw fracture and often occurs when the prosthesis does not fit adequately.
It has been suggested that when using a torque wrench to tighten a screw, it should be rotated approximately one-fourth of a turn to ensure a proper fit.

Addressed by retightening and torquing the screw using either a hand / electronic torque device. However, for screws that have been in service for an extended period, it is recommended to replace them with new ones.

In instances where access to the abutment screw is not available for retightening, then the use of lingual retaining screws is advisable to permit future retrieval of the crown . 100

Other options include fabricating the crown with threaded tubes intended for small screws that can be turned and used to unseat the crown via contact between the end of the screw and the underlying abutment 101or else a cylindrical hole can be incorporated in the crown, along with a corresponding slot in the abutment. This configuration enables a specialized instrument to be inserted into the crown hole, facilitating rotation until the screw becomes loose 102.

Another alternative approach for removal is to use a vacuum-formed template as a guide for drilling a hole through the crown or prosthesis, providing access to the screw 103.

Abutment Screw fracture can occur due to various factors including occlusal overload, parafunctional habits, design of implant-abutment connection, abutment screw design, material properties, and inadequate preload.

They frequently occur at the junction of the screw head and the shank / at the junction where the threaded section begins.
If the screw fractures near the top of its threaded portion, it can be rotated counterclockwise until it can be grasped and removed. For screw fragments that cannot be rotated or grasped easily by a hand instrument, methods of removal include running a drill with cutting blades oriented in a reverse direction or creating a slot into the top of the screw fragment and modifying the instrument so that it fits into the slot and the fragment can thereby be unscrewed easily.104

Although the above methods of removal fail, other screw modification techniques such as a combination of cutting a groove, creating a dimple, a custom-made driver, and a forkshaped instrument can also be used for retrieving the fractured abutment.

The first step in managing any fractured screw is to obtain a detailed history and perform a thorough clinical examination.
Every attempt should be made to determine the cause of the screw fracture to minimize the risk of subsequent complications. In most of the cases, abutment screw loosening preceded the fracture of the same. The etiology is multifactorial and can range from inadequate treatment plan and design, component misfit, inadequate screw tightening, excessive loading, and/or inadequate screw design. 87

Inadequate treatment design and planning can attributed to patient assessment and insufficient number and location of implants. Patient parameters such as age and sex can have an influence on the prevalence of screw loosening and fracture. The included case reports and case series showed sex predilection for males and age wise for the elderly (50–65 years) and were in accordance with the previous study conducted by Lee et al. 88 Literature shows that the incidence of screw fracture is more frequent in posterior region compared to anterior. 67 In the present study involving case reports and case series, incidence of abutment screw fracture in the anterior region was more prevalent than the posterior region.

This may be due to esthetic concern and frequency in seeking treatment in the case of anteriors. Usually, in terms of retention, a higher incidence of screw loosening has been observed in screw-retained implant prostheses than cement-retained implant prostheses. Single crowns are more prone to screw loosening followed by cantilever bridges, splinted crowns, and implant-retained overdenture. 88

The types of abutments included in this study were prefabricated metallic ones which comprise straight. After assessing the reason for fracture, the next step is to confirm that the screw is fractured and to determine the location of the fracture. Fractures mostly occur at the junction of the screw head and screw shank or at the junction of the screw shank and screw thread. 105,89

Screw fracture may be confirmed by direct visualization, radiographic examination, tactile sensation through the use of an instrument, comparison with an undamaged screw of the same system, or by using other undamaged components of the same system to see if an obstruction is prohibiting complete seating.

If the restoration has been missing for an extended period, the periimplant soft tissue may overgrow, making access to and visualization of the implant difficult. In this situation, a low-frequency diode laser is ideal to trim the tissue, since the scratching of the implant surface with surgical blade or scalpel has to be avoided.

The use of an electrosurgery unit should be avoided to expose the implant platform since it causes heat transfer within the implant. Other techniques that may help to improve visualization include the use of dental loupes with a coaxial or light-emitting diode headlamp or a dental surgical microscope, especially in situations with deep screw fracture.106,90

Management of abutment screw fracture is challenging since the preloading and occlusal loading could wedge the fractured abutment into the implant and require high pull-out force.

Saliva, blood, and the limited visibility make it difficult to access.91
In this situation, initial treatment in the form of conservative retrieval is always the first and most preferable option. Sometimes, it may not prove successful, then we have to consider other options. The uncertainty in decision on type of treatment and sequence of treatment make it more arduous. Therefore, the formation of a decision tree can be useful in managing situations that range from routine to highly complex. If an abutment screw fractures above the head of the implant, an explorer, a straight probe, or hemostat might be successful.70,71 The tip of the instrument is moved carefully in a counter-clockwise direction over the surface of the screw segment until it loosens. In the case of abutment screw fracture below the implant platform as well, the first choice of intervention is use of rigid instruments such as a scaler, sickle explorer, or endodontic explorer in the same fashion.72,73,76

Care must be taken to avoid instrument tip breakage. Sometimes, even if the screw gets loosened, it may be difficult to remove it completely out of the fixture, then the use of a cotton swab might be helpful to pull out the fragment.70 Oblique fractures may be easier to manage with this technique because a purchase point usually exists in which the instrument can be engaged. Ultrasonic oscillation assisted by hand instruments is an accessory method to remove a fractured abutment screw fragment which is not possible with hand instruments alone.

74,75 Thin scaler tips in counter-clockwise oscillation may be helpful to back out the fragment, but care should be taken to avoid wedging of the screw into the implant. These are mild approaches which pose only low risk since it will not damage internal threads of the implant and will not increase temperature which affects bone around it.

If the fractured abutment screw fragment is not possible to remove with hand instruments or combination of ultrasonic oscillation and hand instruments, other options must be considered. Burs or drills mounted on a handpiece in counter-clockwise rotation may unwind the fragment. Sometimes, access points or grooves are created on the occlusal aspect of fragment for the mechanical interlocking of scaler tip or customized screwdrivers made from burs or instruments.78,106-108,109,110,103

Furthermore, burs or drills may be modified to avoid damage to internal threads of the implant and better engagement. Screw modification with rotary instruments drilling should be performed intermittently at a reduced speed and under copious irrigation to avoid thermal damage to the surrounding bone. Fabrication of custom-made drill guides employing a high-speed air turbine or a high-speed micro-motor handpiece ensures protection of the internal threads against drilling.105,102 There are several available implant repair kits including ITI® Dental Implant System (Institut Straumann AG, Switzerland),IMZ® TwinPlus Implant System1 (DENTSPLY Friadent, Germany), Screw Removal Kit Replace (Nobel Biocare™, Yorba Linda, California, USA), and Certain® Screw Removal Kit (Biomet 3i™, Florida, USA31).

The application of these systems is to permit a hole to be drilled into the center of the broken screw and drive a removal wedge into the hole that engages the broken screw when reverse torque is applied by removing the instrument.77 If all the attempts of mild and moderate approach have failed and the internal aspect is significantly damaged, the clinician may choose either to remove the implant and replace it with a new one or abandon the implant and cover it with soft tissue.

Many patients may not prefer replacement with new implant since it is an expensive option and require surgical procedures. Abandoning the implant and covering it with soft tissue may lead to compromised function, phonation, or esthetics. Intentional modification of the implant may be necessary to keep the implant serviceable. In cases where irretrievable screw fragment is drilled out, attempts can be made to retap the internal threads to salvage the implant.

If implant's screw threads have been damaged irreversibly and the patient is still unwilling to sacrifice the implant, it is possible to fabricate a custom cast post and core for the implant.104,80-86 These techniques generally start with the removal of remaining screw fragment, followed by removal of the internal threads of the implant by using a diamond rotary instrument or tungsten carbide bur in a high-speed handpiece under copious irrigation. Pattern for casting can either be made directly on the prepared implant or indirectly on a stone cast. The pattern is then cast using nickel-or cobalt-chromium alloys, although other types of metal alloys have also been reported.

Once the seating of the custom cast post and core has been confirmed, it can be cemented. The appropriate restoration can then be fabricated following conventional prosthodontic protocols.

This technique has a few disadvantages such as weakening of the implant body and excessive heat production during cutting of the fractured screw; hence, it is last choice of management.

Prevention is better than cure, and the correct measures should be taken to ensure that screw fracture does not happen. Abutment screw loosening preceded the fracture of the same. For prevention of screw loosening and fracture, clinician should know mechanics of abutment screw.

A screw is tightened by applying a torque and it develops a force within the screw called the preload. Elastic recovery of the screw pulls the two parts together, creating a clamping force. The preload in the screw, from elongation and elastic recovery, is equal in magnitude to the clamping force.93 Preload depends on the torque applied, material, and design of the screw, and surface roughness.

94 Joint separating forces and settling effect cause loosening of initially tightened screw by making loss of preload. Intraoral separating forces include off-axis occlusal contacts, parafunctional forces, and nonpassive frameworks that attach

to the implants. Once external forces exceed the screw joint preload, the joint becomes unstable whereas settling occurs as the rough spots flatten under load, since they are the only contacting surfaces when the initial tightening torque is applied.

It has been reported that 2% to 10% of the initial preload is lost as a result of settling.93 It is recommended in clinical practice that to reduce the settling effect, abutment screws should be retightened 10 min after the initial torque application. 94,95

Mechanical torque gauges should be used instead of hand drivers to ensure a consistent tightening of the implant components to recommended torque values.93

Joint separating or bending forces can be minimized by placing the implants perpendicular to the occlusal plane and frameworks with minimal cantilever lengths. Furthermore, the use of implant components with anti-rotational features and low tolerance levels for component misfit will help in reducing the abutment screw loosening and further complications.96
Loss of Retention of Overdenture Prosthesis

Implant overdentures are a reliable option for edentulous patients, particularly in the mandibular arch.
However, they require continuous maintenance. 111,112

One of the main complications associated with implant overdentures is loss of retention, which is normally attributed to the wear that occurs in the attachment male insert embedded in the denture base. This complication can be easily managed by replacing the male insert with a new one. However, a discussion with the patient about the need for long-term maintenance and follow-up is paramount for patient satisfaction.

Similar complications can occur with bar-supported overdentures, although the literature shows that the incidence of such complications is lower than with freestanding implant overdentures. 77,111

Wear of the overdenture transmucosal abutment in the mouth is another complication that can occur over time, particularly with implants that are off axis and not parallel. To overcome this problem, a new abutment needs to be installed. Such complications are associated with significant treatment cost and need to be addressed with patients in the treatment planning stage. Another factor in the loss of retention in overdenture prostheses is the need for denture relines caused by continuous residual ridge resorption. This complication is common in mandibular 2- implant overdenture prostheses. 112,113

A laboratory or chair-side reline procedure is required to manage this complication.
Fracture or Loss of Overdenture Attachments

Another prosthetic complication related to implant-retained overdenture prostheses is the loss or fracture of the attachment.77

Fracture of the abutment inside the implant requires the retrieval of the remaining abutment part that is still inside the implant connection.

This retrieval has to be done carefully to avoid damaging the connection. Similar techniques for removal of broken abutments or fractured screws must be followed.

It is common for the attachment or its housing within the overdenture to become debonded or lost. Intraoral pickup with either a fast-setting repair resin or a light cured composite resin material is necessary and should always be conducted in a closed-mouth position to ensure that this procedure does not alter the established occlusion of the prosthesis.

Fracture of Prosthetic Framework Complete fracture of a prosthesis framework is a rare complication, but it can occur and present a catastrophic failure of the implant restoration.

This complication can occur in all types of prosthetic reconstruction, from single-unit prosthesis to full arch reconstruction. Management of this complication requires the full replacement of the prosthesis and most of the time a provisional restoration is required while the definitive restoration is being fabricated If the definitive prosthesis was a metal-ceramic restoration, the framework can be soldered or welded and reused as a framework for the replacement prosthesis. Common areas where fracture of framework occur are connector areas and cantilever segments that extend beyond the acceptable limits. 77,79,97,114

The advent of CAD/CAM frameworks has improved both the design and the manufacture of prostheses. The improved fit of these frameworks avoids the requirement of the soldering or laser welding that created at-risk sites for fracture. More recently, zirconia has become a favored material for implant reconstructions, particularly large or full-arch prostheses. Systematic reviews favorably report fewer complications for monolithic zirconia restorations. 114,115

However, Ti Base debonding and rare catastrophic fracture are reported. When veneered, chipping of the veneering material is reported. For prostheses constructed using fully veneered zirconia frameworks, veneer fracture and chipping are more commonly observed 116 and these is not recommended in light of the alternative use of monolithic designs.
Prosthetic Screw Loosening or Fracture

This complication is similar to abutment screw loosening and fracture. Prosthetic (and abutment) screw loosening is more frequently reported than screw fracture case of screw-retained restorations, the prosthesis is fixated by the prosthetic screw and loosening or fracture of the screw results in the prosthesis being mobile or completely dislodged. Normally, such a complication can be addressed by tightening and torqueing the screw in case of loosening. The fracture screw is managed by the removal of the remaining screw inside the implant connection and the complete replacement of the prosthetic screw. For retrieving the fractured screw, a similar protocol to that of the fractured abutment screw retrieval can be followed.
Screw retrieval techniques for fracture at or above the platform of the implant

Author and year Barbosa et al., 2014
Study design and title: Descriptive
The cotton driver: An alternative technique for removing fractured screw fragments
Pressing the cotton swab into the implant head and twist the fractured abutment screw slowly counter clockwise 117

Author and year: Yang and Wu 2019
Study design and title: Descriptive A technique to retrieve a fractured implant abutment screw by using a screwdriver fashioned from a needle
Appropriate sized needle is bending to form screwdriver. After engaging the fractured end, turned counter clockwise for removal. 118
Screw retrieval techniques for fracture below the platform of the implant

Author and year: Fauvell et al., 2006
Study design and title Descriptive The lumen technique.
Retrieval of broken gold screws in dental implants
An applicator tip was seated with apical pressure in implant fixture, wedged it between implant and screw surface and then counterturned to retrieve the retention screw. 119

Author and year: Satterthwaite and Rickman, 2008
Study design and title: Descriptive Retrieval of a fractured abutment screw thread from an implant: a case report
Visualized through a clinical microscope and fragment was removed using endodontic instruments.120

Author and year: Bhandari et al., 2013
Study design and title: Descriptive Ultrasonic oscillations for conservative retrieval of a rare fracture of implant healing abutment
Mandibular first and second molars
Piezoelectric ultrasonic scaler tip in a gentle reverse torque was employed for abutment screw retrieval. 121

Author and year: Chen and Cho, 2018
Study design and title Descriptive
An accessory technique for the intraoral removal of a fractured implant abutment screw
Performed with a combination of ultrasonic device and a dental restoration holder.122

Author and year : Azpiazu-Flores and Lee, 2020
Study design and title: Descriptive
Using the screw shank as a retrieval tool:
A straightforward approach to removing screws with diagonal fractures
After engaging the shank mounted in hexagon driver with fractured screw it is
Moderate approach with moderate risk

Author and year : Luterbacher et al., 2000
Study design and title :Descriptive
Fractured prosthetic abutments in osseointegrated implants:
A technical complication to cope with
Repair set of the ITI Dental Implant System is used to retrieve the fragment.
The service set consists of burs, tap sets of three instruments, drill guides etc. 124

Author and year :Williamson and Robinson, 2001
Study design and title :Descriptive
Retrieval technique for fractured implant screws
A groove was made on the surface of the screw with a round bur and number 1 round bur is modified to be used as a screwdriver. 125

Author and year : Nergiz et al., 2004
Study design and title : Descriptive
Removal of a fractured implant abutment screw: A clinical report
Abutment screw was retrieved using repair kit (IMZ Twin Plus Repair Set).
First, fragment was perforated and achieved retention to unscrew it. 126

Author and year :Reyhanian et al., 2010
Study design and title :Descriptive
The use of the Er: YAG in laser-assisted broken abutment screw treatment
Laser is used for exposing implant platform, ablate granulation tissue and for decontamination. Screw is retrieved after modifying with surgical drill. 127

Author and year :Yilmaz and McGlumphy, 2011
Study design and title : Descriptive
A technique to retrieve fractured implant screw
Stainless steel fork shaped instrument is used in slow-speed hand piece for screw retrieval. 128

Author and year :Walia et al.2012
Study design and title :Descriptive
Removal of fractured dental implant screw using a new technique: A case report
Notch made on the fragment and ultrasonic scaler tip is moved in counter clockwise direction to retrieve implant abutment screw. 129

Author and year :Yohsuke and Sawase, 2012
Study design and title: Descriptive
A modified technique for removing a failed abutment screw from an implant with a custom guide tube
made guide tube. Failed abutment screw is modified with a high speed air-turbine and the tungsten carbide bur was inserted through the guide tube. 130

Author and year :Kurt et al., 2013
Study design and title ;Descriptive
A Technique for Removal of a Fractured Implant Abutment Screw
Groove on the fractured screw with modified flame shaped bur and a handmade screw driver with tungsten carbide bur.131
Author and year : Satwalekar et al., 2013
Study design and title: Descriptive
A simple and cost-effective method used for removal of a fractured implant abutment screw: A case report

Author and year :Gooty et al., 2014
Study design and title: Noninvasive method for retrieval of broken dental implant abutment screw
Deep pit made on the fragment and an ultrasonic tip was engaged in counter clockwise direction.133
Author and year : Carneiro et al.2016
Study design and title :Descriptive
A conservative approach to retrieve a fractured abutment screw – A case report
Author and year : Yoon et al. 2016
Study design and title :Descriptive

Safe removal of a broken abutment screw with customized drill guide and rotary instrument: A Clinical Report

Author and year : Flanagan, 2016
Study design and title :Descriptive
Management of a fractured implant abutment screw
Anterior mandible (Mandibular canine)
Fragment removal is accomplished with festooned #557 bur in counter clockwise rotation and #33 1/3 bur in clockwise rotation. 136

Author and year : Pipko et al., 2004
Study design and title :Descriptive
Retrofitting a cast dowel-core on salvaged dental implant
Removal is accomplished by using number 2 and number 4 friction grip carbide bur and an accurate cast dowel core is retrofitted into the implant. 137
Author and year :Pow and Wat, 2006
Study design and title :Descriptive
A technique for salvaging an implant-supported crown with a fractured abutment screw
Fractured end is removed and elimination of the internal threads were done with rotary cutting instrument followed by post and core crown. 138

Author and year :Maalhagh-fard and Jacobs, 2010
Study design and title Descriptive
Retrieval of a stripped abutment screw: A clinical report
A trough is made between abutment head and internal aspect of implant to facilitate abutment screw accessibility and retrieval is accomplished using fine forceps. 139
Author and year :Yilmaz and McGlumphy, 2013
Study design and title :Descriptive

A technique to salvage a single implant-supported fixed dental prosthesis
having a nonretrievable implant screw fragment
A flat stainless steel washer with a new implant screw was employed to rehabilitate the implant.140
Author and year : Canpolat et al.,2014
Study design and title :Descriptive

Management of a Fractured Implant Abutment Screw: A Clinical Report
Interior of the implant and the fractured screw were machined with high speed hand piece and a custom made cast dowel with ball attachment for rehabilitation. 141
Author and year :Gupta et al., 2014
Study design and title : Descriptive

A new restorative technique for the perishing implant due to abutment screw fracture
Fractured screw was removed with high speed hand piece and a custom made
Author and year : Harshakumar et al., 2014
Study design and title : Descriptive

Salvaging an implant with abutment screw fracture by a custom titanium post and core supported prosthesis - A novel technique

Internal threads and the fractured screw were removed using tungsten carbide bur and titanium cast post for rehabilitation. 143
Author and year : Shah and Lee, 2016
Study design and title : Descriptive

An alternative approach for the management of fractured implant abutment screws on a mandibular implant - retained overdenture: A clinical report

Screw chamber converted into a dowel space for a dowel-core and locator bar attachments were laser welded into the cast custom made abutments.144

SYNTHESIS AND CLINICAL IMPLICATIONS

Dental implant therapy is a predictable and reliable modality for replacement of missing teeth; however, despite high survival rates, complications are frequently encountered during the functional lifespan of implant-supported prostheses. These complications do not always lead to implant failure but can significantly affect prosthesis longevity, patient comfort, function, esthetics, and maintenance requirements.

Implant-related complications are broadly classified into biological, technical, and mechanical complications, of which prosthetic complications mainly comprise technical and mechanical failures.

1. Biological Complications (Brief Overview)
Although not prosthetic per se, biological complications directly influence prosthetic success.
Caused by bacterial plaque accumulation, host-microbial imbalance, occlusal overload, and systemic risk factors (smoking, diabetes, osteoporosis, periodontitis)

Management ranges from non-surgical debridement and antimicrobials to surgical intervention or implant removal in advanced cases

2. Prosthetic Complications
A. Technical Complications
B. Mechanical Complications
(Related to prefabricated implant components and biomechanical forces)

A. Technical Complications
1. Fracture Of Prosthetic Framework
2. Fracture Or Chipping Of Veneering Material
3. Acrylic Resin Fracture (Hybrid Prostheses)
Management includes replacement of acrylic and denture teeth while preserving metal framework

B. Mechanical Complications
Mechanical complications are mainly due to biomechanical overloading, as implants lack a periodontal ligament and shock-absorbing capacity.
1. Screw Loosening (Most Common Complication)
2. Screw Fracture (Abutment Or Prosthetic Screw)
Mild approaches: explorer, scaler, cotton swab, ultrasonic oscillation
Moderate approaches: screw removal kits, modified burs, guide sleeves
Severe approaches: implant modification, cast post-and-core fabrication
3. Implant Fracture (Catastrophic Failure)
4. Cement Failure (Decementation)
5. Overdenture-Related Complications

1. Loss Of Retention
2. Fracture Or Loss Of Attachments
3. Denture Relining
4. Management Principles
5. Prevention Strategies (Key Points)

LIMITATIONS

This narrative review was prepared from the supplied source document. No independent systematic search, risk-of-bias assessment or quantitative pooling was performed. Numerical estimates, clinical recommendations and references reflect the source document and should be checked against the original publications before submission. Recommendations that differ across source passages should be interpreted in their clinical and manufacturer-specific context.

CONCLUSION

While implant prostheses demonstrate excellent long-term survival, prosthetic complications are common and multifactorial. Most complications are manageable if identified early.

The long-term success of implant therapy depends on sound biomechanical principles, precise prosthodontic execution, appropriate material selection, and meticulous maintenance protocols.

Prevention remains superior to corrective management, emphasizing the role of the prosthodontist in achieving durable implant rehabilitation.

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