Frequency of persistent tooth pain after root canal therapy: a systematic review and meta-analysis
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CRD summary
The authors concluded that the frequency of all-cause pain at six months or more after root canal on permanent teeth reflected a lower limit of chronic pain frequency. Higher persistent pain estimates were derived in higher quality and prospective studies. The authors’ conclusions reflected the evidence, but should be interpreted with some caution given the limitations of the included studies.

Authors’ objectives
To estimate the frequency of all-cause tooth pain at six months or more in patients who underwent root canal therapy on permanent teeth.

Searching
PubMed, The Cochrane Library and TRIP databases and Google Scholar were searched between 1949 and June 2009 for articles in any language. Search terms were reported. Reference lists of prominent articles, literature reviews and textbooks were handsearched.

Study selection
Studies that reported on postoperative tooth pain at a minimum of six months follow-up were eligible for inclusion. The endodontic procedure could be initial or re-treatment and surgical or non-surgical. Pulpotomy, partial pulpotomy or pulp capping were excluded. Primary teeth were excluded. Pain could be spontaneous or provoked by biting, palpation or percussion. Studies had to provide baseline and follow-up patient postoperative pain data (reported by the patient or physician) suitable for calculating the frequency of postoperative pain. Abstracts were excluded.

The included prospective and retrospective studies investigated patients following periapical surgery, non-surgical root canal treatment (initial and re-treatment) and combined treatments. Studies were primarily conducted in university-based settings or tertiary care centres. The number of multiple procedures per study ranged from zero to 222.

Two authors undertook the selection process. Disagreements were resolved through consensus or, if needed, arbitration by a third reviewer.

Assessment of study quality
Two reviewers performed the quality assessment using the Strengthening the Reporting of Observational Studies in Epidemiology rankings (STROBE) 22-point scale. Quality scores ranged from 0 to 22; above median scores indicated high quality and below median scores represented low quality.

Data extraction
Two authors independently extracted data on all-cause pain at six months or more after endodontic procedures.

Methods of synthesis
Random-effects meta-regression was used to produce a summary estimate for frequency of all-cause pain at six months or more after endodontic treatment, together with 95% confidence intervals (CIs). Heterogeneity was assessed using $I^2$. Subgroup analysis considered surgical versus non-surgical treatment, prospective versus retrospective study design, follow-up rate of recall, follow-up of less than 12 months versus over 12 months, initial treatment versus re-treatment and study quality. Sensitivity analysis excluded one study at a time.

Results of the review
Twenty-six cohort studies or clinical trials published between 1975 and 2009 were included in the review (n=5,777). Length of follow-up ranged from six months to 20 years. The proportion of teeth followed up ranged from 20% to
100%. The number of teeth included ranged from six to 1,140. The quality of studies varied from zero to 21 out of 22 (median 8.5).

Frequency of all-cause pain over the 26 studies was statistically significant (5.3%, 95% CI 3.5% to 7.2%, $I^2=80\%$).

Sensitivity analysis that excluded one study at a time resulted in the frequency of all-cause pain ranging from 4.5% to 5.8%.

Subgroup analysis based on quality had the biggest impact on results: all-cause pain in high-quality studies was 8.3% and in low quality studies it was 1.4%. Retrospective studies had the lowest estimate of all-cause pain frequency (0.9%); prospective studies had the second-highest all-cause pain estimate (7.6%).

**Authors' conclusions**

Frequency of all-cause pain at six months or more after root canal or permanent teeth treatment was approximately 5%, which reflected a lower limit of chronic pain frequency after endodontic procedures. Higher persistent pain estimates (>7%) were derived in higher-quality studies and studies that used a prospective design.

**CRD commentary**

Inclusion criteria for the review were clearly defined. Several relevant data sources were searched for published studies. There was no restriction by language, which should have minimised language bias. There was no attempt to locate unpublished studies and publication bias was not assessed. Two authors performed study selection, data extraction and quality assessment to minimise risks error and bias in the analysis. Quality assessment indicated generally poor quality of the included studies (acknowledged by the authors). The authors highlighted the fact that only one of the included studies used pain as a primary outcome. Studies were combined using a random-effects meta-regression. Subgroup and sensitivity analysis were undertaken. Significant statistical heterogeneity was present in the analysis and few details on patient characteristics were provided, which made it difficult to determine the reasons for the heterogeneity and the suitability of the studies for pooling.

The authors' conclusions seemed to reflect the evidence, but given the generally poor quality of the included studies and unexplained heterogeneity they should be interpreted with some caution.

**Implications of the review for practice and research**

**Practice:** The authors stated that the generalisability of their findings to the general practice setting was unknown.

**Research:** The authors stated that methodologically rigorous studies would be useful for refining the magnitude of persistent pain. It would also be beneficial to patients and practitioners to evaluate the effects of root canal therapy and determine the associated risk factors.

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