What Do We Do After an Implant Fails? A Review of Treatment Alternatives for Failed Implants

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The problem of failed implants cannot be overlooked. The purpose of this paper is to explore treatment alternatives for failed implants and their strengths and shortcomings. A comprehensive literature search was performed using PubMed and a manual search. Only five studies were identified that explored treatment in sites where implants had failed. In all five studies, the treatment alternative tested was the placement of a new implant in the failed site. The overall survival rate for such implants ranged from 71% to 92.3%. Four other alternatives are also discussed in light of data derived from other studies on the survival of various treatment strategies. These include: a continuation of the original plan using the remaining implants, modification of treatment to a tooth-supported fixed partial denture (FPD) or to a hybrid tooth-implant–supported FPD, or modification to a removable prosthesis. The selection of an appropriate alternative for failed implants is complex and involves biologic, mechanical, and psychologic considerations along with financial aspects. This should be a team decision with the patient's opinion included. (Int J Periodontics Restorative Dent 2013;33:e111–e119. doi: 10.11607/prd.1505)

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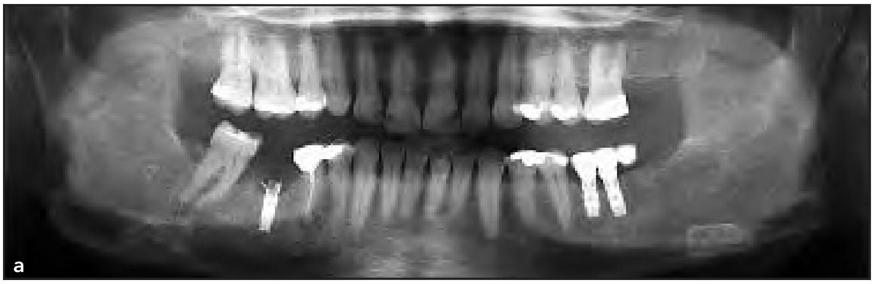
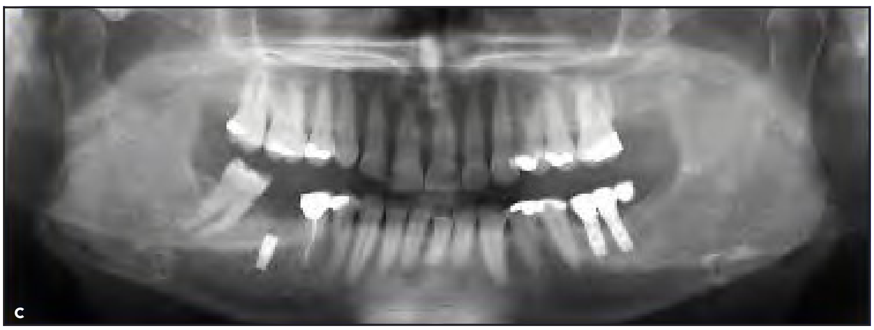
A lost dental implant constitutes an ever-growing problem in clinical practice, one which is likely to intensify in the coming years since the number of implants placed annually is still growing.[1] Unfortunately, the exact magnitude of the problem is not clearly accessible to the scientific community. Data are available, but implant manufacturers are hesitant to share them with the public.

Thus, the extent of this problem can only be estimated. The number of new dental implants placed annually in the United States, Europe, and the Asian-Pacific rim is approximately 10 million.[2] The overall survival rate of dental implants varies significantly.[3,4] Both patient-related factors (such as periodontal condition,[5] diabetes,[6] and smoking habits[7]) and site-related factors (such as bone quality,[8] augmented sites,[9] and implant length[10]) may all affect this rate. A range of 2% to 5% is generally acceptable as the primary failure rate of implants to osseointegrate. These figures may even be higher, as recently suggested by Popelut et al.[11] Thus, 250,000 to 500,000 primary failures may be expected





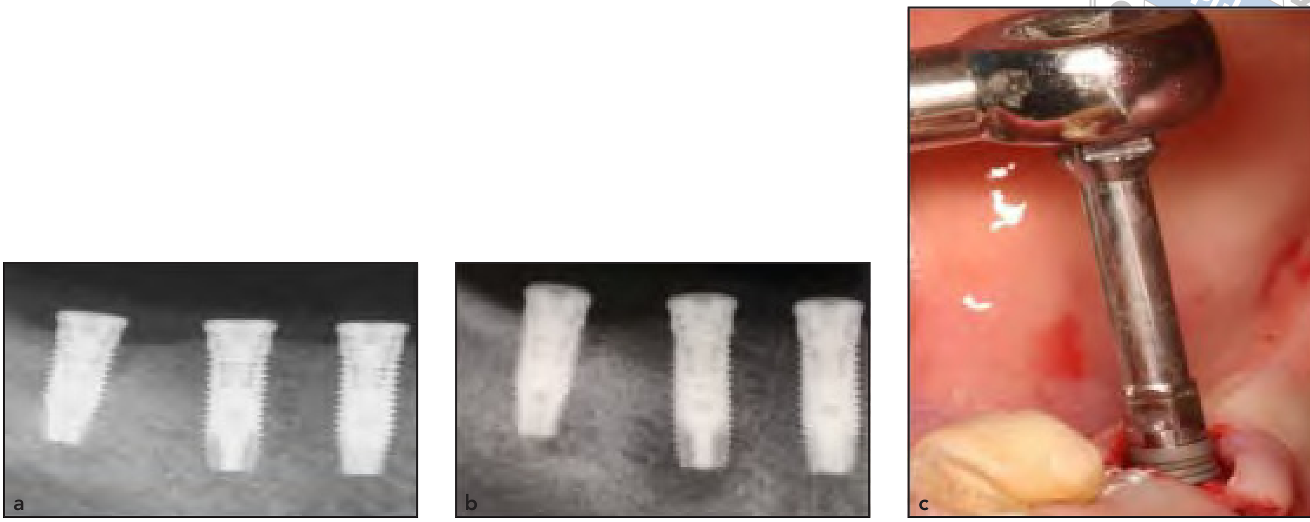
Figs 1a to 1c (a) *Fractured internal hex has caused the failure of the restoration and implant in the mandibular right first molar; a communication to the oral cavity is present. Despite the safe distance from the inferior alveolar canal, the patient refused explantation. Implant was exposed and the remaining part of the hex removed and submerged subcrestally. Bovine-derived xenograft was placed on top of the implant.* (b) *The edentulous ridge healed and the implant is not visible.* (c) *Twelve months later, the implant is completely submerged under 3 mm of bone.*

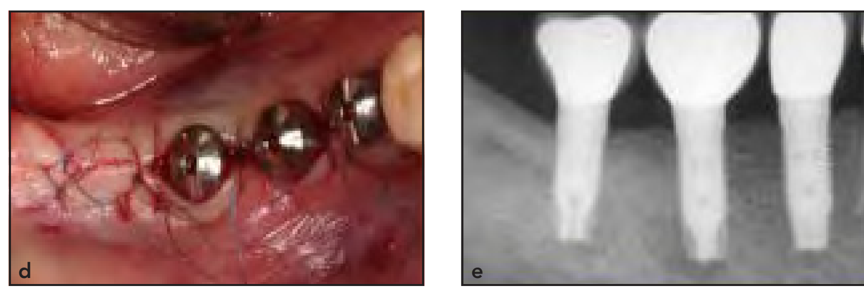
annually. Furthermore, of the over 50 million implants currently in service, an additional 0.5% to 1% (half a million) are likely to develop complications (biologic/mechanical)[11] that will require their removal (secondary failure). Thus, a modest estimation of nearly a million implants that are being removed annually is probably in order. These numbers are likely to grow in the coming years with the further increase in the number of implants that will be inserted annually.[2] In addition, this estimation does not include regions of the world in which data are less accessible (eg, China, India, and South America, with a combined population greater than 3 billion). Thus, a figure of 1 million failed implants annually might be a gross underestimation and shall be used only for safeguarding purposes.

Failed implants (both those that fail to osseointegrate and those with nontreatable peri-implantitis) need to be removed as quickly as possible.[12] Early implant removal is more likely to preserve the alveolar ridge, leaving open all options for future treatment alternatives. Failure to do so will not only result in a severely deficient residual ridge at the failed implant site, but it may also jeopardize neighboring implants/teeth.

In rare cases, the removal of an implant carries with it some potential hazards to neighboring vital structures. This is especially true for mechanical failures such as the fracture of an implant body in the posterior mandible. In such cases, the clinician might opt to perform "burial" of the implant to minimize any potential surgical complications. However, this procedure precludes the possibility of replacing the failed implant with a new one (Fig 1).

The purpose of this paper is to review the available literature pertaining to this problem and explore the potential treatment alternatives





Figs 2a to 2e *One month after implant placement, (a) the patient returned with severe pain. (b) Radiograph showed apical peri-implantitis with radiolucency around the second implant. (c) The area was exposed and the implant removed with a ratchet. (d) A replacement implant was inserted 3 months later. (e) Residual scar tissue is still visible in the apex 36 months postoperation, but no symptoms are present.*

for lost dental implants, along with their strengths and shortcomings.

Treatment alternatives following removal of failed implants

The literature pertaining to treatment alternatives following the loss of dental implants could best be described as negligible. Only papers in which a replacement of a failed implant in the same site were explored. However, the literature pertaining to treatment alternatives to replace missing teeth is vast and comprehensive. Thus, the following discussion will also include other potential treatment alternatives for failed implants using a comparative review of the existing literature to explore the suitability of each of these alternatives.

The treatment alternatives that will be described have their pros and cons. The decision as to which of these alternatives should be selected is complex and involves both biologic and mechanical considerations, as well as psychologic aspects with financial considerations being a silent partner. The treatment of choice should be a team decision with the surgeon, restoring clinician, and patient having an equal say in the final outcome.

Replacement with a new implant

This is the treatment alternative that is most often selected. If performed in a timely manner, the end result might be similar to the original plan with no need to deviate from the original prosthetic scheme (Fig 2).

This alternative has also been studied in several retrospective studies published in the past 6 years, thus highlighting a growing

Table 1 Studies exploring the survival rate of dental implants placed in previously failed sites

Authors (year)	Study design	Success criteria	No. patients	No. implants	Follow-up mean ± SD (range)	Outcome measured	Survival rate (%)
Kim et al[13] (2010)	Retrospective	Implant not removed	49	60	22.0 ± 14.6 mo (NA)	Implant survival	88.3
Machtei et al[14] (2008)	Retrospective	Implant not removed	56	79	29.9 ± 17.8 mo (7–78 mo)	Implant survival	83.5
Grossmann and Levin[15] (2007)	Retrospective	Implant not removed	28	31	19.4 ± 11.4 mo (6–46 mo)	Implant survival	71.0
Alsaadi et al[16] (2006)	Retrospective	Implant not removed	41	58	NA (9–49 mo)	Implant survival	79.3
Mardinger et al[17] (2012)	Retrospective	Implant not removed	144	144	48 ± 1.3 mo (12–180 mo)	Implant survival	92.3

SD = standard deviation; NA = not available.

interest in this field. In these papers, the overall mean observation period ranged from 19.4 ± 11.4 months to 48 ± 1.3 months and the survival rate ranged from 71% to 92.3% (Table 1).[13–17]

The frequency of other confounding factors such as implant diameter and length, medications, and history of site development, along with environmental factors, were not unanimously reported in these studies. Thus, a further analysis of potential risk factors that might be associated with this phenomenon could not be completed. Furthermore, one of these papers (Kim et al[13]) used smoking and confounding systemic disease as exclusion criteria. Therefore, it might very well be that the higher survival rate reported in this study is associated with these stringent inclusion criteria.

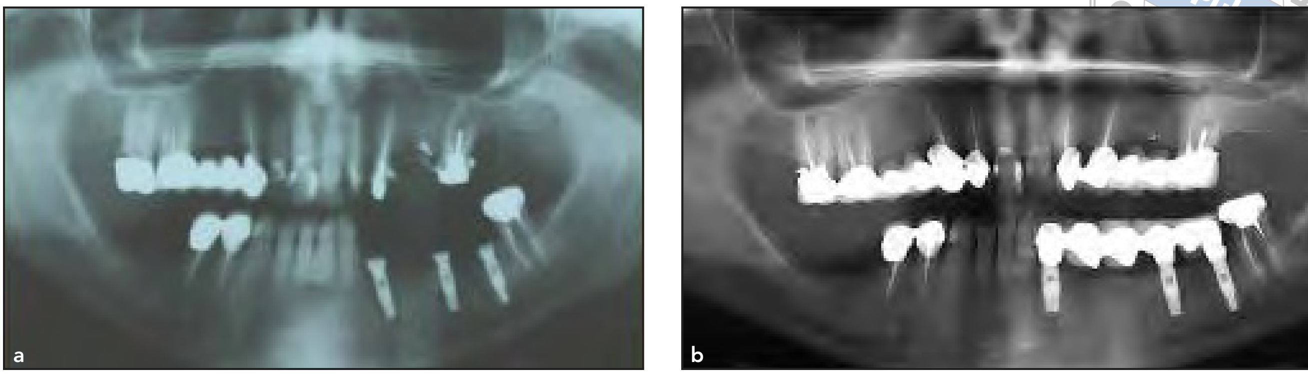
Notwithstanding its many virtues, this alternative carries with it some disadvantages. The lower survival rates found in these studies tend to suggest a major role for site specificity. The matter of site specificity was further substantiated by Kolonidis et al.[18] These authors demonstrated ossointegration of a previously contaminated implant surface that was rinsed with water before being replanted in a more submerged position at the same site. Likewise, a recently published paper in a canine model showed osseointegration of untreated contaminated implants in pristine sites and osseointegration of new implants in sites of previous peri-implantitis.[19]

Another slightly different alternative is to place a new implant at a neighboring pristine site, thus improving the survival rate of the new implant. This alternative is most suitable when the failed implant site has undergone severe bone loss that requires significant site development before it is ready for a new implant (Fig 3).

Finally, if a second failure does occur, a third attempt might be considered but only in specific cases where other alternatives have been excluded. A recent publication of a small series of such second replacement implants support this concept. However, the 1-year survival of such implants was only 60%.[20]

Rehabilitation with remaining implants

The practice of replacing teeth with implants has evolved in the past three decades. The dogma of one



Figs 3a and 3b (a) *An implant placed in the mandibular left canine area failed. The residual ridge in the area is knife edged. A decision was made to remove the mandibular left lateral incisor that had great mobility and replace it with an implant.* (b) *Panoramic radiographs 5 years later show good bone support and a functional restoration.*

implant per missing tooth can no longer be automatically supported. Eliasson et al,[21] in an 18-year retrospective study of 123 implant patients, showed survival rates for two- and three-implant supported prostheses of 96.8% and 97.6%, respectively. Furthermore, the mean bone loss at 5 years was 0.3 mm for both groups. No significant differences in bone loss ($P > .05$), implant failure rate ($P > .05$), or incidence of mechanical complications ($P > .05$) were found. More recently, Salvi and Brägger[22] in a systematic review concluded that the number of implants supporting a fixed partial denture (FPD) was not associated with the prevalence of mechanical or technical complications nor with implant survival or success rates.

Consequently, a loss of a single implant, when multiple implants were performed, may not require a replacement of the lost implant; instead, the FPD may be performed with the remaining implants (when the FPD was not yet prepared) or a new FPD may be fabricated (in previously restored sites) with the same life expectancy. However, the question of cantilever FPDs is yet to be sorted out. Zurdo et al[23] concluded that this type of implant-supported restoration carries with it greater risk for mechanical complications. Earlier, Pjetursson et al[24] in a systematic review and meta-analysis of cantilever FPDs reported an overall survival rate of 81.8% after 10 years and only a 63% success rate (defined as free from complications). To the contrary, Stafford,[25] in a recently published meta-analysis on the survival rate of short-span implant-supported cantilever FPDs, reported the cumulative survival rate of the abutment implants to be 94.3% after 5 years and 88.9% after 10 years. These survival rates are similar to those reported for crown-supported single implants[26] and even better than those reported for teeth-supported cantilever restorations.[27]

Modification of the treatment plan to a tooth-supported FPD

Although dental implants are rapidly becoming the treatment of choice to replace missing teeth,[28] other, no less successful alternatives are present. Of these, the option of replacing a lost single tooth and/or implant with a three-unit tooth-supported FPD is probably the most studied alternative. Pjetursson et al[29] in a literature review and meta-analysis reported a

5-year survival rate of tooth-supported FPDs of 93.8% compared to 95.2% ($P > .05$) for an implant-supported FPD. The 10-year survival rates were 89.2% and 86.7% for teeth- and implant-supported prostheses ($P >. 05$), respectively. Tan et al[30] in a systematic review of tooth-supported FPDs reported the 10-year probability of survival to be 89.1%, with 71.1% for the 10-year probability of success. Likewise, Sharma[31] in similar analysis reported an estimated 10-year survival rate of 92% and an 81.1% estimated 10-year success rate. While these 10-year figures are extrapolation made from 5-year studies, a more recent publication by Napankangas and Raustia[32] reported on an 18-year retrospective follow-up of teeth-borne metal-ceramic FPDs made by dental students. The overall survival and success rates were 78% and 71%, respectively.

Thus, this battle-tested tooth-supported FPD should be given serious consideration when a failed implant occurs between existing natural teeth.

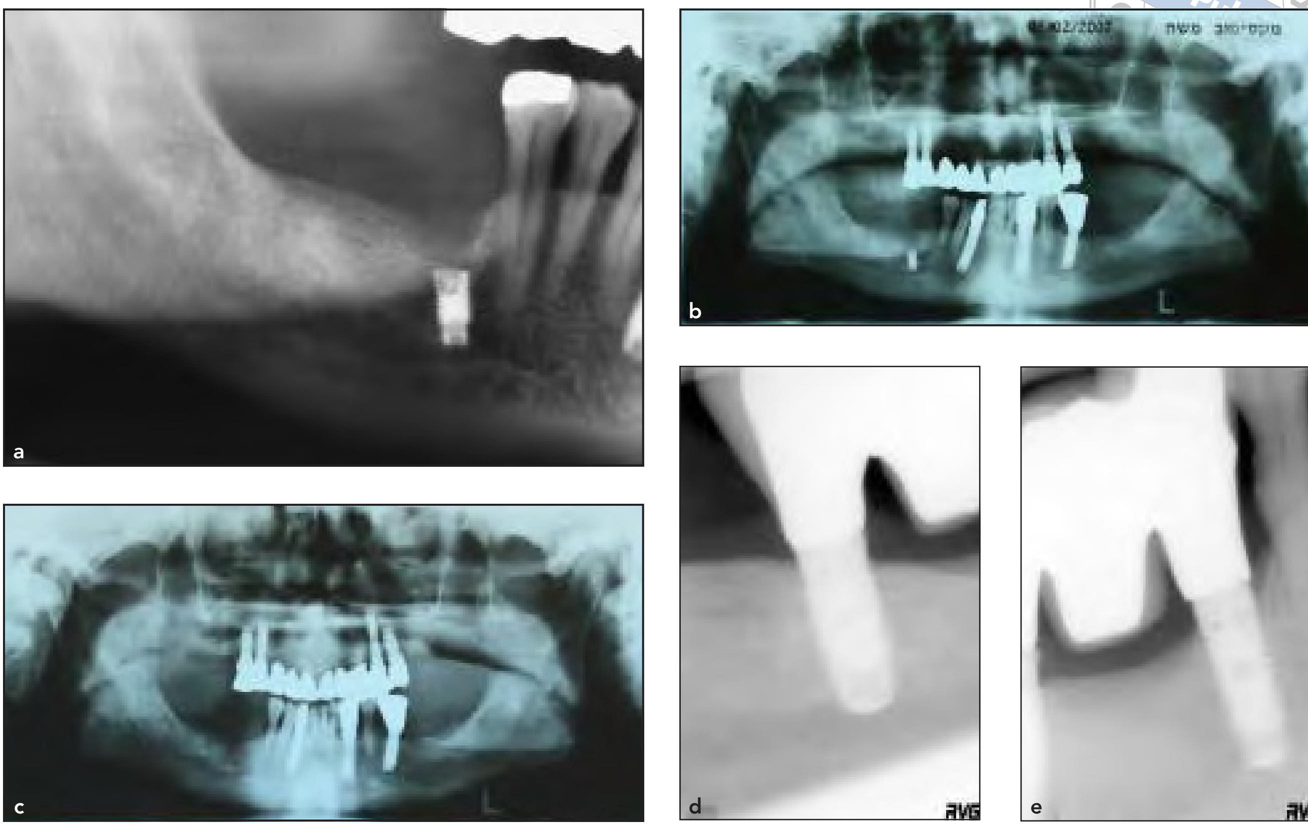
Modification of the treatment plan to an implant-tooth–supported FPD

The difference in the elastic modulus and lining tissues between teeth and dental implants had people believing that the two may not be connected via a fixed restoration. The evidence, however, seems to contradict this notion. In a systematic review, Weber and Sukotjo[33] showed that after an observation period of 6 years or longer, implant survival and prosthetic success were no different between implant-supported and tooth-implant–supported prostheses. Likewise, Lang et al[34] in their systematic review on the survival and complications of combined tooth-implant–supported FPDs reported a 90.1% implant survival rate after 5 years and 82.1% after 10 years. The corresponding figures for the FPD survival were 94.1% and 77.8% after 5 and 10 years, respectively. These results are very similar (both for survival and success) to what was reported for teeth-borne and implant-borne fixed prostheses. Thus, such rehabilitation may be considered in cases where a potential abutment tooth is present across an edentulous site where one of the implants has failed. However, when such hybrid prosthesis surgery is performed, special care should be given to the nature of the tooth-implant connection. Nickenig et al[35] in a 5-year follow-up of 84 hybrid restorations showed a low rate of complications in these prostheses with rigid connections (5.3%), while restorations with nonrigid connections exhibited a significantly greater rate of complications (28.5%). Another risk associated with nonrigid connections is an increased risk for intrusion of the abutment teeth.[36] Thus, if such a treatment alternative is considered, a rigid connection should always be used to avoid the above complications.

Modification of the treatment plan to a removable prosthesis

In those cases with severe alveolar atrophy, where a few implants have failed and most of the natural teeth are missing, a removable prosthesis may be the best treatment alternative.

Wöstmann et al[37] in a long-term analysis of telescopic crown-retained removable partial dentures (RPDs) in 554 patients presented a 5-year probability survival rate of 95.3% for the abutment teeth and 95.1% for the RPDs. Koller et al[38] in a systematic literature review of teeth- and implant-supported RPDs reported that the overall survival rates of these restorations were 90% to 95% for teeth-retained and 97% to 100% for implant-retained RPDs. For hybrid teeth, the implant-supported RPDs had a 100% survival rate after a mean observation period of 3.2 years. Ueda et al[3] followed 147 successive implant-supported RPD patients for 10 to 24 years (mean 16.5 ± 3.9 years). Of the 101 patients available for follow-up, only 13 implants failed, with the majority (11/13) lost 10 to 24 years postoperation. Mean crestal bone loss during this time was only 0.54 ± 0.7 mm. Finally, Bryant et al[39] in a systematic review showed that in a totally edentulous ridge, the type of implant-supported reconstruction (fixed or removable, splinted or nonsplinted) had no effect on implant survival or success. Consequently, an alteration of the treatment plan, from an FPD to an implant and/or tooth-supported



Figs 4a to 4e *The changing paradigm across the years.* (a) *Patient presented in 1996 with a fracture in the body of an implant placed 8 years earlier. A decision was made to not remove the implant due to its proximity to the mental nerve and inferior alveolar canal.* (b) *In 2006, the patient lost the mandibular right second premolar. Note the proximity of the broken implant to the root of the first premolar. At this time,* (c) *Cone beam computed tomography was performed and the implant removed. In 2007,* (d and e) *new implants were placed and a three-unit implant-supported FPD was constructed with no further complications reported.*

restoration should be considered and discussed with the patient. This is especially true when a cluster failure has occurred and FPD construction is not possible.

Conclusion

Failed dental implants present an especially challenging treatment dilemma to the implant dentistry team. All treatment alternatives presented in this paper have both advantages and disadvantages and therefore should be considered for each patient individually.

Objective factors (ie, complexity of treatment alternatives, site-related parameters, occlusal scheme, systemic conditions, medications, smoking status, and oral parafunctional habits) should be considered before selecting the appropriate treatment plan.

Finally, subjective issues such as the patient's desire, referring dentist's preference, time constraints, and financial considerations will all affect the final decision.

It also needs to be pointed out that in the course of time, new treatment modalities, imaging techniques, surgical skills, and even acceptable social standards are likely to modify or change completely the treatment of choice (Fig 4).

The decision-making tree that is included here (Fig 5) is aimed at assisting and simplifying the process of selecting the appropriate alternative once a failure has occurred. It does allow for a difference of opinion and decision making based on the individual clinician's experience and patient's preference.

Failure of dental implants should be perceived as part of the overall risk and consequences of modern dentistry. Clinicians

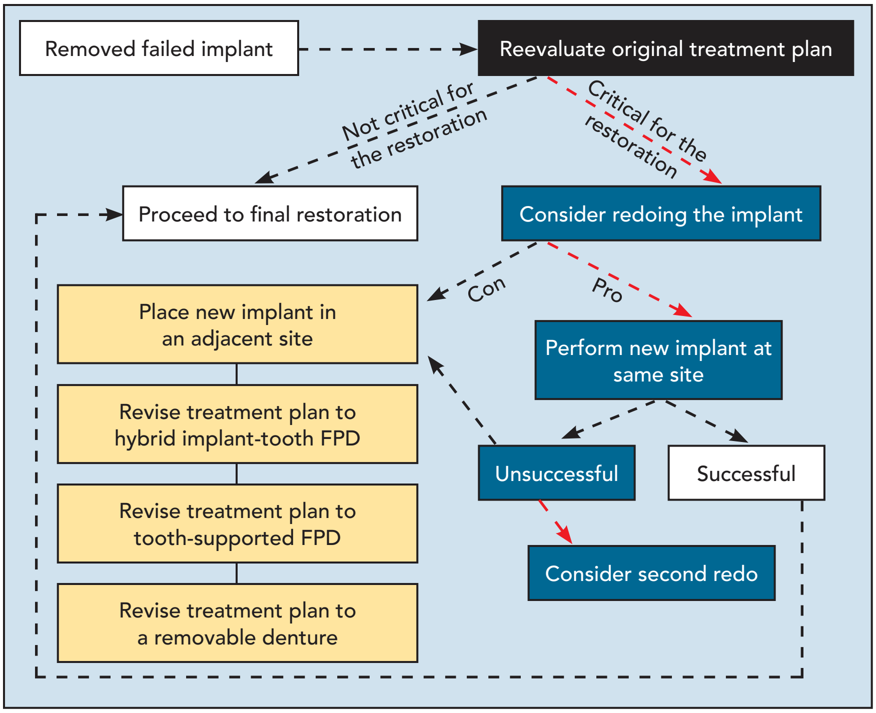


Fig 5 *Decision-making tree to determine treatment following the loss of a single or multiple implants. Decisions should be jointly made by the dental team and the patient with multiple variables being considered.*

should all be prepared to negotiate such unfortunate occurrences with removal of the failed implant followed by one of the aforementioned treatment alternatives.

Finally, the need for direct comparative studies of the various alternatives following implant failure is imperative and pressing. Thus, funding agencies, dental societies, and the industry should consider supporting such future studies.

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