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

Mahmoud Torabinejad, DMD, MSD, PbD,* Nathan A. Dinsbach, DDS, MSD,§ Michael Turman, DDS, MSD, Robert Handysides, DDS,* Khaled Babjri, MD, MPH, and Shane N. White, BDentSc, MS, MA, PbD†

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 prognosis 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 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 a periradicular pathosis at 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 anatomical 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 Areno (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 pertapical 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
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.
Discussion

ISCs had a significantly higher mean survival than IR teeth. Moreover, none of the 8 intentional replant studies reported a higher survival than the mean survival for ISCs (Tables 1 and 2 and Fig. 5). Likewise, only 1 of the 27 ISC studies reported a survival lower than the mean intentional replant survival (50). These data were extremely compelling regardless of inherent differences among the reported studies, search bias, publication bias, and the simple comparison of means methodology. Any systematic review and meta-analysis is inherently limited by the shortcomings of the extant literature; despite the iterative process in defining the research question and methodology, this study was clearly limited by the heterogeneity, publication bias, and age of the intentional replant literature.

Intentional replantation is not a procedure that is frequently performed. It is intended to treat teeth that cannot be feasibly treated by other means (16, 21). Second maxillary and mandibular molars are more common candidates for intentional replantation likely because access is limited by their position and by thick bone. Additionally, their apices may lie near the maxillary sinuses or the inferior alveolar canal; implant placement in these areas can also be challenging because of the need for sinus grafting, proximity to the inferior alveolar canal, and limited access. IR teeth are usually quickly returned to function, whereas the healing time for ISCs may vary considerably.

Intentional replantation for a failing NSRCT molar is likely to be more cost-effective than many other treatment options; it has an initial cost equivalent to that for apical surgery. A recent study, using 75% and 94% survival rates as well as general and specialist fee schedules, found that apical surgery was more cost-effective than 6 other treatment options including nonsurgical retreatment with full-coverage restoration, nonsurgical retreatment with crown lengthening and full-covereage restoration, nonsurgical retreatment with post/core and full-covereage restoration, nonsurgical retreatment with crown lengthening and post/core and full-covereage restoration, extraction with fixed partial denture, and extraction with single-implant–supported restoration (65).

A simple comparison of the samples in this meta-analysis (4130 implants studied in the past dozen years (11) vs 838 IR teeth studied over the past 4 dozen years) reflects the relative interest and usage of these treatments. Interestingly, the year of publication of IR teeth articles over the past dozen years (13) vs 838 IR teeth studied reflects the relative interest and usage of these treatments. Interestingly, the year of publication of IR teeth articles considerably.

Figure 3. Funnel plot of IR tooth survival studies.

Survival of Intentionally Replanted Teeth and ISCs

Meta-analysis revealed an overall mean survival of 88% (95% CI, 81%–94%) for IR teeth (Table 1 and Fig. 5). Root resorption was reported as an adverse outcome in all included studies, with an overall prevalence of 11% (Table 1). Meta-analysis revealed an overall mean survival of 97% (95% CI, 96%–98%) for ISCs (Table 2 and Fig. 5). An independent t test was performed to compare the outcomes of the meta-analysis of the 2 treatment modalities. The mean survival of ISCs was significantly higher than that of IR teeth (P < .001).

Electronic and hand searching located 2160 titles on ISC survival; 71 abstracts were screened, 44 articles received full-text review, and 27 articles were included (37–63) (Table 2). The funnel plot for ISC studies was well distributed, indicating a low risk of publication bias (Fig. 4). The most commonly cited survival criteria were those of Misch et al (64) (ie, implants still in function but not necessarily with ideal conditions). The length of follow-up of the ISC articles described in Table 2 varied; 13 articles had a 2- to 4-year follow-up, 7 had a 4- to 6-year follow-up, and 7 had a >6-year follow-up. Again, it appeared that most ISC losses occurred within the first 2 years.

A total of 838 teeth and 4130 implants were included in this meta-analysis. Sample sizes of the studies varied considerably, ranging from 20 to 287 teeth and from 14 to 521 implants. The mean quality rating scores for studies on intentional replantation and single-tooth implants were both moderate, 10 out of 17.

A test for heterogeneity in survival among the studies (Q = 178.96, P < .001) indicated significant variance among the studies. The z score and P value for individual studies are listed in Figures 1 and 2. Because of the heterogeneity detected between the studies, the DerSimonian-Laird random-effects model was used to report weighted survival means (Fig. 5).

Table 1. Evidence Table Summarizing Survival of Intentionally Replanted Teeth

<table>
<thead>
<tr>
<th>Author [year] (reference)</th>
<th>Number of teeth</th>
<th>Percentage survival</th>
<th>95% CI lower limit</th>
<th>95% CI upper limit</th>
<th>z value</th>
<th>P value</th>
<th>Percentage resorption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grossman [1966] (18)</td>
<td>45</td>
<td>80</td>
<td>67</td>
<td>91</td>
<td>14.8</td>
<td>&lt;.001</td>
<td>18</td>
</tr>
<tr>
<td>Emmertsen and Andreasen [1966] (30)</td>
<td>100</td>
<td>81</td>
<td>73</td>
<td>88</td>
<td>22.4</td>
<td>&lt;.001</td>
<td>31</td>
</tr>
<tr>
<td>Kingsbury and Wiesenbaugh [1971] (31)</td>
<td>149</td>
<td>97</td>
<td>93</td>
<td>99</td>
<td>33.7</td>
<td>&lt;.001</td>
<td>5</td>
</tr>
<tr>
<td>Koenig et al [1988] (32)</td>
<td>177</td>
<td>82</td>
<td>76</td>
<td>87</td>
<td>30.1</td>
<td>&lt;.001</td>
<td>4</td>
</tr>
<tr>
<td>Bender and Rossman [1993] (33)</td>
<td>31</td>
<td>81</td>
<td>65</td>
<td>93</td>
<td>12.4</td>
<td>&lt;.001</td>
<td>19</td>
</tr>
<tr>
<td>Raghoebar and Vissink [1999] (34)</td>
<td>29</td>
<td>86</td>
<td>71</td>
<td>97</td>
<td>12.8</td>
<td>&lt;.001</td>
<td>14</td>
</tr>
<tr>
<td>Abid [2010] (35)</td>
<td>20</td>
<td>90</td>
<td>72</td>
<td>100</td>
<td>11.3</td>
<td>&lt;.001</td>
<td>25</td>
</tr>
<tr>
<td>Choi et al [2014] (36)</td>
<td>287</td>
<td>95</td>
<td>92</td>
<td>97</td>
<td>45.6</td>
<td>&lt;.001</td>
<td>7</td>
</tr>
<tr>
<td>Total</td>
<td>838</td>
<td>88</td>
<td>81</td>
<td>94</td>
<td>24.8</td>
<td>&lt;.001</td>
<td>11</td>
</tr>
</tbody>
</table>

CI, confidence interval.
Dentists may be unfamiliar with intentional replantation and may not consider it in their treatment planning process. The high success rates of NSRCT and subsequent nonsurgical retreatment limit the need for intentional replantation. Past negative opinions may limit the consideration of intentional replantation. Grossman (18) advocated that intentional replantation should be "a procedure of last resort." This opinion has been echoed by others (19, 33, 66). Weine (67) went further, stating that he had found "few dental procedures with a poorer prognosis than intentional replantation."

Treatment variables associated with intentional replantation (apical diagnosis, preoperative antibiotic prophylaxis, prior NSRCT, type of root end filling material, antibiotic regimen, tooth splinting, and so on) have generally not been studied. However, Choi et al (36) retrospectively evaluated the effect of orthodontic extrusion before performing molar intentional replantation. Their sample size (N = 287) represented over one third of the teeth included in this systematic review (Table 1 and Fig. 5). Their mean follow-up period was 25 months. Intentional replantation alone yielded 91% survival, whereas the survival of IR teeth with preoperative orthodontic extrusion was 98%, a statistically significant difference. All of the 19 teeth that underwent resorption that were eventually extracted received no prior orthodontic extrusion. Orthodontic extrusion followed by intentional replantation was used in 162 cases, none of which underwent root resorption. White mineral trioxide aggregate was the sole root end filling material used in that study.

One paper reported that an intentional replantation case, without preoperative antibiotics, failed 3 weeks after replantation (33). The patient was then given preoperative antibiotics and a chlorhexidine rinse, and the tooth was replanted a second time. The authors reported that 46 months later the tooth had healed without complication.

Some of the early literature on intentional replantation involved some teeth replanted following traumatic injury (68, 69). The literature on avulsed teeth now reflects our understanding of the importance of extraoral time, especially dry time (70). It is possible that the resorption occurring after replantation of traumatically avulsed teeth became associated with replantation. Authors studying tooth replantation have recognized the importance of preserving the periodontal ligament and limiting the extraoral time to 30 minutes or less (19, 20, 30, 71).

Examination of Table 1 revealed a general trend—the larger the sample size, the lower the prevalence of resorption. Experience and repetition may improve performance. A study by Emmertsen and Andreassen (30) in 1966 was the sole exception to this trend. However, those authors explained that they had to grind and taper the roots of several teeth to get them to fit back into their sockets; damage to the periodontal ligament could account for their higher rate of resorption.

TABLE 2. Evidence Table Summarizing Survival of Implant-supported Single Crowns

<table>
<thead>
<tr>
<th>Author [year] (reference)</th>
<th>N</th>
<th>Percentage survival</th>
<th>95% CI lower limit</th>
<th>95% CI upper limit</th>
<th>z value</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Krennmair et al [2002] (37)</td>
<td>146</td>
<td>97</td>
<td>94</td>
<td>99</td>
<td>33.77</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Mericske-Stern et al [2002] (38)</td>
<td>109</td>
<td>99</td>
<td>96</td>
<td>99</td>
<td>30.46</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Norton [2002] (39)</td>
<td>40</td>
<td>90</td>
<td>78</td>
<td>98</td>
<td>15.7</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Romanos and Nentwig [2002] (40)</td>
<td>56</td>
<td>96</td>
<td>90</td>
<td>100</td>
<td>20.46</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Andersson et al [2003] (41)</td>
<td>42</td>
<td>98</td>
<td>90</td>
<td>98</td>
<td>18.07</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Groisman et al [2003] (42)</td>
<td>92</td>
<td>93</td>
<td>87</td>
<td>93</td>
<td>25.07</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Morris et al [2001] (43)</td>
<td>251</td>
<td>95</td>
<td>92</td>
<td>97</td>
<td>42.41</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Bianchi and Sanfilippo [2004] (44)</td>
<td>116</td>
<td>100</td>
<td>99</td>
<td>100</td>
<td>32.91</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Block et al [2004] (45)</td>
<td>74</td>
<td>95</td>
<td>88</td>
<td>99</td>
<td>22.85</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Covani et al [2004] (46)</td>
<td>163</td>
<td>97</td>
<td>94</td>
<td>99</td>
<td>35.47</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Dhanrajani and Al-Rafee [2004] (47)</td>
<td>147</td>
<td>94</td>
<td>89</td>
<td>97</td>
<td>31.93</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Doring et al [2004] (48)</td>
<td>275</td>
<td>98</td>
<td>96</td>
<td>99</td>
<td>47.45</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Vigolo et al [2004] (49)</td>
<td>192</td>
<td>95</td>
<td>91</td>
<td>98</td>
<td>37.06</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Ottoni et al [2005] (50)</td>
<td>46</td>
<td>76</td>
<td>63</td>
<td>87</td>
<td>14.37</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Pjetursson et al [2005] (51)</td>
<td>214</td>
<td>93</td>
<td>89</td>
<td>96</td>
<td>38.05</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Schropp et al [2005] (52)</td>
<td>46</td>
<td>93</td>
<td>84</td>
<td>99</td>
<td>17.66</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Turkyilmaz et al [2007] (53)</td>
<td>59</td>
<td>95</td>
<td>88</td>
<td>99</td>
<td>20.48</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Bilhan et al [2011] (54)</td>
<td>165</td>
<td>92</td>
<td>86</td>
<td>96</td>
<td>28.21</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Jung et al [2008] (55)</td>
<td>305</td>
<td>98</td>
<td>96</td>
<td>99</td>
<td>49.8</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Manganese et al [2010] (56)</td>
<td>307</td>
<td>98</td>
<td>97</td>
<td>100</td>
<td>50.39</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MacDonald et al [2009] (57)</td>
<td>14</td>
<td>93</td>
<td>72</td>
<td>94</td>
<td>9.35</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Misch et al [2008] (58)</td>
<td>563</td>
<td>97</td>
<td>96</td>
<td>99</td>
<td>66.67</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Crespi et al [2010] (59)</td>
<td>30</td>
<td>100</td>
<td>94</td>
<td>100</td>
<td>16.35</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Koo et al [2010] (60)</td>
<td>521</td>
<td>99</td>
<td>97</td>
<td>100</td>
<td>45.16</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>De Bruyn et al [2011] (61)</td>
<td>53</td>
<td>100</td>
<td>96</td>
<td>100</td>
<td>19.48</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Finne et al [2012] (62)</td>
<td>82</td>
<td>99</td>
<td>94</td>
<td>99</td>
<td>23.96</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Gottfredsen et al [2012] (63)</td>
<td>20</td>
<td>100</td>
<td>92</td>
<td>100</td>
<td>13.23</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Total</td>
<td>4130</td>
<td>97</td>
<td>96</td>
<td>98</td>
<td>87.87</td>
<td>&lt;.001</td>
</tr>
</tbody>
</table>

CI, confidence interval.

Figure 4. Funnel plot of ISC survival studies.
It was assumed that all of the included teeth in the IR studies exhibited periapical pathoses that necessitated intervention. However, only 2 of the 8 studies explicitly spoke to this point. Again, the overall quality of both IR and ISC studies was only moderate.

There was a decided lack of consensus on the criteria describing successful IR teeth. Success was variously and arbitrarily described as retention of the tooth for 3, 5, or 10 years (68, 70, 72). There was no consensus on the amount of root resorption that constituted a failure. It is possible that the survival of IR teeth in this systematic review was diminished by adverse selection because it has been considered “a procedure of last resort” reserved for hopeless cases.

**Figure 5.** Forest plots of ISC and IR tooth survival studies.
The patients included in the included ISC studies tended to be treated by specialists and in academic institutions. However, a recent study using a real-world Practitioners Engaged in Applied Research and Learning Network produced very different results. Although implant survival was high, approximately 98% with a mean of 4 years of follow-up, a great many implants were classified as failures, 19%–64% depending on the success criteria applied. A like pattern was found for root canal treatment, but the gap between specialty or institutional and community practice was much smaller. Estimates from longitudinal institutional studies must be seen as the upper limits of what is achievable in real-world community practice.

The extremely high mean survival for ISCs (97%; CI, 96%–98%) was in close agreement with prior reports; interestingly, their survival rate appeared to have slightly increased since prior systematic reviews (Table 2) (3, 4). However, the survival of IR teeth was by no means too low; this treatment should be considered as an alternative treatment modality in selected cases. The reported survival rate (88%) is higher than reported healing of nonsurgical endodontic root canal cases (9, 10). A description of all the factors involved in determining whether a tooth should be saved or replaced using an implant is beyond the scope of this article. Some factors include the amount of remaining tooth structure, caries risk, periodontal prognosis, the patient’s systemic health, the patient’s desires and values, and economic considerations (22–27). The dental team must help a patient to understand the risks and benefits of the various treatment options and the prognosis for their individual situation and help them recognize their own values and preferences (28). In this manner, a patient will truly make an informed decision regarding the choice between tooth retention through intentional replantation or replacement using an implant.

Conclusions

A systematic review and meta-analysis found that the mean survival of ISCs (97%) was significantly higher than that of IR teeth (88%). One study indicated that orthodontic extrusion of a tooth before intentional replantation decreased the risk of resorption and increased the survival. This most recent intentional replantation study using contemporary materials reported high survival. Studies using contemporary treatment methods should be performed to identify and measure intentional replantation prognostic and treatment variables.

Acknowledgments

The authors wish to thank Ms Elisa Cortez for her assistance with the search of the literature. The authors deny any conflicts of interest related to this study.

References


学霸图书馆

www.xuebalib.com

本文献由“学霸图书馆-文献云下载”收集自网络，仅供学习交流使用。

学霸图书馆（www.xuebalib.com）是一个“整合众多图书馆数据库资源，提供一站式文献检索和下载服务”的24小时在线不限IP图书馆。

图书馆致力于便利、促进学习与科研，提供最强文献下载服务。

图书馆导航：

图书馆首页 文献云下载 图书馆入口 外文数据库大全 疑难文献辅助工具