

## Review Article

# A Review on Implant Failures

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## ARTICLE INFO



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## ABSTRACT

**STATEMENT OF PROBLEM:**The recent literature underlines high success rates for dental implants but neglects the various complications that do occur with endosseous implants and associated prosthesis.**PURPOSE:**The purpose of this review was to appraise the available literature on the many failures and complications that may occur during implant therapy.

**MATERIAL AND METHODS:**An electronic search restricted to the English language publications beginning in 1969 were performed in Pubmed, Science Direct. Additional publications revealed by reviewing the reference lists of articles identified through PubMed search were also taken into account. The literature search covered the years 1969 to 2015. The focus of the searches were on publications that contained data related to early and late failures, complications and clinical studies associated with dental implants.**RESULTS:**The search produced numerous potentially relevant titles, of which only a few were found eligible. Implant failures can be majorly categorised into 4 categories: biologic, mechanical, positional and esthetic. The most common failures i.e. the one associated with greater than 15% incidence rate are the mechanical failures which majorly includes: screw loosening, screw fracture, abutment fracture. Along with these a few uncommon complications may also occur during implant placement.

**CONCLUSION:**Clinicians should be aware of the various failures and complications associated with dental implants, as they can be prevented by proper patient selection and treatment planning.

## Introduction

The clinical effectiveness of the osseointegration concept introduced by Branemark and colleagues in the 1960s has revolutionized the clinical practice of dentistry.<sup>1, 2</sup> Osseointegrated endosseous dental implants have been deemed an innocuous and predictable form of rehabilitation that are preferred treatment options for replacing missing teeth in both partially and completely edentulous ridges.<sup>3, 4</sup> Dental implants are a viable alternative for many patients in need of a dental prosthesis and are widely accepted in the field of dentistry because they provide the tripartite objective of function, esthetics and comfort.<sup>4</sup> With great advancements in implant

industry, many new dental implant systems have been introduced into the market. The development of bone regeneration and sinus lift procedures and the evolution of implant surface characteristics have made implant therapy one of the most important treatment solutions in contemporary dentistry.<sup>4</sup>

In recent years, there has been a huge increase in scientific knowledge about the biological and biomechanical factors associated with implant success. According to a recent report published by the American Dental Association Council on Scientific Affairs, there has been consistently high rate of endosseous dental implant success or survival in human clinical trials. In 14 trials spanning

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follow-up periods of 2 to 16 years and involving over 10,000 dental implants placed in edentulous, partially edentulous, or single-tooth replacement cases, the overall mean survival rate was 94.4% with a range between 76% and 98.7%.<sup>5</sup>

Still, these figures indicate a small but relevant implant failure rate of less than 10% which proves that state of the art for tooth replacement i.e. osseointegrated dental implants are not without limitations and complications.<sup>5, 6</sup> Implant failures are usually classified either as early, when osseointegration fails to occur, or as late, when the achieved osseointegration is lost after occlusal loading with a prosthetic superstructure.<sup>5, 7</sup> Implant failures can also be classified largely into four main categories: 1) Loss of integration, 2) Positional failures, 3) Soft tissue defects, and 4) Biomechanical failures.<sup>8</sup> Implant failures may also be categorized as biological (eg, due to infection) or mechanical (eg, fracture).<sup>5</sup>

The literature is filled with articles describing potential problems with dental implants awaiting the unsuspecting practitioner and patient.<sup>6</sup> Following is a critical review of the pertinent literature

#### **MATERIAL AND METHODS:**

This is a narrative review of the pertinent literature on failures associated with dental implant therapy based on scientific articles restricted to English language published between 1969 and 2015, indexed in ScienceDirect and PubMed databases. The focus of the searches were on publications that contained data related to early and late failures, complications and clinical studies associated with dental implants.

## **DISCUSSION**

### **BIOLOGIC COMPLICATIONS**

#### **Loss of Osseointegration**

Numerous multi centre studies and several meta-analyses have indicated 93% survival rates of dental implants<sup>9, 10</sup> but the incidence of implant loss due to failure to osseointegrate or to loss of integration after loading has also been well-documented in numerous prospective and retrospective reports. The incidence of implant failure due to loss of integration is usually substantially higher in the edentulous maxilla than in the mandible<sup>6</sup> and in grafted bone than host bone.<sup>11</sup> Johansson and Palmquist<sup>12</sup> reported an incidence of implant failure, 17% in maxilla and 3% in the mandible. This type of failure occurs mostly before loading the implant with the definitive restoration and is usually associated with improper surgical technique or because of poor quality of bone at the implantation site.<sup>6, 8</sup> The major clinical problem in these cases is delay of completion of treatment and patient management. A re-attempt with a larger diameter implant or a bone graft followed by an implant may allow successful osseointegration.<sup>8</sup>

#### **Peri-implant diseases**

The literature provides sufficient evidence indicating that patients who has had a history of periodontal diseases (chronic and aggressive periodontitis) may have an increased susceptibility to peri-implant diseases because of host's immune response.<sup>13-16</sup> Peri-implant diseases are categorized into 2 types: peri-implant mucositis and peri-implantitis. Peri-implant mucositis is characterized by inflammation

of the soft tissues surrounding the implant without any signs of bone loss.<sup>17</sup> The clinical signs include bleeding on probing and/or suppuration, which are usually associated with probing depth of at least 4mm with no evidence of radiographic loss of bone.<sup>18, 19</sup> It is usually reversible, however, it is considered as a precursor to peri-implantitis.<sup>17</sup>

Peri-implantitis was defined during the first European Workshop on Periodontology in 1994 as inflammatory reactions associated with the loss of supporting bone around an implant in function.<sup>20</sup> In recent consensus meetings, peri-implantitis has been described as a peri-implant pathology with multifactorial etiology, including implant related factors (material, surface properties, design), clinician factors (surgical and prosthodontics experience, skill), and patient factors (systemic disease, medication, oral disease, oral hygiene, smoking, bone quality).<sup>21</sup>

In the 5-year follow-up results by Fransson and colleagues<sup>22</sup>, the prevalence of peri-implant diseases was reported to be 92%, whereas in the study by Scheller and colleagues<sup>23</sup>, the prevalence of peri-implant diseases at 5-year follow-up was 24%. Zitzmann and Berglundh<sup>17</sup> reported the prevalence of peri-implantitis to vary between 12% and 43% of implants.

A variety of treatment protocols have been proposed for the management of peri-implantitis: 1) nonsurgical management and 2) surgical management. Nonsurgical treatment involves mechanical removal of plaque and calculus from the implant surface and antibiotic therapy. Surgical management encompass resection and regenerative treatment.<sup>24-27</sup> Recently lasers and photodynamic therapy has also been advocated as treatment modalities.

## MECHANICAL COMPLICATIONS

### Loosening of screw

Screw loosening is an often reported problem with implant supported restorations, especially with single tooth restorations.<sup>28, 29</sup> This may largely be attributed to clinicians not having a good understanding of the mechanics of screw joint and the implant manufacturers not providing components and instrumentation that would allow clinicians to maximise the retentive properties of the screw.<sup>30</sup> Loosening may occur through a number of possible mechanisms like overloading of the screw, tensile forces causing plastic deformation, settling of implant components and through cyclic occlusal loading.<sup>31, 32</sup> Screw loosening causes inconvenience to the patient and practitioner, can become financially burdensome if it occurs frequently and may be a sign of impending failure of other components.<sup>6</sup> One study specifically examined the incidence of loose occlusal screws in a population of patients whose prostheses had been in use for at least 5 years and reported that 40% of slot-headed occlusal screws were loose, whereas 10% of screw with an internal hexagon were loose. The authors recommended routine tightening of occlusal screws every 5 years and perhaps be considered for replacement after a shorter period of time if repeated loosening has been a regular occurrence.<sup>33</sup>

### Component fracture

Breakage or fracture of implant and implant components like abutment screws, occlusal screws and fracture of prosthesis framework, veneers of ceramic or resin, and opposing prosthesis can also occur, often this is due to poor treatment planning and exposing implants to excessive forces. Reduced diameter implants are more likely to fracture as a

result of flexural overload at a much higher rate than implants of a similar material but of greater diameter, due to the physical principle of Moment of Inertia, which dictates that increased resistance to deformation is gained exponentially by increasing the radius of the cylinder into a tube even while maintaining the same cross-sectional area of metal.<sup>6</sup> In the 15-year study of Branemark implants in the treatment of the edentulous jaw, Adell et al.<sup>34</sup> cited an implant fracture frequency of 3.5%. Other studies report implant fracture rates of 0% to 16% over similar time periods.<sup>35-38</sup> The abutment screw is subjected to much greater force, particularly when that force is nonaxial in nature than occlusal screw and is more susceptible to fatigue failure, even though it is more massive structure.<sup>6</sup> Tolman and Laney<sup>38</sup> documented fracture of occlusal or abutment screws on 89 occasions in the mandible of 77 patients, translating it to more than 26% of patients. Fracture of implant components is a significant complication because these emergency procedures rarely occur at a convenient time and they require significant operator time to correct and hence care must be taken when threading screws into implants.

### POSITIONAL COMPLICATIONS

The risk of positional failure is higher when implants are placed 'free hand', without surgical guides.<sup>39, 40</sup> The incidence of this type of failure has been estimated at 10%<sup>9</sup>, however, if more stringent criteria are applied it is likely to be higher. Several guidelines has been suggested for optimizing placement of implants. This type of failure can easily be avoided with proper treatment planning, proper site development, use of surgical guides and

a good understanding of the restorative aspects of implant dentistry by the surgeon. The recent development of virtual restorative planning is promising, because it combines the ideal prosthetic position with the availability of bone. Computer technologies, applied with knowledge, make esthetic complications unlikely and provide optimal function and appearance.<sup>41, 42</sup>

### ESTHETIC COMPLICATIONS

These can be categorized as pink-tissue failures and white-tissue failure.<sup>3</sup> The most frequently reported pink-tissue failures are facial recession, gingival asymmetry, papillary deficiency, and graying of the gingival tissue. Several errors in positioning, timing of placement and design of implant, multiple edentulous space replacement, soft-tissue and hard-tissue management can lead to these failures, but the incidence of these factors can be substantially reduced by proper implant spacing, cautious timing of site preparation, and careful implant placement.<sup>43, 44</sup>

White-tissue failures are related to the general form of the tooth, the outline and volume of the clinical crown, colour (hue and value), surface texture, and translucency and characterization.<sup>3</sup> Butler and Kinzer<sup>45</sup> indicated that the restorative failures are easier to correct than malpositioning problems. Most of these failures depend on technique and are always reversible. Each of the aspects of treatment planning should be considered so that esthetic failures can be avoided and the desired natural-looking outcome can be achieved.<sup>3</sup>

Several uncommon complications that may occur during implant placement are major bleeding, infection, nerve injury, injury to adjacent teeth,

salivary gland injury, mandibular fracture, displacement or infringement of implant, swallowing and aspiration of implants or surgical devices.<sup>46</sup> Prevention of all complications is impossible; however, independent of their type, many failures can be avoided by proper workup and treatment planning.

## CONCLUSION

Rehabilitation using dental implant therapy has become a common practice and is likely to gain in popularity during the next several years. This implies that dental clinicians will have to deal with a lot more implant failure and related complications. While dealing with an implant failure, treatment plan should be made according to each patient taking into account all relevant variables. Patients should be well informed regarding all possible treatment modalities after implant failure and written consent taken for the chosen treatment option.

## References

1. Branemark PI, Adell R, Breine U, et al. Intraosseous anchorage of dental prostheses. I. Experimental studies. *Scand J Plast Reconstr Surg* 1969;3(2): 81–100.
2. Al-Sabbagh M, Bhavsar I. *Dent Clin North Am.* 2015 Jan;59(1):1-23. doi: 10.1016/j.cden.2014.09.001. Epub 2014 Oct 18. Review.
3. Fuentealba R, Jofré J. *Dent Clin North Am.* 2015 Jan;59(1):227-46. doi: 10.1016/j.cden.2014.08.006. Epub 2014 Sep 26. Review.
4. Al-Sabbagh M. *Dent Clin North Am.* 2015 Jan;59(1):xiii-xv. doi: 10.1016/j.cden.2014.09.006. Epub 2014 Oct 5.
5. Paquette DW, Brodala N, Williams RC. *Dent Clin North Am.* 2006 Jul;50(3):361-74, vi.
6. Taylor TD. *J Prosthet Dent.* 1998 Jan;79(1):74-8.
7. Baqain ZH, Moqbel WY, Sawair FA. *Br J Oral Maxillofac Surg.* 2012 Apr;50(3):239-43. doi: 10.1016/j.bjoms.2011.04.074. Epub 2011 May 25.
8. Chee W, Jivraj S. *Br Dent J.* 2007 Feb 10;202(3):123-9.
9. Goodacre C J, Bernal G, Rungcharassaeng K, Kan J Y. Clinical complications with implants and implant prostheses. *J Prosthet Dent* 2003; 90: 121-132.
10. Lindh T, Gunne J, Tillberg A, Molin M. A meta-analysis of implants in partial edentulism. *Clin Oral Implants Res* 1998; 9: 80-90.
11. Becktor J P, Isaksson S, Sennerby L. Survival analysis of endosseous implants in grafted and

- nongrafted edentulous maxillae. *Int J Oral Maxillofac Implants* 2004; 19: 107-115.
12. Johansson G, Palmqvist S. Complications, supplementary treatment, and maintenance in edentulous arches with implant-supported fixed prostheses. *Int J Prosthodont* 1990;3:89-92.
  13. Van der Weijden GA, van Bommel KM, Renvert S. Implant therapy in partially edentulous, periodontally compromised patients: a review. *J Clin Periodontol* 2005;32(5):506–11.
  14. Renvert S, Persson GR. Periodontitis as a potential risk factor for peri-implantitis. *J Clin Periodontol* 2009;36(Suppl 10):9–14.
  15. Schou S, Holmstrup P, Worthington HV, et al. Outcome of implant therapy in patients with previous tooth loss due to periodontitis. *Clin Oral Implants Res* 2006; 17(Suppl 2):104–23.
  16. Roos-Jansaker AM, Renvert H, Lindahl C, et al. Nine- to fourteen-year follow-up of implant treatment. Part III: factors associated with peri-implant lesions. *J Clin Periodontol* 2006;33(4):296–301.
  17. Zitzmann NU, Berglundh T. Definition and prevalence of peri-implant diseases. *J Clin Periodontol* 2008;35:286–91.
  18. Khammissa RA, Feller L, Meyerov R, et al. Peri-implant mucositis and periimplantitis: clinical and histopathological characteristics and treatment. *SADJ* 2012;67:122, 124–126.
  19. Jankovic S, Aleksic Z, Dimitrijevic B, et al. Prevalence of human cytomegalovirus and Epstein-Barr virus in subgingival plaque at peri-implantitis, mucositis and healthy sites. A pilot study. *Int J Oral Maxillofac Surg* 2011;40: 271–6.
  20. Albrektsson T, Isidor F; , Consensus report: implant therapy. *Proceedings of the 1st European Workshop on Periodontology*. Berlin: Quintessence; 1994. p. 365-9.
  21. Albrektsson T, Buser D, Sennerby L. On crestal/marginal bone loss around dental implants. *Int J Prosthodont* 2012;25:320-2.
  22. Fransson C, Wennstrom J, Berglundh T. Clinical characteristics at implants with a history of progressive bone loss. *Clin Oral Implants Res* 2008;19:142–7.
  23. Scheller H, Urgell JP, Kultje C, et al. A 5-year multicenter study on implantsupported single crown restorations. *Int J Oral Maxillofac Implants* 1998;13: 212–8.
  24. Romanos GE, Weitz D. Therapy of peri-implant diseases. Where is the evidence? *J Evid Based Dent Pract* 2012;12:204–8.
  25. Renvert S, Roos-Jansaker AM, Claffey N. Non-surgical treatment of peri-implant mucositis and peri-implantitis: a literature review. *J Clin Periodontol* 2008;35: 305–15.
  26. de Waal YC, Raghoobar GM, Huddleston Slater JJ, et al. Implant decontamination during surgical peri-implantitis treatment: a randomized, double-blind, placebo-controlled trial. *J Clin Periodontol* 2013;40:186–95.
  27. Renvert S, Polyzois I, Claffey N. Surgical therapy for the control of peri-implantitis. *Clin Oral Implants Res* 2012;23(Suppl 6):84–94.
  28. Henry P J, Laney W R, Jemt T et al. Osseointegrated implants for single-tooth replacement: a prospective 5-year multicenter study. *Int J Oral Maxillofac Implants* 1996;11: 450-455.

29. Jivraj S A, Chee W W. Use of a removable partial denture in the management of chronic screw loosening. *J Prosthet Dent* 2005; 93: 13-16.
30. Winkler S, Ring K, Ring J D, Boberick KG. Implant screw mechanics and the settling effect: overview. *J Oral Implantol* 2003; 29: 242-245.
31. Bickford JH. New York: Marcel Dekker; 1981. An introduction to the Design and Behaviour of Bolted Joints; pp. 175–268.
32. Wiskott HW, Nicholls JI, Belser UC. Stress fatigue: Basic principles and prosthodontic implications. *Int J Prosthodont*. 1995;8:105–16.
33. Kallus T, Bessing C. Loose gold screws frequently occur in full-arch prostheses supported by osseointegrated implants after 5 years. *Int J Oral Maxillofac Implants* 1994;9:169-78.
34. Adell R, Lekholm U, Rockler B, Brånemark PI. A 15-year study of osseointegrated implants in the treatment of the edentulous jaw. *Int J Oral Surg* 1981;10:387-416.
35. Albrektsson T, Dahl E, Enborn L, Engevall S, Engquist B, Eriksson AR, et al. Osseointegrated oral implants. A Swedish multicenter study of 8139 consecutively inserted Nobelpharma implants. *J Periodontol* 1988;59:287-96.
36. Naert I, Quirynen M, van Steenberghe D, Darius P. A study of 589 consecutive implants supporting complete fixed prostheses. Part II: prosthetic aspects. *J Prosthet Dent* 1992;68:949-56.
37. Adell R, Eriksson B, Lekholm U, Brånemark PI, Jemt T. A long-term followup study of osseointegrated implants in the treatment of totally edentulous jaws. *Int J Oral Maxillofac Implants* 1990;5:347-59.
38. Tolman DE, Laney WR. Tissue-integrated prosthesis complications. *Int J Oral Maxillofac Implants* 1992;7:477-84.
39. Almog DM, Torrado E, Meitner SW. Fabrication of imaging and surgical guides for dental implants. *J Prosthet Dent* 2001;85(5):504–8.
40. Noharet R, Pettersson A, Bourgeois D. Accuracy of implant placement in the posterior maxilla as related to 2 types of surgical guides: a pilot study in the human cadaver. *J Prosthet Dent* 2014;112(3):526–32.
41. de Almeida EO, Pellizzer EP, Goiatto MC, et al. Computer-guided surgery in implantology: review of basic concepts. *J Craniofac Surg* 2010;21(6):1917–21.
42. Katsoulis J, Pazera P, Mericske-Stern R. Prosthetically driven, computer-guided implant planning for the edentulous maxilla: a model study. *Clin Implant Dent Relat Res* 2009;11(3):238–45.
43. Wheeler SL. Implant complications in the esthetic zone. *J Oral Maxillofac Surg* 2007;65(7 Suppl 1):93–102.
44. Al-Sabbagh M. Implants in the esthetic zone. *Dent Clin North Am* 2006;50(3):391–407, vi.
45. Butler B, Kinzer GA. Managing esthetic implant complications. *Compend Contin Educ Dent* 2012;33(7):514–8, 520–2.
46. Camargo IB, Van Sickels JE. Surgical complications after implant placement. *Dent Clin North Am*. 2015 Jan;59(1):57-72. doi: 10.1016/j.cden.2014.08.003. Epub 2014 Sep 16.