Review Article

Clinical guideline and treatment planning decisions of single-tooth implants versus preserving natural teeth with nonsurgical endodontic therapy

Sourav Bhattacharyya[1], D. P. Das[2], Anirban Bhattacharyya[3], Asim Bikash Maity[3], Debanjan Das[1]

[1]Lecturer, [2]Professor & HOD, [3]Professor, Department of Conservative Dentistry and Endodontics, Haldia Institute of Dental Science and Research, West Bengal, India

Abstract

The outcomes of both dental implants and endodontically treated teeth have been extensively studied. An assessment of whether to rehabilitate a tooth requiring endodontic treatment or to replace it with a dental implant can often involve a challenging and complex decision making process for clinicians now a days. This review describes practical criteria and a systematic process to aid the treatment planning decision of whether to preserve teeth by root canal treatment (RCT) or extract and provide an implant. This article reviews the benefits and disadvantages of both treatment options and discusses success vs. survival outcomes.

Keywords: Decision making, dental implants, endodontic therapy, oral health, outcome, treatment planning, systematic review

Introduction

Helping people to keep their dentition is the ultimate goal of dentistry. Nowadays challenging dilemmas faced by clinicians—and one that has been hotly debated—is when teeth should be extracted and implants used instead. A tendency exists toward a simplified approach of 'extraction and implant', but this is not always simple or ethical.[1]

If a tooth is severely broken down or disease has recurred after endodontic treatment, the treatment plan is more complex and removal of the tooth becomes one of the treatment choices. If the tooth is removed it should be replaced with some type of prosthesis.[2]

Address for correspondence: Dr. Sourav Bhattacharyya, B-5/56 Kalyani, Nadia - 741235, West Bengal, India.
E-mail: dentex83@gmail.com

Received: 20-01-2020 **Revised:** 13-03-2020
Accepted: 15-04-2020 **Published:** 30-06-2020

Access this article online

Quick Response Code:

Website: www.jfmpc.com

DOI: 10.4103/jfmpc.jfmpc_128_20

During the past 40 years, dental implants have evolved to where they are now considered to be a reliable treatment for missing teeth. Dental implant therapy, as inspired by the work of Brånemark *et al.*[3] is, however, rapidly changing fields in dentistry. The applications of dental implant therapy have been broadened dramatically, including single-tooth replacements.

Limitations of endodontic therapy

The goal of clinical endodontics—and the mark of its success—is the prevention and elimination of apical periodontitis.[4] While the quality of care provided by specialist endodontists is very high, still some challenges are there.

- **Causes of failure of endodontic therapy**[5]

Indeed, the degree of success of endodontic therapy has improved significantly since the use of the microscope has

How to cite this article: Bhattacharyya S, Das DP, Bhattacharyya A, Maity AB, Das D. Clinical guideline and treatment planning decisions of single-tooth implants versus preserving natural teeth with nonsurgical endodontic therapy. J Family Med Prim Care 2020;9:2654-8.

Pre operative Cause	Operative cause	Postoperative cause
Incorrect diagnosis	Anatomical variations	Failure following retreatment
Endoperiodontal lesions	Technical difficulties	Failure following surgical retreatment
Altered canal space	Infections	
Traumatic injuries	Poor debridement	
Internal resorption	Broken instruments	
Systemic diseases	Mid-treatment flare-up	
	Mechanical and chemical irritants	
	Access preparation	
	Excessive hemorrhage	
	Under extended filling	
	Overextended filling	
	Sliver points corrosion	
	Improper obturation	
	Improper placement of posts	
	Corrosion of posts	
	Iatrogenic causes (perforation)	

become commonplace.[6] Certain systemic diseases such as uncontrolled diabetes and hypertension may negatively modulate periapical healing.

Endodontic microsurgery—Ultimate endodontic procedure to save teeth

A weighted pooled success rate of 77.2% has been reported with data from 1961 to 2005 (Ng *et al.*,).[7] Re-treatment of failed endodontic cases with apical periodontitis and altered canal morphology such as transportation demonstrated only 40% success (Gorni and Gagliani, 2004). For these situations, or when disassembly of the existing restoration could lead to non-restorability, surgical re-treatment may be advised as a less invasive option, although non-surgical re-treatment is generally preferred (Karabucak and Setzer, 2007).[7]

A systematic review of surgical endodontic outcomes found success rates from 37% to 91%; however, these included historical data with traditional techniques as well as modern studies (Friedman, 2005). Traditional root-end surgery, apicoectomy, essentially used a bur attached to a straight handpiece, a beveled resection, root-end preparation at an inadequate angle, and a retrograde amalgam filling. The success rate of traditional apicoectomy was reported to be 59.0% (Setzer *et al.*).[8]

Modern microsurgical techniques include ultrasonic instruments for root-end preparation along the long axis of the root and an operating microscope to identify the complexity of the canal anatomy on the resected root surface at high magnification (12–24×). Biocompatible root-end filling materials such as mineral trioxide aggregates (MTA) have demonstrated favorable healing (Baek *et al.*, 2005). Two meta-analyses[8] that focused on contemporary microsurgical techniques on teeth with only endodontic pathology but good periodontal supports, using ultrasonic root-end preparation, and modern root-end filling materials, found cumulative success rates of 91.4% to 93.5% after at least 1-year of follow-up.[8]

Success and survival of dental implants

In contrast to root canal therapy (RCT), implants are placed into relatively healthy surroundings. Complications and failures, however, occur either before implant osseointegration (early implant loss) or after initial successful osseointegration (late implant loss) and disease manifestation may require several years of function.[9]

Patient factors in dental implantology

- **Age and gender**—The impact of age and gender on implant failure is unclear. Some authors believe that there is an increased risk of failure for patients over[9] Others suggest that age has a minor effect.
- **Bone quality—**Bone quality and quantity are essential considerations in implant success. Bone quality has been classified into four types.[8]
  - Type I bone is comprised homogeneous, compact bone throughout the entire jaw,(best)
  - Type II bone has a core of dense trabecular bone surrounded by a thick layer of compact bone,
  - Type III bone has only a thin layer of cortical bone surrounding a core of dense trabecular bone,
  - Type IV bone has a core of low-density trabecular bone of poor strength encased in thin cortical bone.

Systemic diseases

Patients with systemic diseases (most commonly uncontrolled diabetes) may experience an increased incidence of implant failure. Uncontrolled diabetes mellitus can impair circulation and further reduce the chemotactic and phagocytic functions of neutrophils. As a result, circulation at the site of an implant may be compromised and the susceptibility to infection may increase.[10]

Infection

The presence of infection may have a role in implant failure. Typically, implant failures have been observed when pathology is at (or within close proximity to) the implant site (e.g. placement in an infected tooth socket), adjacent to an undiagnosed endodontically involved tooth, adjacent to an existing lesion (such as a cyst), or when periodontitis is present.[11]

Oral lesions

Cysts are a contraindication for implant placement and one that can easily be avoided by radiological examination.

Mucosal lesions (severe erosive lichen planus) may lead to dental implant complications.[12]

Obviously, patients with autoimmune diseases (AIDS, HIV, lupus, Crohn's disease, and pemphigus) and those receiving immunosuppressive drugs may have a poor implant prognosis.

Untreated dental disease/oral hygiene

Untreated dental disease nurtures the proliferation of oral bacteria; along with inadequate dental care and oral hygiene (plaque, calculus), it promotes the risk for bacterial contamination of the implant site.[13]

Oral habits

According to the literature, the most common patient habits that adversely affect dental implants are bruxing and smoking, although parafunctional activities (such as chewing ice and nibbling on hard objects) may cause premature implant failure.[14]

- **Clinician-dependent factors of implant success/failure**[15]

Case selection
Site selection
Implant design
Implant number/spacing
Surgical technique
One- or two-stage policy
Premature loading
Design of the prosthesis
Commitment to recall protocol

- **Predictors of implant success or failure.**[16]

Positive Factor	Negative Factors
Bone type (types 1 and 2)	Bone type (types 3 and 4)
High bone volume	Low bone volume/osteonecrosis
Patient is less than 60 years old	Patient is more than 60 years old
Clinician experience (more than 50 cases)	Limited clinician experience
Single implant mandibular placement	Systemic diseases (HIV, lupus, diabetes)
Implant length >8 mm	Short implant <7 mm
Axial loading of implant	Eccentric loading
Good oral hygiene	Chronic periodontitis, smoking

- **Limitations of single tooth implant therapy**

The limits of implant therapy can broadly be summarized into two categories: biologic limitations, and technical limitations.[17]

Biological limitations	Technical limitations
Early biological limitation	Implant fracture
Systemic condition	Crown fracture
Age	Loose screws
Disease (diabetes, osteoporosis)	
Bone density	
Bisphosphonate therapy	
Late biological limitation	
Peri implantitis	
Vertical bone loss	
Soft-tissue complications	
Surgical site	
Environmental conditions	
Smoking	
Braxiusm	

Practitioner-specific treatment planning and perception

It has been argued that even restorable teeth with apical Periodontitis (Greenstein *et al.*,[18] or needing non-surgical retreatment (Dechouniotis *et al.*[18] should be extracted in favor of implants. This may lead to a tendency to pursue the one well-known treatment concept (Avila *et al.*).[18] More than 300 dentists who graduated over the past 30 years were surveyed to evaluate the perceived success rates of endodontic treatment and implant therapy (Stockhausen *et al.*[18] of these, 49% were not aware that different criteria existed for implants and endodontic therapy. A further 30% believed that RCT of teeth with necrotic pulps had a higher success rate than with implants; however, overall, they perceived a superior outcome with implants.[18]

Current status of decision-making

Viable treatment options for severely compromised teeth include, but are not limited to, RCT and restoration, extraction and replacement with an implant-supported single crown (ISC), extraction with replacement by a fixed partial denture (FPD), or extraction with no replacement (Ext).[2] If left only up to clinician preference, the prescribed treatment may not be the best treatment. It stands to reason that some teeth that are extracted could have been successfully treated with endodontic therapy, and some teeth that receive endodontic therapy probably should have been extracted.[2]

According to the ADA, the clinician must rely not only on personal preference and past clinical experience but also on the best available scientific evidence.[18] As there are many scientific articles published annually decision-making can be facilitated if the information can be ranked according to quality; this is achieved 12 through evidence-based medicine. The Centre for Evidence-Based Medicine (based in the United Kingdom) defines evidence-based medicine as "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients".[19]

- **Frequently asked questions**
- **Is Implant Therapy More Expensive than Endodontic Treatment?**

An economic analysis of treatment alternatives should include actual costs, insurance availability, and any treatment-related post-procedural costs required to maintain the treatment. Hess *et al.*[20] stated that treatment selection should be based on a balance of cost-benefit and low risk, and implants should be used only when they provide results as good as those offered by conventional restorations. Moiseiwitsch and Caplan[21] recently evaluated the cost-benefit analysis of endodontics versus single-tooth implants. The results indicated that the restored implant was-70–400% more expensive than the restored endodontically treated tooth.

- **Can Case Selection Improve the Outcome of the Restored Endodontically Treated Tooth?**

Palmer *et al.*[22] required all their patients to be in good health and have a single missing tooth in the anterior maxilla. A clinical examination was carried out to determine the suitability of the patients for implants, particularly with regard to ridge height and width, occlusal relationship, and esthetic demands. No implant losses were observed in 14 of 15 patients available at 5-year recall. The patient selection remains a difficult and controversial area when comparing implant and endodontic studies

- **Are Patients More Satisfied with Implant Therapy than RCT?**

One of the major issues in dental care delivery is patient satisfaction.

However, comparatively few trials have reported on this important aspect of treatment as related to single-tooth implants and restored root canal-treated teeth. In a recent paper Sonoyama *et al.*[23] have pointed out that among the few studies undertaken, implant dentistry has more clearly been shown to increase the quality of life measures for patients when used as anchorage for removable prostheses than when used to restore a bounded edentulous space, such as a single-tooth replacement.[24]

- **Are Implants Associated with More Complications?**

The prevalence, risk factors, and significance of adverse effects are important considerations in treatment planning. A number of single-tooth implants studies have reported an increased incidence of prosthetic complications.[25] Furthermore, most untoward events in root canal-treated teeth occurred during the first 3 years of all treated teeth. Collectively, these data indicate that root canal-treated teeth are not only associated with less post-procedural interventions than implants, but the restorations placed on these teeth are also associated with fewer complications when compared with single-tooth implants

- **What Are the Factors Required for Providing Patient Informed Consent in Selecting RCT or Extraction with Placement of a Dental Implant?**

According to American Dental Association guidelines, quality dental care requires treatment planning decisions wherein both the dentist and the patient participate, and that the patient's decision is based on their general health status and specific oral health needs where the selected treatment is safe, predictable, cost-effective, respectful of patient preferences, aimed at preserving normal anatomy and function, and based on the best available scientific evidence. Importantly, informed consent requires that patients receive appropriate and accurate information about all treatment options. Further information on this issue is provided in a recent position statement by the American Association of Endodontists on treatment planning considerations for placing implants versus saving natural teeth via restored endodontic therapy.[26]

RCT and implant achieved an equivalent proportion of cases having a good prognosis. However, implant restoration was associated with more postoperative complications. Both treatments achieved a predictable improvement in patients. Based on these findings, as long as teeth can be treated successfully with RCT and subsequent crowns, there might be no sound clinical justification to replace them with artificial ones.[27]

- **Systematic reviews as a tool for prognosis**

Literature reviews have the *potential* to sit at the peak of the hierarchy and offer the best evidence because they assemble multiple trials for analysis. This allows the researcher or clinician can glean information from a broader pool of knowledge.[28]

In most countries with primary care, service provides a considerable component of the work to improve oral health. After getting ethical clearance from the ethical committee of our institution, this article was written to provide a systemic review of decision making on treatment planning.

Summery

- What treatment to recommend to which patient remains a decision that must be made on a case-by-case, tooth-by-tooth, and patient-by-patient basis.
- There is a dire need for the endodontic and implant communities to identify and conform to a set of robust and thoughtful criteria for success and survival.
- Studies drawing direct comparisons are lacking, success and survival are defined in many different ways, subjects lost to follow-up are not uniformly accounted for, and treatment complications are largely unaddressed
- There is a further need for good quality, long-term outcomes study for both implants and endodontics that adhere to the CONSORT guidelines

Conclusions

The overall goal of this review was to provide critical analysis of cont literature on tooth implants and RCT in the context of identifying important factors in making treatment planning decisions.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

References

1. Chatzopoulos GS, Koidou VP, Lunos S, Wolff LF. Implant and root canal treatment: Survival rates and factors associated with treatment outcome. J Dent 2018.02.005.
2. Torabinejad, M., Anderson P, Bader J, Brown LJ, Chen LH, Goodacre CJ, *et al.* Outcomes of root canal treatment and restoration, implant-supported single crowns, fixed partial dentures, and extraction without replacement: A systematic review. J Prosthet Dent 2007;98:285-311.
3. Brånemark PI, Adell R, Breine U, Hansson BO, Lindström J, Ohlsson A. Intraosseous anchorage of dental prosthesis: I—experimental studies. Scand J Plast Reconstr Surg 1969;3:81-100.
4. Das UK, Bhattacharyya S, Mazumdar P. Maxillary central incisor with two root canals: A rare case report. Int J Adv Res 2014;2:164-87.
5. Friedman S. Considerations and concepts of case selection in the management of post-treatment endodontic disease (treatment failure). Endod Top 2002;1:54-78.
6. Chalfin, H, Kellert M, Solomon C. Treatment planning considerations for the endodontically compromised tooth. N Y State Dent J 2004;70:30-4.
7. Song M, Shin S-J, Kim E, Outcomes of endodontic microresurgery: A prospective clinical study. J Endod 2011;37:316-20.
8. Popelut A, Valet F, Fromentin O, Thomas A, Bouchard P. Relationship between sponsorship and failure rate of dental implants: A systematicapproach. PLoS One 2010;5:e10274.
9. De Backer H, Van Maele G, De Moor N, Van den Berghe L. Longtermresults of short-span versus long-span fixed dental prostheses: An up to 20-year retrospective study. Int J Prosthodont 2008;21:75-85.
10. Fabricius L, Dahlén G, Sundqvist G, Happonen RP, Möller AJ. Influence of residual bacteria on periapical tissue healing after chemomechanical treatment and root filling of experimentally infected monkey teeth. Eur J Oral Sci 2006;114:278-85.
11. van Steenberghe D, Jacobs R, Desnyder M, Maffei G, Quirynen M. The relative impact of local and endogenous patient-related factors on implant failure up to the abutment stage. Clin Oral Implants Res 2002;13:617-22.
12. Lekholm U, Zarb GA. Patient selection and preparation. In: Branemark PI, Zarb GA, Albrektsson T, editors. Tissue-integrated Prostheses: Osseointegration in Clinical Dentistry. Chicago: Quintessence Publishing; 1985. p. 199-209.
13. Schnitman PA, Shulman LB. Dental implants: Benefits and risk. A National Institutes of Health/Harvard consensus development conference, Publication 81-1531. Washington, DC: U.S. Department of Health and Human Services; 1980.
14. Oh TJ, Yoon J, Wang HL. Management of the implant periapical lesion: A case report. Implant Dent 2003;12:41-6.
15. Sennerby L, Roos J. Surgical determinants of clinical success of osseointegrated oral implants: A review of the literature. Int J Prosthodont 1998;11:408-20.
16. el Askary AS, Meffert RM, Griffin T. Why do dental implants fail? Part I. Implant Dent 1999;8:173-85.
17. Duyck J, Naert I. Failure of oral implants: Aetiology, symptoms and influencing factors. Clin Oral Invest 1998;2:102-14.
18. Setzer FC, Kim S. Comparison of long time survival of implant and endodonticaly treated tooth. J Dent Res 2014;93:19-26.
19. Berglundh T, Persson L, Klinge B. A systematic review of the incidence of biological and technical complications in implant dentistry reported in prospective longitudinal studies of at least 5 years. J Clin Periodontol 2002;29(Suppl 3):197-212.
20. Kan JY, Rungcharassaeng K, Kim J, Lozada JL, Goodacre CJ. Factors affecting the survival of implants placed in grafted maxillary sinuses: A clinical report. J Prosthet Dent 2002;87:485-9.
21. ADA. About EBD. 2011 [cited 2011 4/19/11]. Available from: http://ebd.ada.org/about.aspx.
22. Hess D, Buser D, Dietschi D, Grossen G, Schonenberger A, Belzer UC. Esthetic single-tooth replacement with implants: A team approach. Quintessence Int 1998;29:77-86.
23. Moiseiwitsch JRD, Caplan D. A cost-benefit comparison between single tooth implant and endodontics. J Endod 2001;27:235.
24. Grytten J. Models for financing dental services: A review. Community Dent Health 2005;22:75-85.
25. Becker W, Dahlin C, Becker BE, Lekholm U, van Steenberghe D, Higuchi K, *et al.* The use of e-PTFE barrier membranes for bone promotion around titanium implants placed into extraction sockets: A prospective multicenter study. Int J Oral Maxillofac Implants 1994;9:31-40.
26. ADA position statements. Available from: www.ada.org/prof/resources/positions/statements. [Last accessed 2000 Feb 22].
27. Hamasha AA-H, Nbhan AF. Root canal treatment with postcore restoration versus implant restoration: Clinical and radiographic outcome and quality of life after treatment. Saudi Endod J 2019;988-95.
28. Worthington HV, Glenny AM, Mauleffinch LF, Daly F, Clarkson J. Using Cochrane reviews for oral diseases. Oral Dis 2010;16:592-6.