

Survival of Intentionally Replanted Teeth and Implant-supported Single Crowns: A Systematic Review

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Abstract

Introduction: Although nonsurgical initial root canal treatment and retreatment have high success rates, periapical disease can remain. The survival rates of 2 surgical procedures, intentionally replanted (IR) teeth and implant-supported single crowns (ISCs), have yet to be compared. The purpose of this systematic review and meta-analysis was to examine the literature and quantify the survival of IR teeth and compare it with that of ISCs. **Methods:** Systematic searches were enriched by citation mining. Weighted survival means and 95% confidence intervals (CI) were estimated using a random-effects model and compared. **Results:** The quality of the IR and ISC articles was only moderate. Data for ISCs were much more plentiful than for IR teeth. Meta-analysis revealed a weighted mean survival of 88% (95% CI, 81%–94%) for IR teeth. Root resorption was reported with a mean prevalence of 11%. The weighted mean survival of ISCs was 97% (95% CI, 96%–98%). The mean survival of ISCs was significantly higher than that of IR teeth ($P < .001$). A recent study on IR teeth indicated that orthodontic extrusion before intentional replantation improved survival rates. **Conclusions:** A systematic review and meta-analysis found that the mean survival of ISCs was significantly higher than IR teeth. However, treatment decisions must be based on a wide variety of treatment and patient-specific parameters. Intentional replantation may have a role when ISC is not practicable. Studies using contemporary treatment and analytic methods should be used to identify and measure intentional replant prognostic and treatment variables. (*J Endod* 2015;41:992–998)

Key Words

Implant-supported single crowns, intentionally replanted teeth, survival, systematic review

The primary goals of endodontic treatment are the prevention and/or resolution of pulpal and periapical pathoses with the re-establishment of healthy periradicular tissues. Nonsurgical root canal treatment (NSRCT) provides high long-term survival and success rates (1–4), allowing millions of people to preserve their natural dentitions. However, healing does not always follow NSRCT; apical periodontitis can persist (5–7). Additionally, successfully treated teeth can become reinfected through coronal microleakage after a period of health (8). Such persistent or new pathoses can be treated by nonsurgical retreatment with success rates of 77%–78% (9, 10). When a tooth has been nonsurgically retreated and disease persists, options include no treatment; extraction and replacement using a single-tooth implant, a fixed dental prosthesis, or a removable dental prosthesis; apical microsurgery; and intentional replantation and autotransplantation.

If a patient wishes to retain his or her natural tooth, apical microsurgery may be indicated. Reported healing rates vary considerably (10–12). One systematic review reported early healing rates of 78% at 2 to 4 years, but this dropped to 72% by 4 to 6 years (10). Another systematic review reported a very high success rate of 94% for modern apical microsurgery and a much lower success rate of 59% for traditional apical surgery (12). The high success rate of modern apical microsurgery was attributed to advances in techniques, instrumentation, and materials (12). That review pooled data from studies with different lengths of follow-up, from 6 to 276 months (12). A recent systematic review comparing the outcomes of endodontic microsurgery with that of tooth replacement using an implant-supported single crown (ISC) reported a 92% survival rate for teeth treated with modern apical surgery (13). It has been shown that teeth treated with modern apical surgical techniques can remain healed well after 5 years (14). However, apical surgery may be contraindicated because of anatomic factors such as the mental foramen, mandibular canal or thick bone, periodontal attachment loss, or some medical conditions. Intentional replantation is the treatment of choice for some of these cases.

Intentional replantation is not a new procedure. Albucasis, an Arab physician, provided the earliest reports on intentional replantation in the 11th century according to Weinberger (15). Pierre Fauchard described its use in the 18th century according to Dryden and Arens (16). Dentists were advised to use care in case selection and to not advise the patient of a high probability of success (17). Over time, criteria for performing intentional replantation evolved. In 1966, Grossman (18) listed a wide range of indications including canal obstruction, iatrogenic or natural, and complex anatomy; a desire to remove periapical irritants, extruded materials, or a cyst; and a need to address a perforation when apical surgery is not feasible.

Intentional replantation is often considered to be a procedure of last resort (19, 20), likely because of the wide variance in reported success rates and the absence of an established protocol (21). Knowing the prognosis for intentionally replanted (IR) teeth would assist patients and dentists in making decisions, particularly in choosing between 2 surgical approaches: tooth retention through intentional

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- A. (intentional[All Fields] AND ("tooth replantation"[MeSH Terms] OR ("tooth"[All Fields] AND "replantation"[All Fields]) OR "tooth replantation"[All Fields])) AND ("2009/01/01"[PDAT] : "2014/04/31"[PDAT])
- B. "Tooth Replantation"[Major] AND intentional[All Fields] AND ("1950/01/01"[PDAT] : "2014/04/31"[PDAT]) Limits: English, Human Years: 2009/01/01 to 2014/04/31

Figure 1. Search methodology for IR teeth.

replantation or tooth replacement using an ISC (22–27). Both evidence and patient preference must be considered when dentists use their judgment to formulate a treatment plan (28). ISC treatment has advanced rapidly over the last 2 decades and is now the treatment of choice when replacing missing teeth (3, 4). Comparisons between the outcomes of intentional replantation and ISC could not be identified. The purpose of this systematic review and meta-analysis was to examine the literature and quantify and compare the survival of IR natural teeth with that of contemporary ISCs.

Materials and Methods

The following PICO (population, intervention, comparison, outcome) question was generated to guide meta-analysis of the literature: In patients with periodontally sound teeth with periapical pathosis after nonsurgical endodontic therapy, how does the survival of IR teeth compare with the survival of ISCs?

Articles on intentional replantation were collected according to the described search methodology in PubMed, Cochrane Library, Web of Science, and Embase databases (Fig. 1). Inclusion criteria were publications in the English language from January 1966 to April 2014, human studies, a minimum of 10 cases documented with a 2-year mean follow-up, and intentional replantation for endodontic purposes. The unit studied was the IR tooth.

Articles on ISCs were collected according to the listed search methodology (Fig. 2). Inclusion criteria included publications in the English language from January 2002 to June 2012 (13). Human studies, studies with a minimum of a 2-year mean follow-up, and studies that used dental implants to replace permanent teeth in adults were included.

Articles were excluded from the meta-analysis based on the following criteria: animal studies; intentional replantation after traumatic injury; compromised periodontal health/prognosis; fewer than 10 documented cases; less than a 2-year mean follow-up; articles published in a language other than English; and expert opinions, review articles, or articles that only described the procedures. Abstracts were reviewed and rejected if any of the exclusion criteria were met. Full-text articles were then reviewed to ensure that the inclusion criteria

were met. Consensus was obtained between reviewers that the criteria were observed.

Each reviewed article was evaluated using a 31-question data abstraction form to identify the type of study, the sample size, the demographic makeup of the subjects, the location of the study, the methods of assessment, the mean follow-up interval, the outcomes measured, the psychosocial outcomes, and the type of statistical analysis used. Consensus was reached by 2 investigators through discussion in cases of initial disagreement. If articles did not explicitly provide survival data, means were calculated whenever possible from the data provided. Finally, an overall study quality rating score was determined, as previously described (3, 29).

The Cochran *Q* test for heterogeneity was used to assess if a fixed- or random-effects model would be used in the meta-analysis of the data. Forest plots were generated to display the results of the meta-analysis and the 95% confidence interval (CI) estimates. Publication bias was assessed by creating funnel plots. An independent *t* test was performed on the data collected in the meta-analysis.

Results

Description of the Reported Literature

Electronic searching and hand searching located 975 titles on the survival of IR teeth; 71 abstracts were screened, 46 articles received full-text review, and 8 articles were included (Table 1) (18, 30–36). A funnel plot for IR teeth indicated some publication bias (Fig. 3). Few of the intentional replant articles included detailed explanation of the mean or minimum length of follow-up, precluding time-rate analyses. However, the data reported in Table 1 were considered to entail at least a 2-year mean follow-up; two studies had a mean follow-up of approximately 5 years, another had a median of approximately 6 years, some cases were followed for up to 22 years, and 1 study provided a 4-year Kaplan-Meier tooth survival curve. This Kaplan-Meier analysis indicated that most losses of IR teeth occurred within the first year, after which a steady state was reached (36). Only 2 of the intentional replant articles were published in the last dozen years; even these differed in clinical technique, hence limiting the definition of the nature of contemporary intentional replant practice, analysis, and interpretation.

- A. (((("Dental Implants, Single-Tooth"[MeSH] AND ("2006/01/01"[PDAT] : "2012/12/31"[PDAT]) AND "humans"[MeSH Terms] AND English[lang])) AND ("treatment outcome"[MeSH Terms] OR ("treatment"[All Fields] AND "outcome"[All Fields]) OR "treatment outcome"[All Fields])) AND ("Dental Implants, Single-Tooth"[MeSH] AND ("2006/01/01"[PDAT] : "2012/12/31"[PDAT]) AND "humans"[MeSH Terms] AND English[lang])) AND ("survival analysis"[MeSH Terms] OR ("survival"[All Fields] AND "analysis"[All Fields]) OR "survival analysis"[All Fields])
- B. ("Dental Implants"[MeSH] AND "survival analysis"[MeSH]) OR ("Dental Implants"[MeSH] AND "Treatment Outcome"[MeSH]) AND ("2006/01/01"[PDAT] : "2012/12/31"[PDAT]) AND "humans"[MeSH Terms] AND English[lang])
- C. "Dental Implants, Single-Tooth" AND ("2006/01/01"[PDAT] : "2012/12/31"[PDAT]) AND "humans"[MeSH Terms] AND English[lang])

Figure 2. Search methodology for ISCs.

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