Secondary Treatment for Asymptomatic Root Canal Treated Teeth: A Cost-effectiveness Analysis

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Abstract

Introduction: When faced with a clinically asymptomatic root canal treated tooth with certain radiographic findings (e.g., underextended or overextended root fillings or persistent periapical lesions), clinicians need to decide between endodontically retreating the tooth before restoration or not retreating it now but possibly later on. The present study compared the cost-effectiveness of both strategies. **Methods:** A Markov model was constructed following a root canal treated, clinically asymptomatic molar with one of the described radiographic findings in a 50-year-old patient during his lifetime. Hazard functions were derived from systematically and non-systematically assessed literature, and costs were estimated for German health care. Monte Carlo microsimulations were performed for teeth with composite restorations, crowns, or post-core crowns, and costs per year of tooth retention were calculated. **Results:** Regardless of the radiographic findings, not performing immediate retreatment was found to be significantly less costly (589–954 Euro) and more effective (retention time, 25–29 years) than immediately performing secondary root canal treatment (1163–1359 Euro, 25–27 years). Both strategies had similar effectiveness only for teeth that received post-core crowns, whereas immediate retreatment remained more expensive. The uncertainty around the obtained strategy ranking was low. **Conclusions:** The high costs for secondary root canal treatment do not seem to be outweighed by the increased risks associated with certain radiographic findings in asymptomatic teeth. Our results should be interpreted with caution because the quality of the underlying data is limited. *(J Endod 2015;41:812–816)*

Key Words

Dental, endodontics, health economics, secondary root-canal treatment, success, survival

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Root canal treatment of both vital and nonvital teeth has been found to be a highly successful treatment, allowing for long-term tooth retention (1–4). In case of complications (pain, swelling, sinus formation), secondary root canal treatment (ie, nonsurgical retreatment) is often advised, which was mostly found more efficacious and cost-effective than surgical root canal treatment or removal and replacement of the tooth (4–9).

Dentists are faced with an even greater decision dilemma when confronted with a root canal treated tooth without clinical complications but certain radiographic findings such as an underextended or overextended root filling or a persistent periapical lesion: On the one hand, there is no subjective need to retreat, whereas on the other hand, these conditions have been found to increase the risk of long-term complications (2). Thus, dentists need to weigh the costs and effects of retreatment against the risk of complications if no such retreatment is provided. Decision-making is further complicated in case a restoration is planned for these teeth: For teeth receiving direct restorations, which are easily repaired or replaced in case a secondary root canal treatment is required later on, the decision might lean toward not performing retreatment, whereas retreatment will more often be considered for teeth receiving conventional or post-and-core crowns. The resulting uncertainty leads to substantial interindividual variation of treatments (10), with therapeutic decisions often being made on the basis of clinical judgment but without comprehensive consideration of other relevant aspects such as patient's preference or costs (11). We aimed at evaluating the costs and effectiveness of these 2 treatment strategies and attempted to evaluate the degree of uncertainty associated with each decision under different clinical conditions.

Methods

The execution and reporting of this study follow guidelines for health economic analyses (12).

Target Population and Subgroups

We compared the cost-effectiveness of different treatment strategies for asymptomatic teeth that had recently received a root canal filling, were clinically asymptomatic, but showed certain radiographic findings that have been found to increase the risk of failure (ie, underextended or overextended root fillings or periapical lesions). Analyses were performed for 3 restorative scenarios: teeth receiving a direct composite restoration, a crown, or a post-and-core crown. The teeth were assumed to have been filled with gutta-percha and to have been restored with a temporary material. The base-case analysis was performed for a single molar tooth in a 50-year-old male patient (the age of the patient determines the length of the simulated time period, ie, the time until death). No distinction between upper and lower molars was made because of limited data availability. Sensitivity analyses were performed to evaluate the cost-effectiveness in incisors instead of molars and in situations where restorations required full renewal instead of repair after endodontic retreatment.

Setting and Perspective

Cost-effectiveness was assessed under the assumptions of German health care. A private-payer perspective was adopted; costs were derived from the private item fee catalog (GOZ), which allows more detailed calculation than the public fee catalog and has been used for similar calculations (13, 14).

Comparators

The following comparisons were analyzed:

1. Immediate restoration without secondary root canal treatment (no retreatment)
2. Secondary root canal treatment followed by restoration (retreatment)

The comparisons were performed for the following scenarios:

1. Underextended root canal filling. We did not evaluate different degrees of underextension because different studies used different cutoffs, and data for a dose-response are limited (2).
2. Overextended root canal filling. Again, we did not specify how much overextended the root filling was (2).
3. Presence of a periapical lesion (ie, chronic apical periodontitis) (2).

Note that we did not combine different findings within this study (ie, a tooth with an underextended filling and a periapical lesion).

Time Horizon and Outcomes

The analysis was performed to evaluate the retention time of the tooth during the patient's lifetime. The following outcomes were recorded: costs (in Euro) and retention time of the tooth (in years).

Measurement of Effectiveness

Retention time of the tooth was determined by transition probabilities. These probabilities reflected the risk of complications and the need for follow-up treatments. We discriminated endodontic from non-endodontic complications; both were estimated from systematically synthesized data, distributed along observation times, and subsequently regressed by using ordinary least-square regression analyses to calculate hazard functions (15). If applicable, ranges (between minimum and maximum) or confidence intervals of transition probabilities were derived from the literature or from own calculations for random sampling.

Costs and Discount Rate

Costs were estimated in Euro on the basis of the private item fee catalog (GOZ) for 2014. For GOZ, factoring of chargeable item-points is common to determine prices, allowing one to individualize the fee according to the required time and effort for each treatment (15). We used both the standard multiplication factor, which is $\times 2.3$, and average national multiplication factors (the mean of the actually used factors in Germany) for the most frequently used items (16). Costs were then derived by random sampling from a uniform distribution between these 2 cost estimates. Because of the lack of primary data, opportunity costs of patients' time in treatment were not accounted for. Costs were discounted with 3% per annum, as recommended by German authorities (17). No such discounting was performed for effectiveness despite occasionally being recommended (17) because discounted time is difficult to interpret.

Choice of Model

A tooth-level Markov model was constructed (TreeAge Pro 2013; TreeAge Software, Williamstown, MA), which consisted of initial and follow-up health states. As described, the likelihood of teeth translating from one to the other health state was based on transition probabilities, with each transition generating costs. Model validation was performed internally by checking the impact of distributions and key parameters and externally by comparing the modeled outcomes with those from epidemiologic studies.

Assumptions

The following assumptions were made:

1. Root canal treated, asymptomatic teeth with 1 of the described 3 radiographic findings were either submitted to secondary root canal treatment or not. In both cases, a definite restoration was to be provided by using a three-surfaced composite restoration, a non-precious metal crown, or a post-core crown.
2. Depending on their endodontic and restorative status, teeth had certain risks of endodontic and non-endodontic complications. Endodontic complications were clinical (pain, swelling, formation of sinus) or radiographic (persistent or increasing periapical lesion). The risk of endodontic complications was derived from studies reporting on success or need to retreat (2, 3, 7, 18, 19). It should be highlighted that within these studies, dropouts were treated as censored; these studies are thus prone to underestimate the true risk of complications. Because this was the case in all treatment groups, the impact on our results was presumably limited.
3. Teeth that had not received secondary root canal treatment and had been restored with a composite restoration or a conventional crown, not a post-core crown, were allocated to secondary endodontic treatment in case of endodontic complications. In the base-case analysis, restorations in these teeth were repaired after secondary treatment (ie, the access cavity was closed by using composite resin). Teeth that had received post-crowns or previous secondary treatment and experienced endodontic complications afterwards were allocated to surgical retreatment. Note that this is potentially not the only but most likely treatment in this case. If the latter failed, extraction was performed. Because there were insufficient data as to how exactly primarily or secondarily root canal treated teeth fail depending on their initial radiographic status, we modeled the probability of persistent or increasing periapical lesions within a uniform distribution between 0.01 and 1 (ie, maximum uncertainty). Thus, we accounted for the possibly increased risk of complications after retreating teeth with persistent lesions (20).
4. Non-endodontic complications included restorative failure (ie, secondary caries or loss of restoration, and fracture of the tooth). The probability of non-endodontic complications was affected by the type of coronal restoration, with higher risks for teeth restored by using composite, not crowns (4). If composites failed, crown placement was performed. Replacement of crowns was performed by using post-crowns. Teeth with failed post-crowns were assumed to be extracted. We did not model omission of these steps (ie, assumed failures in teeth restored with composite or crowns to be mendable). This might lead to overestimation of survival but should not affect the comparative results, because all strategies followed this restorative path.
5. Costs of diagnostics (ie, examination, radiographs) were not included in our analysis except when they were clearly associated with a treatment (eg, radiographs during secondary root canal treatment).

Analyses

Cost-effectiveness was calculated by using Monte Carlo microsimulations. Joint parameter uncertainty of transition probabilities was introduced by randomly sampling transition probabilities from triangular distributions between the 5% and 95% percentiles, 95%