Effect of smear layer on sealing ability of canal obturation: a systematic review and meta-analysis

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CRD summary
This review, which evaluated the effectiveness of smear layer removal in reducing leakage of extracted human teeth hardened with gutta-percha and different sealers in vitro, concluded that sealing of the root canal is more effective with smear layer removal. The review had various limitations and the authors’ conclusions should be interpreted with caution.

Authors’ objectives
To assess the effectiveness of smear layer removal in reducing leakage of extracted human teeth hardened (obturated) with gutta-percha and different sealers in vitro.

Searching
PubMed was searched between January 1975 and January 2005 for publications in the English language; the search terms were reported. Reference lists were also checked for further relevant articles.

Study selection
Comparative studies were eligible for inclusion.

Specific interventions included in the review
Studies using gutta-percha to obturate extracted human teeth were eligible for inclusion. Studies assessing the effects of laser treatment for morphology and permeability of apical dentin surfaces, and dentinal adhesive systems on pulp chamber seal, were excluded. The included studies used cold, warm, chloroform or softened obturation techniques with gutta-percha, together with zinc oxide-eugenol, calcium hydroxide, resin or glass ionomer sealants, or without a sealer.

Participants included in the review
There were no specific inclusion criteria for the participants. However, studies focusing on extracted human teeth with or without smear layer removal were eligible for inclusion.

Outcomes assessed in the review
Studies comparing differences in leakage were eligible for inclusion. In the included studies, leakage was assessed by a variety of tests: dye leakage, fluid filtration, electrochemical, bacterial leakage or volumetric dye leakage.

How were decisions on the relevance of primary studies made?
Two endodontists screened studies for relevance. No other details were provided.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
The authors did not state how many reviewers performed the data extraction. The mean and standard deviation were extracted for quantitative data and the percentage for qualitative data.
Methods of synthesis
How were the studies combined?
A meta-analysis using a random-effects model was used to pool the mean differences for studies using the dye leakage test. Publication bias was assessed using Begg's adjusted rank correlation test and funnel plots.

How were differences between studies investigated?
Meta-regression was used to examine possible reasons for heterogeneity (leakage test, obturation technique, sealer type, dye). Between-study variation was also assessed using the restricted likelihood method.

Results of the review
Twenty-six studies (65 comparisons) were included in the review. Forty-four comparisons used the dye leakage test, 7 used the fluid filtration test, 7 used the electrochemical test, 6 used the bacterial leakage test, and the remaining comparison used volumetric dye leakage.

There was no evidence of publication bias from Begg's test (0.3, p=0.403) and funnel plots.

Thirty-five (53.8%) of the 65 comparisons showed no significant difference between removal or non-removal of the smear layer; 27 (41.5%) identified a significant difference in support of smear layer removal and 3 (4.7%) reported a significant difference favouring non-removal. The chi-squared test showed a significant difference between these figures (p<0.001). The comparison between percentages and sample size indicated a significant difference, with large sample sizes favouring removal of the smear layer (p<0.046). The sample sizes ranged from 10 to 44 human teeth.

Subgroup analyses indicated that removal of the smear layer decreases dye leakage (z-score of difference 0.37, p=0.021). Results for other measures were reported in the paper. There was significant methodological heterogeneity. Meta-regression identified no significant association between effects of smear layer removal and obturation type, site of leakage test, sealer type, type of dye used or duration of leakage test.

Authors' conclusions
Sealing of the root canal was more effective with smear layer removal, as shown by in vitro leakage studies. Factors such as obturation technique or sealer type had no significant effect on treatment.

CRD commentary
The review question was clear and inclusion criteria were referred to for the interventions, outcomes and study design. One electronic database was searched for published studies. The authors restricted the inclusion criteria to English language publications, thus potentially introducing language and publication bias. They did, however, assess publication bias in their analyses. It is unclear whether appropriate steps were taken to minimise reviewer bias and error in the study selection and data extraction processes. The authors do not appear to have assessed the quality of the primary studies in a standardised manner.

Limited study details were reported. There was evidence of methodological heterogeneity, which restricted the data synthesis, and confidence intervals, which were not reported on the forest plot for dye leakage results, appeared wide for many of the studies. In addition, small sample sizes limited the conclusions drawn from the remaining data synthesis. The authors highlighted that most of the included studies were carried out with ex vivo tests, and that this should be considered when interpreting the results. Given these limitations, the authors' conclusions should be interpreted with caution.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors stated that future studies should explore the issue with in vivo tests to allow the results to be extended to clinical practice.
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