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Review Article

Biological Factors Responsible to the Failure of Osseointegrated Dental Implants

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Abstract

In the last few decades, the field of dental implantology is advancing significantly, leading to more predictable treatments for the rehabilitation of fully and partially edentulous patients. Owing to the remarkable success, there have been various researches going on to find out factors responsible for the failure of implants. The present review is aimed at individuating factors associated with biological factors of osseointegrated oral implants. The factors contributing to failure of osseointegration have been identified as medical status of the patient, smoking, bone quality, bone grafting, irradiation, bacterial contamination, lack of preoperative antibiotics, degree of surgical trauma, and operator experience. Furthermore, it appears that implant surface properties, roughness and premature loading influence the failure pattern the ability to anticipate outcomes is an essential part of risk management in an implant practice. Recognizing conditions that place the patient at a higher risk of failure will allow the surgeon to make informed decisions and refine the treatment plan to optimize the outcomes.

Keywords: Dental implants; Osseointegration; Biologic factors; Bone healing; Implant failure

Introduction

Oral implants have revolutionized the practice of dentistry. Dental implant survival is initially dependent on successful osseointegration following placement. Any alteration of this biological process by excessive surgical trauma, infection, or metabolic upset may adversely affect treatment outcomes [1]. Subsequently, as an implant is restored and placed into function, bone remodeling becomes a critical aspect of implant survival in responding to the functional demands placed on the implant restoration and supporting bone [2]. Dental implant success is related to operator skill, quality, and quantity of bone available at the site and patient's oral hygiene. Albrektsson et al. proposed the criteria for successful integration of dental implants have been. Of these, a lack of mobility is of prime importance as 'loosening' is the most often cited reason for implant fixture removal [3]. Adell et al. reported the success rate of 895 implant fixtures over an observational period of 5 years after placement. Eighty-one per cent of maxillary and 91% of mandibular implants remained stable [4]. Despite high success rates, implant fixture failure may occur and is defined as 'the inadequacy of the host tissue to establish or maintain osseointegration'.

Esposito et al. defined biological failures related to biological process, and mechanical failures related to fractures of components and prosthesis [5]. This article provides an overview of the important biological factors that affect osseointegration and thus lead to implant failure. There are various systemic and local factors which may impair bone healing or may interfere with the maintenance of osseointegration. Success or failure of dental implants depends on proper or improper selection of the host and important factors responsible for dental implant failure can be enumerated as follows:

Patient factor: Patient factors are important determinants of implant failure. Ekfeldt et al. identified the patient risk factors leading to multiple implant failures and concluded that a combination of several medical and local situations could provide a contraindication to implant treatment [6].

Age: Aging is a physiological process that interferes directly with local bone quality and quantity. Several studies suggest that old age is a risk factor for implant-rehabilitating therapy, considering the rate of bone formation around the implants decreases with age [7]. With aging, changes occur in the mineral composition, collagen, bone morphogenetic proteins (BMPs) content and conformation of the bone [8]. An experimental study which evaluated bone healing around hydroxyapatite (HA)-coated implants in rats of different ages yielded a decreased rate and quantity of regenerated bone with increasing age [9]. It is therefore, conceivable that in older patients bone healing may be slower and failure rates may be slightly increased. Theoretically, patients with increased age will have more systemic health problems, but there is no scientific evidence correlating old age with implant failure [10]. Although Salonen et al. stated that advanced age was a possible contributing factor to implant failure; other reports have showed no relationship between old age and implant failure [11].

General health: The nutritional status and general disease such as bone metabolic disease (e. g. osteoporosis, osteomalacia, hyperparathyroidism, Paget's disease), rheumatic disease (rheumatoid arthritis, Sjogren syndrome, systemic lupus erythematosis), hormonal disease (diabetes, Cushing's syndrome, hyperparathyroidism), lichen planus, anomalies of neutrophil granulocytes, delayed hypersensitivity, immunological disorders and malabsorption syndromes, have been suggested to influence the outcome of implant treatment [12-14]. The critical dependence on bone metabolism for implant survival may be heightened in patients

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with diabetes [15]. Diabetes is a chronic disease that occurs when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin that it produces. Diabetic patients have increased frequency of periodontitis and tooth loss, and diabetes has been considered a risky condition for dental implants with the fact that it is associated with delayed wound healing, prevalence of micro vascular disease, and impaired response to infection. Accordingly, diabetes remains a relative contraindication for implant therapy; that is, well-controlled diabetic patients may be considered appropriate for implant therapy, while diabetic patients lacking good glycaemic control may be denied the benefits of implant therapy [2,15]. Osteoporosis is a disorder characterized by a general diminution bone mass, may therefore represent "didactic contraindication" or a risk factor for osseointegration [16]. Despite the fact that osteoporosis has been considered as risk factor for implant treatment, particularly in post-menopausal women, there has been limited studies published on these topic yet. A review of literature suggested that there is no scientific background to conform osteoporosis as a risk factor for oral implants [17]. However, more precise information is needed and the use of register -based investigations together with well-designed prospective follow-up studies appear to be crucial.

Smoking is one of the factors often discussed in relation to implant failure. Several studies have shown that smoking can be associated with higher failure rates, complications and altered peri-implant tissue conditions [18,19]. Nicotine presents as a main element of cigarette reduces proliferation of red blood cells, macrophages, and fibroblast which are the main element of healing. It also increases platelet adhesiveness which can lead to poor perfusion due to micro clots. It also acts as sympathomimetic by increasing the release of epinephrine and nor epinephrine and causes increased vasoconstriction which limits over all tissue perfusion [20,21]. Studies suggest smoking as the factor associated with complications like marginal bone loss [22]. Studies also suggested that effect of smoking on implant may be reversible, and therefore suggest that smokers should realize satisfactory outcomes if they cease smoking even temporarily [23].

Bone quality is believed to be one of the most important aetiological factors for early implant failures. A high success rate for the preservation of the alveolar bone around oral implants is predicated on good bone quality [24]. Implantation into bone types 1, 2 and 3 results in good clinical outcomes, whereas type 4 is associated with a lower success rate [25]. Some studies indicated that the bone quality did not significantly influence the failure rate of the implants [26,27].

Bruxism: The higher failure rate among the bruxers is not so surprising because a high and unpredictable or uncontrolled loading of the implant could lead to micromotions above the critical limit, resulting in fibrous encapsulation of the implant instead of osseointegration [28]. Glauser et al. evaluated 41 patients who received 127 immediately loaded implants. Their results showed that implants in patients with a parafunctional habit (bruxers) were lost more frequently than those placed in patients with no parafunction (41% versus 12%) [28].

Oral hygiene: Dental plaque is also directly or indirectly leads to implant failure. The role of dental plaque on late failures has attracted much attention, but is indeed still controversial [29]. Kourtis et al. evaluated the clinical outcomes of 1692 implants. The oral hygiene was evaluated subjectively as good, medium or insufficient in all recall appointments. The failed implants in patients with good oral hygiene were 13 (17.6% of all failures), in patients with a medium level of oral hygiene 27 (36.5%), and in patients with insufficient oral hygiene, 34 failures (45.9%) were noticed. The failure rate in good ormedium oral hygiene groups was 2.5% and 2.9%, respectively, and in patients with insufficient oral hygiene, almost four times higher (13.8%). The survival rate probability was also influenced accordingly [30]. According to Tonetti & Schou, an imbalance of the host-parasite equilibrium can manifest itself in a series of inflammatory changes leading to two distinct syndromes: a) peri-implant mucositis, which is a lesion confined to the superficial soft tissues; and b) peri-implantitis. The latter involves the deeper tissue as well as the peri-implant bone [31].

Irradiation therapy: Radiotherapy in combination with surgical excision is the treatment generally employed for malignant tumors in that region, and osteoradionecrosis is one of the oral effects of radiation therapy. Irradiation therapy provokes early and late alterations in tissues and also has a profound effect on bone cells and blood vessels. [32,33]. In fact, not only the tumour cells are affected, but the entire population [29]. Besides, a decrease in bone -to-implant contact, bone resorption, fibrosis, and avascular necrosis (osteoradionecrosis) has been reported. The end result is often a hypocellular, hypovascular and hypoxic tissue which does not tolerate traumatic or surgical insults [29]. Few experimental studies demonstrated an improved bone healing capacity by a factor of 2.5, one year after irradiation. The interval time between radiotherapy and implant placement and the radiation doses are not associated with significant implant failure rates. The placement of implants in irradiated bone is viable, and head and neck radiotherapy should not be considered as a contraindication for dental rehabilitation with implants [34]. Moreover, before starting the reconstructive phase, a long healing interval following irradiation has been suggested [35]. Some authors advocate the use of Hyperbaric Oxygen (HBO) therapy prior to implant placement to provide support to areas with compromised blood flow [32,36]. Hence, Dental implants installed in the irradiated area of an oral cavity have a high survival rate, but strict monitoring is needed to prevent complications, thereby reducing possible failures [37].

Medications: Bisphosphonates (BPs) are an important group of drugs. Osteonecrosis of the jaw is a complication observed in patients who use oral or intravenous bisphosphonates. It is called Bisphosphonate-Related Osteonecrosis of the Jaw (BRONJ) [38]. Therefore, it is important to inform all the patients undergoing bisphosphonate therapy about the possible risks of development of osteonecrosis [39]. Glucocorticoids are widely used to suppress inflammation in chronic diseases, such as asthma, rheumatoid arthritis, inflammatory bowel disease and autoimmune diseases [40]. Bone loss is one of the most common and debilitating side effects associated with prolonged high-dose glucocorticoid therapy, and this may negatively affect implant osseointegration [41]. Selective Serotonin Reuptake Inhibitors (SSRIs) have been used successfully to treat depression [42]. It has been suggested that serotonin receptors found in osteocytes, osteoblasts and osteoclasts can be activated by SSRIs and, thus, alter their function. 43Taking all these factors into

consideration, Wu et al. postulated that treatment with SSRIs may have a negative effect on dental implant osseointegration [44].

Conclusion

The long-term efficacy and prognosis of dental implants is usually measured by the survival rates. Implant failures are multifactorial in nature. Reported predictors for implant success and failure are generally divided into patient-related factors e. g. general health status, smoking habits, uncontrolled diabetes, quality and quantity of bone, oral hygiene maintenance etc. Daily self-care and adherence to maintenance recall is mandatory for the long term success of implant and should be conveyed to patients during consultation period only. Since interest of patient and commitment to post treatment care is very important factor.

References

1. Accursi GE. Treatment outcomes with osseointegratedBrånemark implants in diabetic patients: a retrospective study (thesis). 2000; Toronto, ON: University of Toronto.
2. Chrcanovic BR, Albrektsson T, Wennerberg A. Diabetes and Oral Implant Failure: A Systematic Review. J Dent Res. 2014; 93: 859-867.
3. Albrektsson T, Zarb GA, Worthington P, Eriksson AR. The long-term efficacy of currently used dental implants: a review and proposed criteria of success. Int J Oral Maxillofac Implants. 1986; 1: 11-25.
4. Adell R, LekholmU, Rockler B, Branemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. Int J Oral Surg. 1981; 10: 387-316.
5. Esposito M, Hirsch J, Lekholm U, Thomsen P. Differential diagnosis and treatment strategies for biologic complications and failing oral implants: A review of the literature. Int J Oral Maxillofac Implants.1999; 14: 473-490.
6. Ekfeldt A, Christiansson U, Eriksson T, Lindén U, Lundqvist S, Rundcrantz T, et al. A retrospective analysis of factors associated with multiple implant failures in maxillae. Clin Oral Implants Res. 2001; 12: 462-467.
7. Pedro REL, De Carli JP, Linden MSS, Lima IFP, Paranhos LR, Costa MD, et al. Influence of Age on Factors associated with Peri-implant Bone Loss after Prosthetic Rehabilitation over Osseointegrated Implants. J Contemp Dent Pract. 2017; 18: 3-10.
8. Syftested G, Urist MR. Bone aging. ClincOrthop. 1982; 162: 288-297.
9. Shirota T, OhnoK, Suzuki K, Michi K. The effect of aging on the hydroxyapatite implants. J Oral Maxillofac Surg. 1993; 51: 51-56.
10. Hadi S, Ashfaq N, Bey A, Khan S. Biological factors responsible for failure of osseointegration in oral implants- A Review. Biology and Medicine. 2011; 3: 164-170.
11. Salonen MA, Oikarinen K, Virtanen K, Pernu H. Failures in the osseointegration of endosseous implants. Int J Oral Maxillofac Implants. 1993; 8: 92-97.
12. Matukas VJ. Medical risks associated with dental implants. J Dent Educ. 1988; 52: 745-747.
13. Zoldos J, Kent JN. Healing of dental implants. In: Block MS, Kent JN, edsEndoosseous implants for maxillofacial reconstructions, Philadelphia: W.B. Saunders Co. 1995; 40-69.
14. AdeliR. The surgical principles of osseointegration. In: Worthington P, Branemark PI, eds Advanced osseointegration surgery: Applications in the maxillofacial region. Chicago: Quintessence Publishing Co., Inc., 1992; 94-107.
15. Oates TW, Huynh-Ba G, Vargas A, Alexander P, Feine J. A critical review of diabetes, glycemic control, and dental implant therapy. Clin Oral Impl Res. 2013; 24: 117-127.
16. Anitua E, Orive G, Arguirre J, Andia I. 5 Year Clinical Experience with Bti dental implants: Risk factors for implant failure. J Clin Periodontol. 2008; 35: 724-732.
17. Dao TTT, Anderson JD, Zarb GA. Is osteoporosis risk factor for osseointegration of dental implants? Int J Oral Maxillofac Implants. 1993; 8: 134-144.
18. Smith RA, Berger R, Dodson TB. Risk factors associated with dental implants in healthy and medically compromised patients. Int J Oral Maxillofac Implants. 1992; 7: 367-372.
19. Jones JK, Triplett RG. The relationship of cigarette smoking to impaired intraoral wound healing: a review of evidence and implications for patient care. J Oral Maxillofac Surg. 1992; 50: 237-239.
20. Bain CA, Moy K. The association between the failure of dental implants and cigarette smoking. Int J oral maxillofac implants. 1993; 8: 609-615.
21. Yamano S, Berley JA, Kuo WP, Gallucci GO, Weber HP, Sukotjo C. Effects of nicotine on gene expression andosseointegration in rats. Clin Oral Implants Res. 2010; 21: 1353-1359.
22. Goutam M, Singh M, Patel D. A literature review on effects of smoking on the success of dental implants. J Dent Implant. 2013; 3: 46-51.
23. Cesar-Neto JB, Benatti BB, Sallum EA, Nociti FH Jr. Bone density around titanium implants may benefit from smoking cessation: A histologic study in rats. Int J Oral Maxillofac Implants. 2005; 20: 713-719.
24. Sakka S, Coulthard P. Bone quality: a reality for the process of osseointegration. Implant Dent. 2009; 18: 480-485.
25. Martinez H, Davarpanah M, Missika P, Celletti R, Lazzara R. Optimal implant stabilization in low density bone. Clin Oral Implants Res. 2001; 12: 423-432.
26. Chrcanovic BR, Albrektsson T, Wennerberg A. Reasons for failures of oral implants –A Review. J Oral Rehabil. 2014: 41; 443-476.
27. Lemmerman KJ, Lemmerman NE. Osseointegrated dental implants in private practice: a long-term case series study. J Periodontol. 2005; 76: 310-319.
28. Glauser R, Ree A, Lundgren A, Gottlow J, Hammerle CH, Scharer P. Immediate occlusal loading of Branemark implants applied in various jawbone regions: a prospective, 1-year clinical study. Clin Implant Dent Relat Res. 2001; 3: 204-213.
29. Esposito M, Hirsch JM, Lekholm U, Thomsen P. Biological factors contributing to failures of osseointegrated implants (II).Etiopathogenesis. Eur J Oral Sci. 1998; 106: 721-764.
30. Kourtis SG, Sotiriadou S, Voliotis S, Challas A. Private practice results of dental implants. Part I: survival and evaluation of risk factors–Part II: surgical and prosthetic complications. Implant Dent. 2004; 13: 373-385.
31. Tonetti MS, Schmid J. Pathogenesis of implant failures. Periodontol. 2000. 1994; 4: 127-138.
32. Granstrom G, Jacobsson M, Tjellstrom A. Titanium implants in irradiated tissue: Benefits from hyperbaric oxygen. Int J Oral Maxillofac Implants. 1992; 7: 15-25.
33. Ohrnell L-O, Branemark R, Nyman J, Nilsson P, Thomsen P. Effects of irradiation on the biomechanics of osseointegration: An experimental *in vivo* study in rats. Scand J Plast ReconstrSurg Hand Surg. 1997; 31: 281-293.
34. Zen Filho EV, Tolentino Ede S, Santos PS. Viability of dental implants in head and neck irradiated patients: A systematic review. Head Neck. 2016 ; 38: 2229-2240
35. Jacobsson MG, Jonsonn AK, Albrektsson TO, Turesson IE. Short and long-term effects of irradiation on bone regeneration. PlastReconstrSurg. 1985; 76: 841-850.
36. Jisander S, Grenthe B, Alberius P. Dental implant survival in the irradiated jaw: a preliminary report. Int J Oral Maxillofac Implants. 1997; 12: 643-648.
37. Smith Nobrega A, Santiago JF Jr, de Faria Almeida DA, Dos Santos DM, Pellizzer EP, Goiato MC. Irradiated patients and survival rate of dental implants: A systematic review and meta-analysis. J Prosthet Dent. 2016; 116: 858-866.
38. Gheorghiu IM, Stoian IM. Implant surgery in healthy compromised patients-review of literature. J Med Life. 2014; 7: 7-10.

39. Javed F, Almas K. Osseointegration of dental implants in patients undergoing bisphosphonate treatment: a literature review. J Periodontol. 2010; 81: 479-484.

40. Coutinho AE, Chapman KE. The anti-inflammatory and immunosuppressive effects of glucocorticoids, recent developments and mechanistic insights. Mol Cell Endocrinol. 2011; 15: 335: 2-13.

41. Fu JF, Bushutski JD, Al-Hezaimi K, Wang HL. Statins, glucocorticoids, and nonsteroidal anti-inflammatory drugs: their influence on implant healing. Implant Dent. 2012; 21: 362-367.

42. Aviv Ouanounou, SiavashHassanpour, Michael Glogauer. The Influence of Systemic Medications on Osseointegration of Dental Implants. J Can Dent Assoc. 2016; 82: g7.

43. Tsapakis EM, Gamie Z, Tran G, Adshead S, Lampard A, Mantalaris A, et al. The adverse skeletal effects of selective serotonin reuptake inhibitors. Eur Psychiatry. 2012; 27: 156-169.

44. Wu X, Al-Abedalla K, Rastikerdar E, Abi Nader S, Daniel NG, Nicolau B, et al. Selective serotonin reuptake inhibitors and the risk of osseointegrated implant failure: a cohort study. J Dent Res. 2014; 93: 1054-1061.

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