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Review Article

Factors influencing the survival of dental implants - A review

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ABSTRACT

Dental implants are extensively used and are considered to be one of several treatment options that can be used to replace missing teeth. A number of implant-supported treatment alternatives have been used successfully to restore a single tooth and multiple teeth, as well as a completely edentulous jaw. However, as the number of patients who have dental implants is increasing, dental personnel are more likely to see patients with implant-supported restorations or prostheses. There are many systemic and local factors that effect the survival of implants, Therefore, a basic knowledge of dental implants and associated factors for the survival of dental implants is necessary for the success of dental implants.

1. Introduction

Individuals with edentulism can be treated with either fixed or removable prosthesis however these prosthesis they are not satisfactory in a significant number of individuals and dental implants are a boon in such cases.

Nowadays dental implants are used as a treatment modality in majority of patients and are significantly used in future for oral rehabilitation.

A dental implant supports the dental prosthesis such as a crown, bridge, denture, facial prosthesis to act as a bone anchor. Even though dental implants are widely used implant failures occur, and managing the complications is a greatest challenge.

The failures may be early implant failures or delayed failure; early complications of implant include bleeding from implant site, infection, and pain. Late failures include lack of osseintegration, infection of the peri -implant tissue, infection, and pain. [1]

There are few indications and contraindications for implant placements. The contraindications of implant placement are patients with epilepsy, children and adolescents, patients having endocarditis, history of osteoradionecrosis, smokers, and diabetic patients. Absolute contraindications are patients with history of myocardial infarction, cerebrovascular accident, patients with history of bleeding, history of heart transplant, immune suppression, active treatment of malignancy, drug abusers, and psychiatric illness.

Dental implants are contraindicated in patients with epilepsy, patients with endocarditis, osteoradionecrosis, smokers, and diabetes mellitus. And absolute contraindications include myocardial infarction, cerebrovascular accident, patients with bleeding disorders, history of heart transplant, immunosuppression, and active treatment for malignancy, drug abusers and psychiatric illness.

This article reviews about various local and systemic factors that affect the survival of dental implants.

The various local factors that affect the survival of dental implants include.

1.1. Local factors

Bone quality and quantity,
Implant shape,
Implant surface macro-structure
Implant micro-structure (roughness)
Material biocompatibility

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1.2. Systemic factors

Diabetes

Osteoporosis:

Human Immunodeficiency Virus

Cardiovascular Disease and Antihypertensive Medications

Neurologic Disorders

Hypothyroidism.

Rheumatoid Arthritis

Selective Serotonin Reuptake Inhibitors

Proton Pump Inhibitors

1.3. Local factors

1.4. Bone quality and quantity

Many factors have been reported to play role in obtaining osseointegration and resulting in subsequent success of implants.

Higher incidence of implant failure is seen in bone with poor quality than compared with a bone of higher quality.[2]

Implants in posterior maxillary region have lower survival rate than when placed in the mandibular arch, this is because of the difference in the bone quality between the two arches.

1.5. Implant shape

Implants can be parallel (straight or tapered walled) , tapered type implants have better primary stability than parallel type , tapered type implants help in the compression of the bone laterally and increase in the stiffness of the interface bone, which helps increasing the primary stability.[3]

1.6. Implant length and diameter

When wider diameter implants are used it results in over instrumentation and heat generation, implants of less than 5.0 mm diameter results in the reduction of the heat generation in the drilling process and damage to the bone, the amount of heat that is released and distributed by implant placement is not known. and the increased heat released by a larger diameter implant is distributed over a large osseous surface and the amount of heat received by each unit area of bone may be the same with a regular or narrow diameter implant .

Studies have shown that implants with a diameter of 5.0 mm diameter have higher failure rate than 3.75 – 4.0 mm diameter implants.[4]

1.7. Implant length

Implant length is the dimension from platform to the apex of implant , larger implants have greater success rates and prognosis , therefore a linear relationship between length and the success rates of dental implants.[5]

Implants with 7mm length exhibit greater failure than other implant lengths, the shorter implant lengths are not recommended because the occlusal forces must be transmitted spread over a large implant surface area to prevent excessive stress at the interface.[6]

1.8. Implant surface macrostructure (Threads)

Implants may be threaded or smooth surfaced, to improve primary stability threads are incorporated, there are various thread designs and among all “V”, square or reverse buttresses.[7]

Studies conducted by Stegna and colleagues on animals have proved that effect of thread type on peri-implant bone formation[8,9]

Implants with square thread design has more bone implant contact and greater reverse torque movements.

1.9. Implant microstructure

The bone to implant contact with different surface modifications in an histomorphic analysis was studied by Bruser et al[10] and found that SLA treated implants showed bone to implant contact (50-60 %) in comparison to various other surface modifications as titanium plasma spray (30- 40 %) or electro polished implants (20- 25%) .

The acid etches implant biomechanical properties are improved by sandblasting and studies conducted by Lieat[11] had shown that compared to machined and acid etched, SLA implants have a higher removal torque values.

1.10. Implant material

The implant material may be bio inert or bioactive , bioinert such as CPTi and Ti alloys , bioactive materials include ceramics such as hydroxyapatite , tri and tetra calcium phosphate , and bio- glass.

Past over five decades Ti is the most commonly used material in dental implants due to its biocompatibility , with advancements in technology ceramic materials are used as implant substrates because Yt- stabilised tetragonal zirconia polycrystalline has better mechanical properties . superior wear and corrosion resistance and has a higher flexural strength and their superior properties make them an alternative to Titanium.[12,13]

1.11. Abutment implant connection

Implant in function is connected with prosthesis or restoration , the connection may be internal or external[14,15] in internal connection implant is inserted into the access hole in the implant plate form , where as in external protrusion located above the implant plate form is inserted into the recess in the apical part of the abutment .

Internal hex design is preferred over external hex because the occlusal load is transferred through the implant body and the screw is protected from load.[16]

1.12. Systemic factors

1.12.1. Diabetes

1. Distinctive nature is high blood glucose levels
2. In longrun proinlammatory cytokines and mediators are released like TNF alpha, IL 6 that rise and bringdown osteoblast- osteoclast coupling which are two essential cells for implant osseointegration.
3. In the same way diabetes also act on the ratio of receptor activator of nuclear factor kappa-B ligand (RANKL) and osteoprotegrin (OPG), prime regulators of osteoclast function.
4. In cases of hyperglycemia, this ratio is destroyed and accentuates bone resorption
5. Eventually, these patients are liable to both systemic and localized infections, and thus are at a danger for osseointegration collapse due to infection.[17]
6. Altogether, these changes could be a reason for a probable cause for implant failure in diabetic patients.
7. Therefore, diabetic control is estimated by determining the levels of glycosylated hemoglobin, hemoglobin A1c (HbA1c). Infact, dental measures exist for patients with uncontrolled diabetes, and most clinicians limit their positioning of dental implants, as well as non emergency surgical procedures, in patients with uncontrolled diabetes.
8. One study explored osseointegration rates in patients with uncontrolled diabetes and found no distiction in patients with high or low HbA1c.[18]
9. Another study that involved 23 patients with HbA1c from 6 to 13.9 who had a sum of 70 implants placed found no distinction in osseointegration among groups.[19]
10. In both studies, implant existence rates were comparable, with no statistical differences among groups. However, with low sample sizes, it is tough to draw up definite opinion for implants in patients with poorly controlled diabetes.
11. Osseointegration rates in all groups were similar, with no statistically remarkable differences
12. Although these outcomes are inspiring for osseointegration and short-term implant survival, marginal bone loss and longlasting implant survival may be affected by diabetic status; this focuses the need to closely escort these patients for conservation and potential problems.

1.12.2. Osteoporosis

1. Since osteoporosis is a disorder of reduced bone mass, increased bone delicacy, and prone to fracture, the thin cortical bone and enlarged trabecular spacing is thought to impart higher implant failure.
2. Mostly seen in postmenopausal women on hormone replacement therapy, particularly in the less dense maxillary(type IV) bone.[20,21]
3. Osteoporosis treatment usually incorpotrates an antiresorptive medication such as a bisphosphonate (BP) or denosumab (Dmab).
4. Both BPs and Dmab hamper osteoclast differentiation and function, contributing to decreased bone resorption and remodeling.
5. . But, most studies have failed to show a adverse effect on implant osseointegration or survival after BP therapy, osteonecrosis of the jaw (ONJ) and alveolar bone loss have been described after dental implant placement.[22,23]
6. With the likely destructing effects of ONJ, accepted treatment guidelines should be followed, including avoiding non emergency positioning of dental implants in patients on antiresorptive therapy for malignancies and utilizing a drug holiday and a thorough informed consent in patients on antiresorptives for osteoporosis.[20]

1.12.3. Human Immunodeficiency Virus

1. The lONGIVITY for people existing with HIV has increased over the past two decades
2. Numerous individuals who are HIV-positive survive much longer, healthy lives
3. As a matter of fact, the regular causes of illness and death in people surving with HIV are alike to those of non-HIV patients that involve heart disease, kidney disease, liver disease, diabetes, depression, and cancer.
4. However, there is a practical association between HIV-positive individuals and bone metabolic alterations
5. Rationale for this are low calcium/vitamin D intake, low testosterone, alcohol and opiate abuse, smoking, depression, physical inactivity, and HAART.[24]
6. To date, there is little evidence of the effect of HIV, and more specifically HAART therapy, on osseointegration and long-term success and survival of dental implants.[25]
7. Nevertheless, the authors inferred that prophylactic antibiotic treatment, the administration of highly active antiretroviral therapy, and control of the CD4+ T lymphocyte counts were solution in the effective treatment of these groups of patients

1.12.4. Cardiovascular Disease and Antihypertensive Medications

1. In reality, heart disease is the chief cause of deceased for both men and women, and coronary heart disease is the frequent type, killing over 370,000 people annually.[26]

2. Of the different forms of cardiovascular disease, hypertension, atherosclerosis, vascular stenosis, coronary artery disease, and congestive heart failure have the most direct effect on peripheral blood supply.
3. This will lead to deficient oxygen supply to local tissues, reduced fibroblast activity, collagen formation, capillary growth, and macrophage activity which will have direct effect on bone healing and osseointegration.[27]
4. In a retrospective study analyzing nearly 7,000 implants, Alsaadi and coworkers analyzed the impact of local and systemic factors on the incidence of oral implant failures, up to abutment connection.[28]
5. They concluded that certain factors, such as cardiac diseases, coagulation problems, hypertension, or hypercholesterolemia, did not lead to an increased incidence of early failures.[29]

1.12.5. Neurologic Disorders

1. From ancient times, patients experiencing neurologic diseases have been eliminated from receiving dental implants
2. The primary rationalization for the exclusion has been the association with poor approach to oral health care, poor oral hygiene, oral parafunctions such as bruxism, harmful habits, and behavioral problems.
3. Newer technology and improvements in medicine have permitted for enhancement in patient care and personal satisfaction, including patients suffering from neurologic disorders.
4. This improvement in patients' emotional and social well-being has been a key factor in the reinstitution of dental implants, allowing them to work alike to their natural teeth.
5. Unfortunately, there is limited documentation to contribute the use of dental implants in patients affected by neurologic disorders.
6. In a prospective study, Ekfeldt et al[30] evaluated the medium- to long-term outcome of dental implant therapy in patients with neurologic disabilities.
7. Twenty-seven patients with different disabilities and in need of prosthodontic treatment were treated with various implant-supported prostheses.
8. Nonetheless, the authors concluded that implant therapy can be a valid option for the rehabilitation of patients with neurologic disabilities.

1.12.6. Hypothyroidism

1. Hypothyroidism is a familiar endocrine disorder, most commonly affecting women of advanced age
2. As many organs have receptors for thyroid hormone, its inadequacy impedes withvast number of the body's metabolic processes.
3. In addition to controlling temperature, generalized energy, metabolism, skin moisture, gastrointestinal motility, muscle metabolism, mental and memory ability, libido, and menstrual cycle, thyroid hormone affects bone metabolism.[31,32]
4. Thyroid hormone regulates adult bone mass and revives production of insulin-like growth factor-1 (IGF-1), which rises osteoblast formation and differentiation, and bone remodeling.[33,34]
5. For bone metabolism, hypothyroidism has been associated with RETARDED bone regeneration, proliferates fracture risk, and retards fracture repair.[35,36]
6. Treatment hypothyroidism, including long-term levothyroxine, has correlation with accentuated risk for osteoporosis and late fracture recovery in animal studies, making the condition and its therapy a cause for concern in patients seeking dental implants.[34]
7. Studies that have investigated implant survival in patients with hypothyroidism did not demonstrate a significantly higher rate of implant failures as compared to control patients.[37,38]

1.12.7. Rheumatoid Arthritis

1. RA is an autoimmune disease in which the body's immune system produces inflammation that leads the synovium to stiffen, developing inflammation edema and pain in and around the joints, gradually destructingthe bone itself.
2. RA is usually followed by osteoporosis as a result of increased systemic bone turnover and anti-inflammatory and/or combined anti-immune treatment regimens.
3. Although the etiology of RA is idiopathic, there is documentation that genetics, hormones, and environmental factors are involved in the process.
4. Genes associated to RA include: STAT4, a gene that plays important roles in the controlling and renewing of the immune system; TRAF1 and C5, two genes relevant to chronic inflammation; and PTPN22, a gene associated with both the development and progression of RA.
5. iIndividuals with RA with or without concomitant corticosteroid treatment will develop localized osteopenia and generalized osteoporosis in 30% to 50% of all cases.
6. But, there is scanty documentation on the effect of RA on osseointegration and dental implant outcomes.[39]
7. In a case series, Weinlander et al[40] evaluated implant and prosthodontic treatment outcomes of patients suffering from rheumatic disorders such as RA and connective tissue diseases (CTDs).
8. The authors concluded that a high implant and prosthodontic success rate can be anticipated, even for patients suffering from autoimmune rheumatic

disorders such as RA and CTDs.[41]

1.12.8. Selective Serotonin Reuptake Inhibitors

1. Usually adviced antidepressants that accentuates levels of serotonin in brain
2. They stop the uptake of 5HT by inhibiting 5^{HT} transporter
3. Recent studies have shown a wider role for the SSRIs, as 5-HT plays an active role in numerous pathways including that of bone metabolism.[42]
4. The results of this study suggested that SSRIs may lead to an increase in the rate of osseointegration failure, although not reaching statistical significance.

1.12.9. Proton Pump Inhibitors

1. They are employed for the elimination and therapy of acid-related conditions such as esophageal, duodenal, and stomach ulcers; NSAID-associated ulcer; gastroesophageal reflux disease (GERD); and Zollinger-Ellison syndrome.

2. They are used together with antibiotics for preventing Helicobacter pylori, a bacterium in combination with acid results ulcers of the stomach and duodenum.

3. longterm use of PPIs could have potential adverse effects, due to the effect of chronic acid suppression on the absorption of vitamins and nutrients. Gastric acid secretion can affect the absorption of a number of nutrients, drugs, and vitamins, particularly Vitamin B12, iron, calcium, and magnesium.

4. Recent studies showed a possible association between chronic PPI use and increase in bone fractures, possibly by decreasing calcium absorption.[43]

5. The most widely assumed mechanism is that long-term PPI use leads to decreased intestinal absorption of calcium, resulting in negative calcium balance, increased osteoporosis, development of secondary hyperparathyroidism, increased bone loss, and increased fractures.

6. Even though evidence exists on the negative effects of PPIs on bone, there is little evidence on their effect on osseointegration and dental implants.

7. Statistical analysis revealed that the failure rates were 6.8% for people using PPIs compared to 3.2% for nonusers.[42]

8. In their conclusions, the authors also suggested that the intake of PPIs may be associated with an increased risk of dental implant failure.

2. Conclusion

Dental implants are extensively used and considered as one of the options by which missing teeth are replaced. They are used successfully to replace single and multiple missing teeth as well as a completely edentulous jaw. The use of dental implants are increasing and dental professionals are more likely to see patients who have implant-supported restorations/ prostheses. Therefore, basic understanding of dental implants is necessary for dental personnel. Several factors are known to affect success of any implant system. These factors may be related to features locally, or systemically. Local factors such as Bone quality and quantity, Implant shape, Implant surface macro-structure, Implant micro-structure (roughness), Material biocompatibility and Systemic factors such Diabetes, Osteoporosis, Human Immunodeficiency Virus, Cardiovascular Disease and Antihypertensive Medications, Neurologic Disorders, hypothyroidism, Rheumatoid Arthritis, Selective Serotonin Reuptake Inhibitors, Proton Pump Inhibitors are the factors that help in the survival of dental implants.

3. Source of Funding

None.

4. Conflict of Interest

None.

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