Comparison of Success of Implants versus Endodontically Treated Teeth

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Abstract

Implants verses root canal therapy is a current controversy in dentistry. The purpose of this investigation was to compare the success of each treatment, with minimal subjective grading. Outcome was determined by clinical chart notes and radiographs. Failure was defined as removal of the implant or tooth. Uncertain findings for implants were defined as mobility class I or greater, radiographic signs of bone loss, or an additional surgical procedure. Mobility, periapical index score of 3 or greater, or the need for apical surgery was classified as uncertain for endodontically treated teeth. Success was recorded if the implant or tooth was in place and functional. Implants were placed by periodontists in a group practice, whereas the endodontic treatments were performed by endodontists in group practice. Charts of 129 implants meeting inclusion criteria showed follow-up of an average of 36 months (range, 15–57 months), with a success rate of 98.4%. One hundred forty-three endodontically treated teeth were followed for an average of 22 months (range, 18–59 months), with a success rate of 99.3%. No statistically significant differences were found ($P = .56$). When uncertain findings were added to the failures, implant success dropped to 87.6%, and endodontic success declined to 90.2%. This difference was not statistically significant ($P = .61$). We found that 12.4% of implants required interventions, whereas 1.3% of endodontically treated teeth required interventions, which was statistically significant ($P = .0003$). The success of implant and endodontically treated teeth was essentially identical, but implants required more postoperative treatments to maintain them. *(J Endod 2008;34:1302–1305)*

Key Words

Endodontics, implant, success

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Implant and endodontic treatments both are highly predictable procedures. Arguments are often made that one treatment is more predictable than the other, but it is difficult to make an objective comparison. Many of the classic endodontic success studies show success as artificially low because of stringent definitions of success, such as total radiographic healing or lack of any of adverse signs or symptoms (1–3). It might be argued that survival is a better measure of success. Several studies base endodontic success on survival (4–6). Most implant outcome studies use survival as the sole criterion (7). Other authors attempt to use more stringent clinical and radiographic criteria to evaluate success (8). It remains difficult to compare the success rates because of differing methodologies and definitions of success.

Numerous factors have been shown to contribute to the predictability of both implants and endodontically treated teeth. Factors that have been linked to implant success are location in the mouth and type of restoration. Other patient factors such as systemic disease, smoking, and bone quality have also been implicated as contributing to lowered success. In addition, the type of restoration, occlusion, and esthetics play roles in the success of the treatment. Other problems arise when evaluating endodontic success. Prognosticators implicated most strongly are the presence of a preoperative radiolucency, the periodontal condition of the tooth, the quality of the fill and its length, and the quality of the coronal seal. Host factors such as systemic disease appear to have little correlation to endodontic success (9, 10).

Another factor that complicates comparison of the 2 treatments is the fact that the 2 treatments have different biologic factors related to their outcome. Endodontic failure is generally the result of infection (11–13). It is widely accepted that some portion of the root canal system provides a niche for infection to evade the body's defenses. This niche might be a missed canal, infected dentinal tubules, or a portion of the canal that was not totally obturated, allowing a persistent biofilm. Implant failures are usually a result of an inability of the body to tolerate the implant material. Failures of implants occur during the treatment phase, immediately after placement, or later during the maintenance phase. Early failures are generally the result of inadequate osseointegration and are attributed to formation of a fibrous connective tissue interface with the implant body. This type of failure is at the implant-bone interface, often caused by overheating of the bone during placement or poor quality of the bone (14). Areas of bone with large cancellous spaces such as the posterior maxilla have been shown to have lower success rates as a result of the bone quality. Inflammation at the site of placement increases the rate of fibrous connective tissue healing around implants. Failures during the maintenance phase are generally caused by bacterial infection or biomechanical factors that progressively deprive the implant of osseointegration in a process similar to that of periodontal disease around the implant body (15–17). Roos-Jansaker (18) noted progressive periimplant bone loss in conjunction with a soft tissue inflammatory response as a "common" occurrence in implants 9–14 years after placement. The etiology of this disease is the accumulation of plaque around the implant and restoration, which progresses to cause bone loss. Roos-Jansaker et al. (19) found a higher rate of periimplantitis in smokers and in patients with a history of periodontal disease. Karoussis et al. (20) found a higher rate of periimplantitis among periodontitis patients (28.6% vs 5.8%) and corresponding overall success rate (90.5% vs 96.5%).

Biomechanical factors also lead to problems during the maintenance phase. Excessive biomechanical forces on the implant lead to stress and microfractures in the bone-implant interface, which manifest as loss of osseointegration around the neck of

TABLE 1. Sample of Data Collection Sheet

Implant Data	Root Canal Therapy Data
Tooth #	Tooth #
Patient age at treatment	Patient age at treatment
Gender (M, F)	Gender
Ethnicity	Ethnicity
Smoker (yes, no, no. of y)	Smoker (yes, no, no. of y)
Diabetes	Diabetes
Presurgical procedure	Most recent recall
Most recent recall	Radiographs taken at recall
Radiographs taken at recall	Root canal therapy tooth in function
Implant in function	Root canal therapy tooth present in mouth
Implant present in mouth	No. of appointments
Periimplant radiolucency	Obturation length
Mobility	Post present
Post-treatment intervention	Preoperative area
Intervention time	Post-treatment intervention
Endodontic treatment adjacent to implant (yes, no)	Intervention required
Brand of implant	Periapical index
Length of implant (mm)	
Width of implant (mm)	
Bone loss (mm)	
Healing after extraction	
Time to uncovery/function	

TABLE 2. Summary of Periapical Index Scoring System Used to Grade Endodontic Treatments (13)

PAI 1	Intact PDL
PAI 2	Possible broken PDL
PAI 3	Broken PDL
PAI 4	Break in PDL with possible radiolucency
PAI 5	Broken PDL with definite radiolucency

PAI, periapical index; PDL, periodontal ligament.

the implant. Rarely forces can be produced that fracture implant components or even the implants themselves (21).

Because of the vast differences in the 2 treatments and the methods used to evaluate them, the clinician is faced with a dilemma when attempting to determine which treatment is most appropriate. Survival is a way to determine whether the treatments are providing patients with functioning members of the dentition. There are many factors that contribute to the outcome of each treatment, but there are few studies directly comparing the 2 treatments. The purpose of this project was to directly compare the outcomes of implant treatments and endodontic treatments.

Materials and Methods

This study was approved by the University of Alabama at Birmingham Institutional Review Board as a chart review study. A chart review was carried out in 2 group specialty practices in the same city. Implant data were collected from a periodontic practice and endodontic data from patients presenting for routine recall or treatment of another tooth at an endodontic practice. Charts were selected in alphabetical sequence, with no exclusions made for systemic disorders, time of implant loading, or tooth implant position in the mouth, and were reviewed on patients with clinical and radiographic follow-ups more than 1 year after treatment. Table 1 depicts the data collected. The clinical data were gathered from the chart notes, and radiographs were evaluated and graded by the principal investigator. Implants were loaded by agreement with the periodontist and the restoring dentist, typically shortly after uncovery. All restorative treatments were completed by the patient's general dentist. Success was defined as radiographic evidence that the implant or treated tooth was still present in the mouth, and that there was no notation of signs or symptoms requiring intervention during the follow-up period in the chart notes. Uncertain findings were defined for implants as charted mobility greater than class I, radiographically detectable bone loss, or additional surgical procedure required. Typical surgical interventions for implants were flap exposures for debridement, with or without grafting osseous material. Uncertain findings for endodontic treatments were defined as charted mobility greater than class I, radiograph judged as periapical index score of 3 or greater (Table 2), or orthograde endodontic procedure or apical surgery required (22). Preoperative values were not considered.

Failures were defined as removal of the implant or tooth. For a summary of the definitions used, see Table 3. The data were recorded and graded by the primary investigator. The Fisher exact test was used to compare the success of both treatments.

Results

One hundred twenty-nine implants met the inclusion criteria. The average recall was 36 months, with a range of 15–57 months. Seventy-seven implants were in the maxillary arch and 52 in the mandible. Eighty-nine were anterior implants, and 40 were posterior. One hundred forty-three endodontically treated teeth met the inclusion criteria, with an average recall time of 22 months and a range of 18–59 months. Ninety-nine molars were treated endodontically, as were 26 premolars and 18 anterior teeth. The treatments were scored on the clinical and radiographic findings as described in Table 1. Of the implants only 2 were lost, for a success rate of 98.4%. Of the endodontic treatments only 1 was lost, for a success rate of 99.3%. The differences were not statistically significant with Fisher exact test ($P = .56$). Fourteen implants were scored as uncertain, whereas 13 endodontically treated teeth were placed in the uncertain category. No statistically significant difference was found between the uncertain findings with Fisher exact test ($P = .69$). When uncertain findings were added to the failures, implant success dropped to 87.6%, and endodontic success declined to 90.2% (Fig. 1). Again this difference was not statistically significant ($P = .61$). However, 12.4% of implants required interventions, whereas only 1.4% of endodontically treated teeth required interventions (Fig. 2). This difference was statistically significant ($P = .0003$).

TABLE 3. Definitions of Criteria Used to Evaluate the Procedures

	Failures	Uncertain Findings	Success
Implants	Removal of implant	Mobility class I or greater, radiographic signs of bone loss, additional surgical procedure needed	No additional procedures
Endodontic treatment	Removal of tooth	Mobility class I or greater, periapical index score of 3 or greater (definite presence of periapical rarefaction), apical surgery needed	No additional procedures

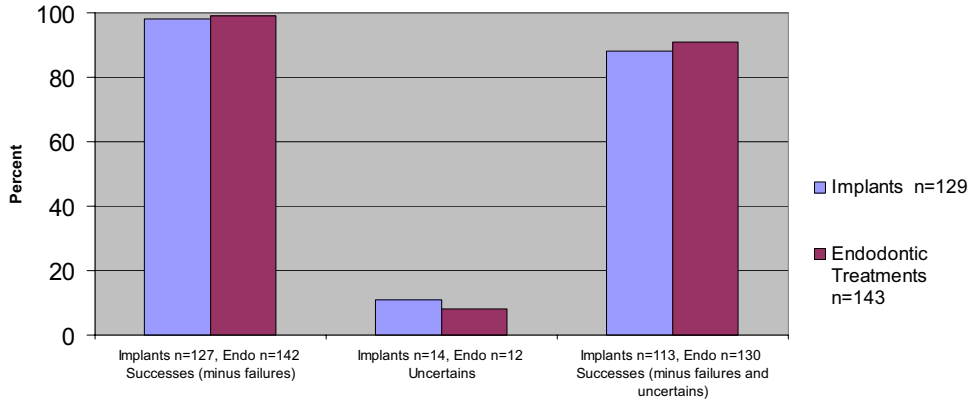

Figure 1. Outcomes. No statistically significant differences were found. Successes minus failures ($P = .56$); uncertain group ($P = .69$); successes minus failures and uncertains ($P = .61$).

Discussion

There appears to be little difference in the success of the 2 treatments. Both implants and endodontically treated teeth appear to function with few problems. Although the sample was relatively small, it indicates that both therapies are equally successful when judged by similar standards. Our observation is in agreement with Iqbal and Kim (23), who found no difference in long-term prognosis between single-tooth implants and restored root canal–treated teeth.

The only significant difference in the 2 groups was the percentage that required post-treatment interventions. Implants required additional procedures more frequently than endodontically treated teeth. Perhaps the shorter recall times for endodontic treatments were not long enough to observe a problem. Patients continuing treatment in the same specialty office could select for patients with problems, or it might select for those satisfied with their outcome, although the periodontists having longer recalls were forced or were more willing to recommend additional surgical procedures. We were not able to draw any conclusions on systemic disease and treatment outcome. The small number of patients with systemic disease in our sample made it impractical to attempt to correlate systemic disease with outcome. The data were collected as part of a larger project comparing implant and endodontic outcome funded by the American Association of Endodontists that will have more robust numbers to draw more powerful conclusions.

The practice experience of all the operators was relatively similar in length of time they had been practicing. Also the restorative work was all completed by the referring dentists, giving another measure of similarity. The difference in group sizes was due to time limitations available in the different practices.

The only criterion for inclusion was a recall of more than 12 months. No attempt was made to make any distinction on the location in the mouth or type of treatment. Endodontic treatments were counted equally if they were retreatments, or if they were initial treatments. Implants included 1-stage and 2-stage treatments. All treatments were weighted equally, regardless of any complexities of treatment. Evidence suggests that systemic disease has little effect on endodontic success, whereas many such conditions might lower implant success. Doyle et al. (9) found that no appreciable difference in outcomes existed for diabetes mellitus patients versus other implant or endodontic patients. Periapical pathology was present in the sole tooth lost in the endodontic group. The quality of the bone at the placement site might affect the ability of the implant to osseoinetgrate. The presence of periodontal disease and caries is believed to lower the success of implant treatment, because oral hygiene is important in the prevention of periimplantitis. All of these factors must be considered before treatment.

Balevi (24) and Torabinejad et al. (25) performed meta-analyses and found direct comparisons of endodontic and implants to be quite rare. This study used preliminary data from a large study currently underway.

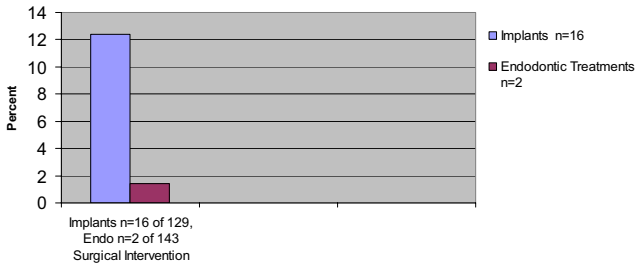

Figure 2. Percentage of treatments requiring intervention after initial treatment. Difference is statistically significant ($P = .0003$).

Acknowledgments

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