Endodontic or dental implant therapy
The factors affecting treatment planning

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For decades, all disciplines of dentistry have strived to prevent and treat caries and periodontal disease, as well as to restore function and esthetics to patients affected by oral diseases or traumatic injuries. Despite these efforts, many nonrestorable teeth and teeth with severe periodontal involvement have been extracted, and traditionally they have been replaced with fixed or removable prostheses.

Advances in implant dentistry have provided thousands of completely and partially edentulous patients with a more functional and attractive alternative to fixed and removable prostheses. The introduction of cylindrical endosseous implants[1,2] to dentistry and their high survival rates have had a significant effect on treatment planning in prosthodontics and periodontics.[3] These advances also can affect treatment planning for teeth requiring endodontic treatment.

An ideal treatment plan should address the chief complaints of the patient; provide the longest-lasting, most cost-effective treatment; and meet or exceed patients' expectations whenever possible. However, treatment planning usually is

ABSTRACT

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Background. Clinicians are confronted with difficult choices regarding whether a tooth with pulpal and/or periapical disease should be saved through endodontic treatment or be extracted and replaced with an implant.

Methods. The authors examined publications (research, literature reviews and systematic reviews) related to the factors affecting decision making for patients who have oral diseases or traumatic injuries.

Results. The factors to be considered included patient-related issues (systemic and oral health, as well as comfort and treatment perceptions), tooth- and periodontium-related factors (pulpal and periodontal conditions, color characteristics of the teeth, quantity and quality of bone, and soft-tissue anatomy) and treatment-related factors (the potential for procedural complications, required adjunctive procedures and treatment outcomes).

Conclusions. On the basis of survival rates, it appears that more than 95 percent of dental implants and teeth that have undergone endodontic treatment remain functional over time.

Clinical Implications. Clinicians need to consider carefully several factors before choosing whether to perform endodontic therapy or extract a tooth and place an implant. The result should be high levels of comfort, function, longevity and esthetics for patients.

Key Words. Decision-making factors; endodontic therapy; dental implants; systemic disease; oral health; treatment planning.
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affected by the views of the stakeholders (that is, patients, insurance companies, dentists), who have varying perspectives and expectations regarding the outcome of treatment. Treatment should be patient-centered, not be based only on dental insurance benefits and not be guided solely by the desires and clinical experience of the practitioner. It must be based on scientific evidence, and ideally it should preserve the biological environment while maintaining or restoring esthetics, comfort and function. Clinicians regularly are confronted with difficult choices. Should a tooth be saved through endodontic treatment or be extracted and replaced by a single implant?

The factors involved in the decision-making process regarding whether a tooth should receive endodontic treatment or be extracted and replaced by an implant pertain to the patient, the tooth and periodontium, and treatment-related considerations. The purpose of this article is to explore the major factors that can affect the decision regarding whether a tooth receives endodontic treatment or is extracted and replaced by an implant.

PATIENT HEALTH-RELATED FACTORS

Systemic and local health factors. Systemic and local health factors can affect endodontic treatment outcomes. Clinical data show that a history of diabetes may have a negative effect on the healing of periapical lesions.[4] The presence of a periapical lesion is the main preoperative factor associated with less favorable outcomes of endodontic treatment.[4-10]

A patient's systemic health status also can affect the outcome of implant therapy.[11] People who have uncontrolled or poorly controlled diabetes,[12] are immune-suppressed[11] or smoke[13-20] have an elevated risk of developing complications after implants have been placed.

Patient comfort and perceptions. The majority of endodontic and implant procedures are performed with minimal patient discomfort and complications.[21,22] However, a patient's positive and negative experiences with either treatment can affect his or her decision as to which modality should be pursued.

Clancy and colleagues[23] reported general satisfaction, comfort, esthetics and function for patients who received dental implants. The patients in their study reported experiencing some discomfort related to the surgery, but they experienced little discomfort after healing. They indicated that implant treatment was "worth the investment in time and expense" and they would accept a similar treatment plan again.[23] Weibrich and colleagues[24] reported similar findings for patients who received dental implants.

TOOTH- AND PERIODONTIUM-RELATED FACTORS

Pulpal and periodontal conditions. Indications for endodontic treatment include teeth with irreversible pulpitis, necrotic pulps, restorable crowns, treatable periodontal conditions, salvageable resorptive defects and a favorable crown-to-root ratio.[25] Endodontic treatment is contraindicated when there is limited remaining tooth structure and the definitive crown will not be able to engage at least 1.5 to 2.0 millimeters of tooth structure with a cervical ferrule.[26,27] Eckerbom and colleagues,[28] Randow and colleagues[29] and Reuter and Brose[30] found that when a fixed partial denture had been used, abutment teeth that had undergone endodontic treatment failed more often than did teeth with vital pulps.[28-30] Aquilino and Caplan[31] found a strong association between crown placement and the survival of endodontically treated teeth.

Implants are indicated when teeth cannot be prepared with adequate retention and resistance form. Other indications for implants include edentulous sites adjacent to teeth without restorations or the need for restorations and edentulous sites adjacent to abutment teeth with large pulpal chambers and those with a history of avulsion or luxation.[32]

Biological and environmental considerations. Some patients are frustrated because of recurring problems with caries or periodontal disease. Retaining such teeth via endodontic treatment may not be the best option, because the frequently required re-treatment procedures can be challenging and frustrating for the practitioner and the patient, and they produce compromised results. It may be prudent to extract such teeth and place implants. In addition, implants may be a better option for patients who have limited ability to perform routine oral hygiene procedures.

Teeth with unique color characteristics. Color matching can be a significant challenge for certain highly visible teeth with unique dentin colorations or large areas of enamel translucency or transparency. When such a tooth requires endodontic treatment but does not need a ceramic

crown, the clinician may find it to be esthetically advantageous to retain the tooth through endodontic treatment, rather than extract it and place an implant crown that does not match the surrounding environment. Because of these color-matching challenges, it sometimes is prudent to perform challenging and difficult endodontic treatment rather than to extract such teeth and replace them with implants.

When a tooth with challenging color characteristics requires both endodontic treatment and a ceramic crown, it may not be possible to achieve an appropriate color match because of thickness limitations imposed by the amount of required tooth reduction. Although a ceramic crown made for an implant may not be ideal, the dentist usually can achieve a better color result because the implant can be fabricated with a thicker amount of porcelain that enhances the color-matching potential, particularly in the challenging cervical areas.

Quantity and quality of bone. The quantity of available bone affects the feasibility of placing implants without bone grafting. Bone quality also affects implant success, with type 4 bone resulting in less success compared with types 1 through 3 bone.[33] Goodacre and colleagues[33] reported that the success rate was lower when short implants (that is, those 10 mm or less in length) were used than when longer implants were used. Although new implant surfaces and geometries have produced promising results[34-36] that may overcome the lower success rates associated with short implants, the available clinical data are limited.

After extracting a tooth, the clinician can place an implant immediately in the root socket, thereby avoiding much of the bone resorption that accompanies extraction.[37] However, when substantial infection is associated with an extracted tooth, the clinician may have to postpone implant placement to permit resolution of the infection.[38]

Retaining a tooth with a poor long-term prognosis via endodontic treatment, particularly a cracked tooth, can lead to substantial bone loss by the time the tooth eventually is removed. The resulting bone defect can substantially affect the esthetic result. Consequently, early removal of the tooth and immediate placement of a dental implant may produce an environment that is more suitable for implant positioning and result in optimal esthetics.[39]

Soft-tissue anatomy. The esthetic result around crowns can be affected negatively by an interdental papilla that does not fill the cervical embrasure space. This can occur around crowns that attach to endodontically treated teeth or dental implants. Choquet and colleagues[40] reported that soft tissue fills the cervical embrasure around dental implants when the incisocervical distance from the proximal contact to the interproximal bone crest is 5 mm or less.[40]

The periodontal biotype also affects the potential for soft tissue to fill the cervical embrasure space around implants. In the presence of a thin biotype, papillae adjacent to implants seldom can be re-created when the distance between the interproximal bone crest and the desired height of the interdental papillae is more than 4 mm.[41]

When the biotype is thin but healthy around a natural tooth, preservation of the tooth through endodontic therapy may provide more appropriate soft-tissue esthetics than does extracting the tooth and placing a dental implant.

TREATMENT-RELATED FACTORS

Procedural complications. Endodontic treatment, like other disciplines of dentistry, occasionally is associated with procedural accidents. These mishaps can occur during access preparation, cleaning and shaping, and obturation, as well as during preparation of the post space.[42] Some of these accidents have a negative effect on the outcomes of endodontic treatment.[43-45] In addition, the extension of root canal filling materials[10,46] and quality of obturation[47,48] affect the prognosis for endodontic treatment.

Complications also can occur in conjunction with dental implants. They include surgical complications such as hematomas, ecchymosis and neurosensory disturbance.[33] Implant loss can occur as a result of the implant's failure to integrate with the bone or bone loss subsequent to integration. Soft-tissue complications such as inflammation and/or proliferation, soft-tissue fenestration and/or dehiscence before stage II surgery and fistulas have been reported.[33] Mechanical complications such as screw loosening, screw fracture, prosthesis fracture and implant fracture also can occur.[33] Some of these complications, such as screw loosening, are corrected easily, while others can result in clinical failure.

Adjunctive procedures. A number of adjunctive procedures affect the comparison of complicated and/or high-risk endodontic treatment with

tooth extraction and placement of an implant and a crown. For instance, retaining some teeth via endodontic therapy may result in the need for treatment for periodontal disease, crown lengthening through surgery or orthodontic extrusion, a core buildup or a post and core, or a crown. Each of these procedures adds complexity, can present additional complications and risks, increases the cost of treatment and makes it more difficult for patients to comprehend and accept a treatment plan.

Implant therapy presents similar complexities. Before or in conjunction with implant placement, the clinician may need to perform grafting or distraction osteogenesis so that adequate bone is available. Sinus grafting may be needed in the posterior maxilla, and horizontal/vertical bone grafting may be required in other areas of the mouth to provide an edentulous ridge with sufficient bone in the correct location. Ridge grafting that requires bone harvesting from a remote site increases patient discomfort. These procedures also increase the cost and treatment time, and they can complicate the provisional replacement of missing teeth for esthetic and functional reasons.

Treatment outcomes. Torabinejad and colleagues[49] performed a systematic review of the literature between January 1966 and September 2004 pertaining to the success and failure of nonsurgical endodontic therapy, and they assigned levels of evidence to these studies. Their search revealed that during the past 40 years, 306 articles were published with regard to the outcome of nonsurgical endodontic treatment. Fifty-one of these articles reported studies involving at least 100 teeth. The authors recorded and analyzed the success rates at one, two and five years using 95 percent confidence interval estimates.

The data show a radiographic success rate of 81.5 percent during the five-year period. Friedman and colleagues[9] reported similar healing rates (81 percent overall) in their clinical and radiographic assessment of the four- to six-year outcome of endodontic treatment. The healed rate in their study was significantly higher for teeth without apical lesions (92 percent) compared with that for teeth with apical periodontitis (74 percent). Based on survival rates, it appears that more than 95 percent of teeth that have undergone endodontic treatment remain functional over time.[50-52] These findings do not reflect new advances and innovations in the art and science of endodontics.[53]

On the basis of the results of studies published after 1996, the American Dental Association's Council on Scientific Affairs reported high implant survival rates for various clinical situations.[11] With regard to the single-tooth implant, the Council's evaluation of 10 studies involving more than 1,400 implants revealed survival rates ranging from 94.4 to 99 percent, with a mean survival rate of 96.7 percent. The Council also reported a mean survival rate of 87.1 percent for implant overdenture treatment and a mean survival rate of 86.8 percent for bone grafting/implant treatments.[11] The Council report stated that immediate loading of implants does not lower the survival rates, with three studies reporting survival rates ranging from 93.5 to 95.6 percent.[11]

In a systematic review of clinical studies of implants, Creugers and colleagues[54] reported a four-year survival rate of 97 percent for single-tooth implants. In another report, Lindh and colleagues[55] performed a meta-analysis of implant studies involving partially edentulous patients. They reported a success rate of 97.5 percent after six to seven years for a single-implant crown.

CONCLUSION

The decision by the clinician and patient to retain or remove teeth should be based on a thorough assessment of information related to risk factors affecting the long-term prognosis for endodontic and dental implant treatment. The clinician should consider several factors when determining whether to save a tooth through endodontic therapy or extract it and place an implant. These factors pertain to the patient's health status, the condition of the tooth and periodontium, and treatment-related considerations.

Patient-related factors include systemic and oral health, as well as patients' comfort and perceptions about treatment. Tooth- and periodontium-related factors include pulpal and periodontal conditions, biological environmental considerations, color characteristics of the teeth, quantity and quality of bone, and soft-tissue anatomy. Treatment-related factors include an assessment of potential procedural complications, required adjunctive procedures and treatment outcomes data. ■

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