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Complications In Implant Therapy: A Review

Review Article

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Abstract

The most common complications in implant dentistry occur after loading of an implant. There are many factors that need to be considered by the clinician while planning for an implant prosthesis. These include patient factors like bone density, ridge defects,systemic factor and implant related factors like implant angulation, type of loading of implant, type of occlusion given, implant component factors and others. A comprehensive search was initiated in PubMed Central, Medline, Cochrane, Embase, Ovid, Science Direct, Copernicus and Google Scholar databases for terms related to complications in dental implants. Systematic reviews, Randomised Controlled Trials, Prospective clinical studies, and Case control studies were included. Case reports, In vitro studies and studies involving animals were excluded from the search. Based on the analysis, implant complications were divided as biological complications and prosthetic complications. Prosthetic complications were further classified as mechanical and technical complications. Implants are more susceptible to biological complications which include Peri-Mucositis and Peri-implantitis. These are treated with curettage, laser therapy, antimicrobial therapy and bone regenerative techniques. The most common prosthetic complication is screw loosening occurring due to loss of preload, however, other complications like screw fracture, abutment fracture, veneer chipping and framework fracture are also observed to occur. Proper planning and awareness are required to prevent these complications and thereby increase the success of implant therapy.

Introduction

Edentulism is a condition in which there is partial or complete loss of teeth that can adversely affectaperson's appearance and functions such as mastication and phonation which ultimately affects the well being and quality of life [20]. The use of dental implants to replace natural teeth lost to trauma, dental caries, or periodontal disease has become a predictable form of prosthetic treatment and is gaining popularity since the early 1980s [27]. These are usually endosseous implants placed in the residual jaw bone or after grafting procedures [3]. These procedures could present complications.

The placement of dental implants require precision, operator skill and are highly patient sensitive [5]. The osseointegration of a dental implant depends on bone remodelling process, patient metabolic factors as well as other systemic factors [22]. The complications in implant therapy may be due to poor planning, poor case selection, or even poor implementation of the treatment plan [23]. In addition once the surgical phase is over, the longevity is dictated by the restoration as the implant is loaded only after the restoration [26]. The implant is introduced to function in the oral cavity after the crown is placed on it and that is when it receives masticatory forces; this is when maximum complications could happen [15]. Natural tooth is surrounded by a periodontal ligament which acts as a shock absorber to harmful forces before distributing them to the bone whereas the implant bone connection is rigid and the forces are directly transferred to the bone [9]. The success rates for dental implants have been measured by the presence of osseointegration and lack of peri-implantitis [10]. Dental implants have high rates of long term survival (≥10 years) when used to support various types of dental prostheses [30]. However, because functional implants and their restorations may be prone to mechanical and biological difficulties, long-term success of dental implants is not the same as survival [29]. A clear understanding of the complications of dental implants is prudent

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as they are becoming more popular due to increased patient demand for fixed prosthesis. Therefore, the aim of this review is to present an overview on the causes of various types of complications related to implant therapy and to provide the practitioner with clinical concepts on their prevention and management.

Materials And Methods

Search databases: A comprehensive search was initiated in PubMed Central, Medline, Cochrane, Embase, Ovid, Science Direct, Copernicus and Google Scholar databases for terms related to complications in dental implants. Manual search for relevant articles were done in the Journal of Prosthetic Dentistry, Journal of Prosthodontics and Clinical Oral Implants and related Research to supplement the electronic search. No limitations regarding publication type and publication date were set.

Inclusion and Exclusion criteria: Systematic reviews, Randomised Controlled Trials, Prospective clinical studies, and Case control studies were included. Case reports, In vitro studies and studies involving animals were excluded from the search.

Search strategy: Article search and analysis was performed according to the guidelines and the principles of an integrative review. The keywords used were screw retained prosthesis, cement retained prosthesis, biological complications, mechanical complications as the objective of this review was to compileall complications related to dental implants.

Results And Discussion

Out of the 109 articles obtained from searching all databases, 75 studies were excluded based on title and abstract. Out of the remaining 34 studies, 18 were excluded based on the inclusion and exclusion criteria and 16 studies were included on the basis of their core data.

Depending on the data collected Implant Complications can be divided as follows:

1. Biological Complications
2. Prosthetic Complications

A. Mechanical Complications - related to complications of prefabricated or industrialcomponents.
B. Technical Complications - related to complications of laboratory-fabricated prostheses and/or their materials.

Biological Complications

Biological complications associated with dental implants are primarily inflammatory conditions of the soft tissues and bone surrounding implants and their restorative components [4]. These are induced by the accumulation of plaque and bacterial biofilm. Such conditions have been named peri-implant mucositis and peri-implantitis, and need to be differentiated so that the clinician may assign a proper diagnosis and select a proper treatment modality in cases where disease is present [36]. The prevalence of peri-implantitis is estimated to be 4-15% among the surviving implant population (i.e., implants still in the mouth) [25]. The progression of this soft tissue inflammation leads to progressive bone loss.

The new classification for peri implant diseases and conditions [6, 43] is described below:

1. Peri-implant health: Clinically, peri-implant health is characterized by an absence of visual signs of inflammation and bleeding on probing [1].

2. Peri-implant mucositis: The main clinical characteristic of peri-implant mucositis is bleeding on gentle probing. Erythema, swelling, and/or suppuration may also be present. An increase in probing depth is often observed in the presence of peri-implant mucositis due to swelling or decrease in probing resistance. While there is strong evidence that peri-implant mucositis is caused by plaque, there is extremely limited evidence for non-plaque induced peri-implant mucositis. There is strong evidence from animal and human experimental studies that plaque is the etiological factor for peri-implant mucositis [14].

3. Peri-implantitis: Peri-implantitis was defined as a plaque-associated pathologic condition occurring in the tissue around dental implants, characterized by inflammation in the peri-implant mucosa and subsequent progressive loss of supporting bone. Peri-implant mucositis is assumed to precede peri-implantitis. Peri-implantitis is usually present in patients with a history of severe periodontitis due to poor plaque control [41].

4. Hard and soft tissue implant site deficiencies: Normal healing following tooth loss leads to diminished dimensions of the alveolar process/ridge that result in both hard and soft tissue deficiencies. Larger ridge deficiencies can occur at sites associated with severe loss of periodontal support, extraction trauma, endodontic infections, root fractures, thin buccal bone plates, poor tooth position, injury and pneumatization of the maxillary sinuses. Other variables that alter the ridge include drugs and systemic disorders that reduce the amount of naturally generated bone, tooth agenesis, and prosthetic pressure [13].

Majority of the implants used presently are platform switched as this shifts the implant abutment junction towards the centre of the fixture thus creating a microbial seal. The platform switched connections seemed to reduce the crestal bone loss which was corroborated in previous systematic reviews [50, 51]. However, with improved surface treatments and presence of microthreads there appears to be no significant difference in the bone loss in the platform matched and platform switched implants [33]. Bone level implants seem to have greater biological complications as compared to tissue level implants as the microgap between the implant and abutment is matched at bone level in the bone level implants [7]. In addition, the junction being at the tissue level for the latter gives space for soft tissue integration, this is not the case with bone level implants [7]. Maximum bone loss occurs up to first year after implant placement [2, 32]. In most cases up to first year the loss is usually up to first thread. Bone is weakest to angled or shear forces and the strongest to compressive forces [18]. According to a systematic review rough threaded implant platforms may be helpful in maintaining the amount of marginal bone around implants as compared to machined smooth neck implants [55]. Meta-analysis showed that micro-threaddesign in the implant neck can reduce the amount of Marginal bone loss as compared to implants without microthreads [32]. When micro-

threads are present at the crestal level the forces are transmitted in a mild yet steady manner and perpendicular to bone. This inturn helps in bone remodelling and preserving the crestal bone [16].

Treatment strategies: Peri-implant mucositis can be reversed with measures aimed at eliminating the plaque [21]. Peri-implantitis and other biological complications can be treated with nonsurgical or surgical approaches. They include nonsurgical mechanical debridement, local antimicrobial delivery in periodontitis and peri-implantitis with the help of tetracycline or doxycycline chips, and surgical debridement with bone grafting [24]. The implant has to be removed if more than 60% of bone is lost or if there is evidence of mobility [39, 24]. Mechanical debridement can be done with titanium curettes, however they have a chance of changing the surface microtopography of the implant [48]. Laser treatment has proven to be effective to treat peri-implantitis [31]. According to recent research Chitosan (a polymer) coated brushes do not affect the surface of implant and have shown good results in the treatment of peri-implantitis [49].

Prosthetic Complications

Mechanical Complications: These are related to problems arising withprefabricated or industrial components. They frequently occur due to biomechanical overloading when the implant position has a horizontal or an apical offset or when crowns are not given in occlusal harmony with the opposing teeth.

Screw loosening - This is one of the most common mechanical complications [4, 19]. A certain amount of preload is given to the screw during the final cementation of an implant prosthesis by torquing it. The screw elongates at microscopic level, and this provides the tensile force required for preload application. Over a period of time due to masticatory forces,the metal surface of the screw gets worn and consequently there is loss of preload. The screw finally gives way when it has exceeded 75% of its ultimate tensile limit. The question that arises is "Is screw loosening a success or failure in implant therapy?". In Implant Dentistry,Screw loosening is considered a regular norm as compared to other therapies. Internal connections have a higher preload value than that of the external hexagon design [44]. The conical configuration can spread the load along the fixture and the surrounding bone more homogeneously than both the external hexagon and traditional internal connections [34]. According to a systematic review, a 5-year complication rate of 10.1% for internal connection and 12.4% for external connection [35]. Normally, such a complication can be addressed by tightening and torquing the screw in case of loosening. However, it is a remedial measure and repeated tightening simply induces more chances of screw loosening over a prolonged routine usage.

Screw fracture - Screw is the weakest part of the implant prosthetic components and likely to fracture first on unwanted forces [54]. In most finite element analysis studies, the factor of safety is lowered below 1 in the screw alone. Most of the time screw fracture occurs in cases having a non-passive framework. The micro gap between platform and framework results in flexure of the screw (contraction) every time the patient bites and may cause the screw to [42].

The methods proposed to remove a fractured screw include a dental instrument (explorer, hand scaler, ultrasonic scalers) rotated counter-clockwise, drilling a horizontal groove cut into the screw head has been advocated to engage the instrument with a flat-head driver or instrument, screw-retrieval kits are also available. Drilling must be done carefully to avoid damaging the internal bore threads.

Abutment fracture - This complication usually occurs in angulated implants or in cases with increased vertical cantilever [17]. When non-parallel implants are subject to occlusal loads there are shear or lateral forces acting on them that may cause fracture of the abutment. This is also the case when abutments over tilted implants are excessively milled in an attempt to make them parallel, the abutments become thin and subsequently have an increased chance of fracture. Ceramic abutments, both internally and externally connected, demonstrated a significantly higher incidence of abutment fractures than metal abutments [35].

Implant fracture: Fracture of implants is a terminal failure for implant therapy. It is associated with several factors, including material, implant diameter and length, presence of a cantilever, and bruxism, fit ,narrow implants, bone density [12]. Occlusion and cantilevers are considered important risk factors in the outcome of the implant restoration.Bruxism may significantly reduce implant survival [12, 8].

Technical Complications: These complications are related to complications of laboratoryfabricated prostheses and/or their materials. The frequency of occurrences of technical complications is greater in implant-supported FPDs as compared to the implant-supported removable prosthesis.

Fracture of veneering porcelain

There is an increased risk of this complication occurring in cases with excess horizontal or vertical cantilevers. An incidence of 3.4% for the fracture of the veneer ceramic and metal- ceramic restorations after 5 years was reported in a review [37]. The incidence of complication in posterior implant was 3.1% whereas it was only 1.7% in anterior implants [46]. This could be because there are increased masticatory forces in the posterior regions as compared to anterior region. The incidence of veneering material fracture increases to 12.4% in multiunit fixed implant-supported prostheses after 5 years [51, 52]. This complication can be reduced by following the principles of implant protected occlusion [28].

Fracture of the framework

Implant prosthesis has to be given in such a way that it does not jeopardize the endurance limit of the prosthesis. This is possible if the fit of the prosthesis is passive. A misfit of the prosthesis produces additional strains on the framework which are time and again acting during mastication which could lead to fracture of the prosthesis [38]. When there is less inter-arch space in partially edentulous jaws, the implant-abutment interface and abutment retention screw are exposed to higher lateral bending loads, tipping, and elongation forces the risk of framework fracture is more. 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 Refined approaches withpreciselaboratory procedures are still a requisite to achieve a passive fit with an implant-supported superstructure. Cement-re-

tained implant-supported single crowns had a greater rate of biological issues, whereas screw-retained crowns had a greater rate of technical difficulties and screw loosening [47]. The introduction of CAD/CAM frameworks has enhanced both the design and production of prosthetics [45]. The enhanced fit of these frameworks eliminates the need for soldering or laser welding, which would have resulted in fracture-prone areas [40].

Conclusion

Implant therapy does not stop after delivery of the implant prosthesis. It is the duty of the clinician to consider all the possible complications that might occur. This article is corroborated by clinical evidence and gives an overview of possible implant complications. Biologic complications such as peri-implantitis or technical complication such as screw loosening may be expected and prevented with awareness on their etiologic factors.

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