Journal of Health, Medicine and Nursing
ISSN 2422-8419 An International Peer-reviewed Journal
Vol.52, 2018

A Contemporary Study of Endodontic Therapy Versus Dental Implants

Dr. NADIA AWADH M ALUNAZI[1] Dr. Eatmad Ahmad Al-saif[1] Dr. Yasir Saleh Alolayqi[1]

1- Ministry of Health, Saudi Arabia

Abstract

Purpose: This study aimed at analyzing the endodontic therapy versus dental implants as a contemporary study.

Methods: This study discuss the various factors need to be considered, such as clinician's expertise, strategic location of the tooth, bone quality, soft-tissue quality and quantity, the patient's periodontal status, tooth restorability, and the patient's medical history when giving patients options for their restorations, an implant surgeon must address the possibility of endodontic therapy and general dentists/endodontists must discuss the ramifications of implant therapy.

Discussion: When comparing these two treatment modalities, the clinician should be able to estimate both the endodontic and the restorative prognosis of a tooth. Clinical factors, such as the presence/size of a periapical lesion or the necessity of repetition of an older failing root canal treatment have been negatively related with prognosis of those teeth. Furthermore, the experience of the operator seems crucial since specialists in endodontics were reported to have higher success (up to 98% in a 5-year period) than general practitioners.

Conclusion: A simple comparison of long-term survival or success rates of root filled teeth and implants does not fulfil the demand for a comprehensive decision-making process, which includes multiple factors to evaluate, individual case evaluation and a thorough treatment planning.

1.1 Introduction

Clinicians frequently face the dilemma of whether to endodontically treat and retain a questionable tooth or to extract and potentially replace it with a dental implant. Dentists appear to make the decision for extracting a tooth on the basis of multiple risk factors including endodontic and periodontal criteria, remaining tooth structure, restorability with core build-ups and post and core, extent of previous restorations as well as the perceived strategic value of a tooth within the dentition. Whilst single identifiable risks may be easy to manage clinically, the presence of multiple risks appears to jeopardize the survival of a compromised tooth (Zitzmann, Krastl, Hecker, Walter & Weiger, 2009).

Evidence-based data from the literature should be the foundation for the individual risk assessment and determination of the long-term prognosis of the respective tooth requiring root canal treatment (RCT) or extraction and replacement with an implant.

Recently, dental implants have become a common alternative in dental care. Though implants have been used in dentistry for decades, the idea that something man-made can become integrated and used to restore function where it had long been lost still instills a certain amount of awe. Of course, the fact that they are described as alternatives suggests there are other treatment options available. Indeed, a recent study suggested endodontic success rates reaching as high as 99.5%. The authors believe that the natural dentition is the best implant, and the first goal should be the preservation and restoration of a healthy dentition. Of course, not all patients present with clear-cut treatment needs. One such conundrum is treatment planning an endodontically treated tooth that may require re-treatment vs extracting that same tooth and placing an implant (ADA, 2004).

Clinicians are frequently facing the dilemma of weather to perform endodontic treatment in order to retain a necrotic tooth or to extract and replace it with a dental implant (*see fig. 1*). According to recent reviews, the long-term survival rates of sound or even compromised teeth surpassed those of oral implants (Zitzman, Krastl, Hecker, Walter & Weiger, 2009).

During the last decade, the endodontic therapy improved continuously due to modern equipment and high technology, represented by nickel-titanium rotary instrumentation, magnification provided by operating microscopes and cone-beam computed tomography as a diagnostic method for difficult cases. Therefore, numerous studies discussed the benefits of preservation of necrotic and damaged teeth by non-surgical or surgical methods, compared to implants. A frequent issue was the long-term success rates, i.e. weather "the implant is better than a tooth" or "the implant is a more reliable abutment".

Figure (1): Dental implant

There are many benefits to preserving one's natural dentition vs. extraction and implant therapy. When performed to the standard of care, endodontic therapy provides patients with a long-term result and a shorter mean time to restoration.[1]Time to restoration is also reduced relative to implant therapy (Christensen, 2006).

The literature, however, contains inconsistencies in terms of the definitions of success and survival of endodontically treated teeth and implants (Iqbal & Kim, 2007).

Equally, the reported success rates do not necessarily equate to the probability of a favored outcome (prognosis) when applied to a particular case or clinical scenario (John et al., 2007).

In a systematic review, Iqbal & Kim (2007) observed that much more stringent outcome criteria were normally applied to the assessment of 'successful' RCT, including the absence of a periapical radiolucency. On the other hand, the use of less stringent criteria in implant studies (generally simple survival) may translate inherently to higher success rates. This is even more obvious when early implant losses that occur during the initial healing period are not accounted for. According to a recent review, the survival of sound and even compromised and treated teeth surpassed that of oral implants, provided that implant loss before loading was added to that during function over 10 years (Holm-Pedersen et al., 2007).

In addition, endodontic therapy provides patients with a service that maintains the periodontal ligament, or PDL. The PDL is crucial to proprioception in order to maintain occlusal feedback and avoid damage to the

temporomandibular joint. Preservation of the natural periodontal complex also allows for future orthodontic movement if needed, whereas an Osseo integrated implant is an ankylosed structure that may impede orthodontic therapy. The negative psychological implications of tooth loss is never experienced by a patient who keeps his or her own dentition, and the long-term satisfaction rate is just as high relative to implant therapy (Dugas, Lawrence, Teplitsky, Friedman & Endo, 2002).

1.2 Problem Statement

When deciding upon extraction and implant therapy vs. saving the dentition via endodontic therapy, we must consider each case on an individual basis. Treatment decisions should be patient-centered, evidence-based, long-lasting, and cost-effective. Various factors need to be considered, such as clinician's expertise, strategic location of the tooth, bone quality, soft-tissue quality and quantity, the patient's periodontal status, tooth restorability, and the patient's medical history. When giving patients options for their restorations, an implant surgeon must address the possibility of endodontic therapy and general dentists/endodontists must discuss the ramifications of implant therapy. Therefore the problem of this study is to discuss the various factors need to be considered, such as clinician's expertise, strategic location of the tooth, bone quality, soft-tissue quality and quantity, the patient's periodontal status, tooth restorability, and the patient's medical history when giving patients options for their restorations, an implant surgeon must address the possibility of endodontic therapy and general dentists/endodontists must discuss the ramifications of implant therapy.

1.3 Endodontic treatment versus implants

Root canal treatment is most often a treatment of necessity to alleviate symptomatic pathology and reduce the risk for tooth loss. Successfully treated endodontically involved teeth present high survival rates (up to 97%) that are comparable to those for a single crown implant restoration (Jung, et al., 2012).

When comparing these two treatment modalities, the clinician should be able to estimate both the endodontic and the restorative prognosis of a tooth. Clinical factors, such as the presence/size of a periapical lesion or the necessity of repetition of an older failing root canal treatment have been negatively related with prognosis of those teeth. Furthermore, the experience of the operator seems crucial since specialists in endodontics were reported to have higher success (up to 98% in a 5-year period) than general practitioners.

1.4 Factors influencing endodontic and implant treatment outcome

When comparing outcome data for root canal treated teeth and dental implants, clinicians must be aware that several differences exist, associated with the origin of the tooth and the implant, the definition and interpretation of success and survival, the study design and samples, operators conducting the treatment, and changes in treatment modalities overtime (Setzer & Kim, 2014).

Several preoperative, intraoperative and postoperative factors influence the prognosis of root canal treatment, and have also been identified for the implant treatment outcome (*see table 1*).

Table (1): Factors influencing endodontic and implant treatment outcome

Variable	Endodontic retreatment	Implant treatment
Preoperative	+ Root canal filling >2 mm short of the apex + No periapical lesion Large periapical lesion Altered root-canal morphology or perforation Adequate existing root canal filling	Insufficient bone volume Specific anatomic findings History of periodontitis Previous implant failure Insufficient oral hygiene and smoking
Intraoperative	+ Addressing previous technical shortcomings + Adequate root canal filling feasible	+/- Type of implant and surface +/- Type of bone) Fenestration, bone defects Specific anatomic findings Bone augmentation Immediate implant placement
Postoperative	Restoration failure (coronal leakage, no cuspal coverage)	Wound healing problems Iatrogenic factors (e.g., excess cement) Insufficient oral hygiene and smoking Peri-implantiti

1.5 Success and survival of RCT teeth

A tooth considered for primary RCT or endodontic retreatment may has been in function for many years or even decades. Reasons for treatment may include irreversible pulpitis due to microbial infection originating from a carious lesion, trauma or periodontal involvement, or AP in teeth with non-vital pulp. The starting point for any longevity assessment is thus a disease state, involving the pulp tissues and/or the periapical bone and the primary goal is the eradication of infection. Although clinical symptoms regularly diminish within several hours or days of initiating root canal treatment, complete healing of the periapical bony lesion may require several months or even years (Friedman, 2002).

The absence of clinical symptoms and a radiograph with an intact periodontal ligament space in the apical region are indications of healing, whilst the persistence of AP is a sign of a continued disease state. If the radiolucency decreases overtime (within 4–5 years), the pathos's is also considered to be 'healing'. This healing pattern,

particularly in teeth with AP at the time of initial treatment, indicates that success rates of RCT (in terms of periapical health) start at 0% and increase overtime. Fristad et al. (2004) found a 95.5% radiographic success rate with retreated teeth recalled 20–27 years postoperatively, whilst the same sample had a 85.7% success 10 years previously.

According to a recent meta-analysis, the pooled outcome of primary RCT was 75% when strict success criteria (absence of periapical radiolucency) were applied, and reached 85% based on loose criteria (reduction in size of radiolucency) (Ng et al., 2007).

Preoperative absence of a periapical radiolucency, root filling with no voids, root filling extending to 2 mm within the radiographic apex and satisfactory coronal restoration were found to improve the outcome of primary RCT significantly (Ng et al., 2008).

In teeth without a periapical radiolucency, initial RCT secured a success rate of 96% after 8–10 years, whilst healing was reduced to 86% in cases with pulp necrosis and periapical radiolucency (Sjo¨gren et al. 1990).

1.6 Success and survival of dental implants

A functioning dental implant represents a de novo situation, in which neither caries nor endodontic problems exist. In contrast to root canal treatment, implants are placed into relatively healthy surroundings. Complications and failures, however, occur either prior to implant osteointegration (early implant loss) or after initially successful osteointegration (late implant loss) and disease manifestation may necessitate several years or even decades of function (Quirynen et al.. 2007).

Osteointegration is considered to be a phenomenon of direct apposition of bone substance on the implant surface followed by structural adaptation in response to mechanical load (Novaes, Souza, Barros, Pereira, Iezzi & Piattelli, 2010).

Whilst initial implant fixation following placement is simply derived from mechanical stabilization, osteointegration with an intimate contact between living bone and the titanium surface requires several weeks (Alla, Ginjupalli, Upadhya, Shammas, Ravi & Sekhar, 2011).

Early implant failures occur mainly during the first weeks or months after implant placement and are frequently related to surgical trauma, complicated wound healing, insufficient primary stability and/or initial overload. Late implant losses are caused by microbial infection, overload or toxic reactions from implant surface contamination (e.g., acid remnants). Whilst overload leads to a sudden loss of osteointegration with implant mobility, microbial infection initiates peri-implant mucositis that corresponds to gingivitis and may progress into peri-implant it is that corresponds to periodontitis. According to the consensus report from the 1st European Workshop on Periodontology, peri-implant mucositis was defined as a reversible inflammatory reaction in the soft tissues surrounding an implant, and peri-implantitis was described as inflammatory reactions associated with loss of supporting bone around an implant in function. Hence, peri-implantitis is clinically diagnosed by bleeding on probing (and/or suppuration) in combination with radiographic bone loss (Heitz-Mayfield 2008).

During the first year following implant placement, bone remodeling may cause bone resorption in the marginal area (average 1.3–1.5 mm around implants placed at the bone level). Any further bone loss, particularly reaching ‡2.5 mm, is considered as disease manifestation, and affects at least 28% of subjects. Despite disease progression, the implant remains non-mobile until the apical portion of implant osteointegration is affected. In the implant literature, the majority of studies report implant survival rates defined as simple retention. If success

criteria are applied, the absence of clinical symptoms, no signs of inflammation and a limited marginal bone loss (e.g., not exceeding 0.2 mm after the first year in function) are frequently mentioned. In several studies, however, disease symptoms are not consistently investigated, i.e., probing is not applied, and bone level assessments are made from panoramic radiographs with limited accuracy.

1.7 General endodontic and implant contraindications

In patients with high caries activity, possibly related to dry mouth as a common side effect of several medications (e.g., antihypertensive, diuretics, antidepressants, atropine, anticonvulsants, spasmolysants and appetite suppressants) or associated with syndromes, less effort will be made to maintain a questionable tooth, and implant treatment may be favored. Further, patients with diabetes seem to have a somewhat increased likelihood of endodontic complications (symptomatic periapical diseases and flare-ups) following nonsurgical RCT, particularly in cases with preoperative periarticular lesions (Fouad & Burleson 2003). Impaired integrity of the patient's nonspecific immune system was found to be a significant predictor for a negative outcome of initial nonsurgical RCT or retreatment, whilst other patient-related factors such as age and smoking had no impact on the healing rate. Other authors suggested a possible negative influence of smoking on the prognosis of RCT teeth, but this was mainly attributed to delayed bone healing, and to an increased prevalence of periodontal disease and root caries in smokers (Duncan & Pitt Ford 2006). There are few absolute and permanent implant contraindications, but several temporary restrictions such as incomplete cranial growth.

In young adults requiring single tooth replacement in the maxillary anterior region, implant placement should be postponed until after the age of 25 due to the changes in anterior face height and posterior rotation of the mandible, particularly in women.

This continuous alveolar bone development entails a vertical infraposition of the implant with the mucosal margin too far apical and significant aesthetic implications may occur. Patients under intravenous bisphosphonate medication for more than 2 years and a history of complicated wound healing, e.g., following tooth extraction, are not a candidate for implant treatment due to the risk of bisphosphonate-induced osteonecrosis.

When clinicians face the dilemma of whether to retain/restore a compromised tooth or replace it with an implant, their personal experience, access to technology, postgraduate education in combination with local factors (periodontal, endodontic, restorative) together with patient-related parameters should guide the final decision (Donos, et al., 2012).

Clinical decisions should also be based on the best available evidence regarding the predictability and effectiveness of each the suggested treatment protocols. Systematic reviews, where the majority of the studies assessed are randomized controlled clinical trials (RCTs) present usually the highest level of evidence. However, for several clinical scenarios, an evidence-based decision-making process may not always be possible since in prosthetic dentistry there are hardly any RCTs addressing whether an implant-supported restoration is superior to a tooth-supported restoration .

In such a case, dentists involved in implant dentistry should take into consideration well-documented evidence from other disciplines like periodontics or endodontics regarding the longevity and complication rate of periodontal and endodontically affected teeth following treatment.

1.8 Conclusions

A simple comparison of long-term survival or success rates of root filled teeth and implants does not fulfil the demand for a comprehensive decision-making process, which includes multiple factors to evaluate, individual case evaluation and a thorough treatment planning. Several retrieved publications implied that the decision for extraction of a natural tooth depends less on the health of that individual tooth, but rather on the overall rehabilitation planned and that sacrificing a tooth can be preferable for a 'better, more predictable, more economic long-term rehabilitation on implants'. Applying this opinion without critical appraisal of site-specific and patient-related factors may fail to recognize risks for complications and failures possibly associated with implant treatment. For single tooth restorations, an increased risk in restoring a tooth with a questionable prognosis is acceptable in a particular case. The respective tooth, however, should not be included as an abutment in a long-span FDP. Multiple risk factors may indicate tooth extraction and possible replacement by an implant, particularly in the posterior region and when aesthetics is not paramount. Although priority should be given to preservation of the natural dentition, implant placement enhances treatment planning options, thereby facilitating short-span reconstructions or single units with reduced risk of failure for the patient and the practitioner. Hence, using implants for replacement of single missing teeth may facilitate retention of a neighboring compromised tooth, which otherwise would have been extracted. In case of full-mouth rehabilitation, single tooth prognosis and the site-specific treatment recommendation is possibly overruled by the overall treatment planning and a therapy-related decision for a strategic extraction may be required to perform reasonable

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