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- Sonderdruck – Endocarditisprophylaxe – Was ist neu? (Deutsche Herzstiftung 2008)

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Impact of a Retained Instrument on Treatment Outcome: A Systematic Review and Meta-analysis

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Abstract

Introduction: Fracture of root canal instruments is one of the most troublesome incidents in endodontic therapy. This systematic review and meta-analysis aim to determine the outcome difference between retained fractured instrument cases and matched conventional treated cases. **Methods:** The MEDLINE database, EM-BASE, Web of Science, and the Cochrane Database were searched. Reference lists were scanned. A forward search was undertaken on identified articles. Papers citing these articles were identified through Science Citation Index to identify potentially relevant subsequent primary research. A systematic data extraction sheet was constructed. Data in these studies were independently extracted. Risk differences of included studies were combined by using the generic inverse variance data and fixed effects method. A 2-stage analysis was conducted. The first was limited to case-control studies, and the second included case series in which data were available for teeth with and without periradicular lesions. **Results:** Two case-control studies were identified and included, covering 199 cases. Weighted mean healing for teeth with a retained instrument fragment was 91%. The 2 studies were homogeneous. Risk difference of the combined data was 0.01, indicating that a retained fragment did not significantly influence healing. Overall, 80.7% of lesions healed when a periapical lesion was present, compared with 92.4% remaining healthy when no lesion was present initially ($P < .02$). **Conclusions:** On the basis of the current best available evidence, the prognosis for endodontic treatment when a fractured instrument fragment is left within a root canal is not significantly reduced. (*J Endod* 2010;36:775–780)

Key Words

Broken instrument, outcome, prognosis, separated instrument, success

During cleaning and shaping of the root canal system, procedural accidents can occur that might affect the prognosis. Examples of procedural accidents include ledge formation, artificial canal creation, root perforation, and extrusion of irrigating solution periapically (1). Not all procedural problems lead to a reduced prognosis, but any error that compromises microbial control is likely to increase the risk of a poor outcome. Fracture of root canal instruments is one of the most troublesome incidents in endodontic therapy, especially if the fragment cannot be removed.

Fractured root canal instruments might include endodontic files, lateral or finger spreaders, spiral fillers, or Gates-Glidden burs, whether manufactured from nickel-titanium (NiTi), stainless steel (SS), or carbon steel. The prevalence of retained fractured endodontic hand instruments (mostly SS files) has been reported to range from 0.5%–7.4%, but it has been variably reported on a per tooth or per canal basis (2–9). With the advent of rotary NiTi files, there has also been a perceived increase in the occurrence of broken instruments (10). This perception is probably unwarranted, particularly when retained fragments in the root canal space are considered; the frequency of retained fractured NiTi instruments might be lower than that for SS files (11). The fracture incidence among discarded rotary NiTi files after clinical use has been shown to lie in the range of 0.4%–3.7% (5, 7, 12–14). In most circumstances fracture results from incorrect use or overuse of an endodontic instrument. Although there is a perception that rotary NiTi instruments might fracture without warning, recent work indicates that fracture involves many factors, the most important of which seems to be the clinician's conscious decision to use instruments a specified number of times or until defects (unwinding, torsional fracture, or flexural fracture) were evident (15).

A number of treatment protocols for removing obstructions have been described in the literature. Earlier authors have suggested that the object, regardless of the primary endodontic diagnosis, should be left in the canal, and that the canal coronal to the object should be treated according to standard endodontic procedures (3, 16). Others have suggested that the object should be bypassed and incorporated into the root filling material (17). Surgical techniques for removal of either the object itself or the entire portion of the root encompassing the object have been recommended (18, 19). In addition, several authors have introduced special instruments and techniques for intradental retrieval of the obstructing object (10, 20–23). However, the removal procedure might result in loss of considerable tooth structure and clinical complications such as root perforation (24, 25). Thus it is important to assess the impact on prognosis of a retained fractured instrument so that it can be compared with the risk of damage during attempted removal.

This systematic review and meta-analysis were undertaken to determine the influence of a retained instrument fragment on the prognosis of root canal treatment. The clinical question to be answered in this systematic review (a problem, intervention,

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TABLE 1. MEDLINE Search Strategy Developed to Find Articles Related to Retained Instrument Fragments

Search strategy	Results
broken instrument OR fractured instrument OR separated instrument AND ("Endodontics" [MeSH] OR "Root Canal Filling Materials" [MeSH] OR "Dental Pulp Test" [MeSH] OR "Dental Pulp Diseases" [MeSH] OR "Periapical Abscess" [MeSH] OR endodontics [Text Word] OR root canal filling materials [Text Word] OR dental pulp test [Text Word] OR dental pulp diseases [Text Word] OR periapical abscess [Text Word] OR apicoectomy [Text Word] OR pulpectomy [Text Word] OR pulpotomy [Text Word] OR root canal therapy [Text Word] OR dental pulp devitalization [Text Word] OR root canal obturation [Text Word] OR root canal preparation [Text Word] OR retrograde obturation [Text Word] NOT (("Dental Implantation, Endosseous, Endodontic" [MeSH] OR "Dental Pulp Capping" [MeSH] OR "Tooth Replantation" [MeSH]) NOT ("Apicoectomy" [MeSH] OR "Pulpectomy" [MeSH] OR "Pulpotomy" [MeSH] OR "Root Canal Therapy" [MeSH])) NOT ("animals" [MeSH:noexp] NOT humans [MeSH])	125

comparison and outcome [PICO] question) can be framed as follows: in adult patients who have had nonsurgical root canal treatment, does the retention of a separated instrument, compared with no retained separated instrument, result in a poorer clinical outcome?

Materials and Methods

Literature Search

An exhaustive search was undertaken to identify all clinical studies that reported postoperative healing after endodontic instrument separation. The MEDLINE database was searched via the EviDents search engine (<http://medinformatic.uthscsa.edu/EviDents/>, last accessed September 3, 2009) by using "broken instrument OR fractured instrument OR separated instrument" as key words, which automatically created a complex search strategy (Table 1). This complex search strategy was similar to the one recommended by the Cochrane Collaboration as outlined in the Cochrane Reviewers' Handbook (26). The search of the MEDLINE database included all years from 1966–July 2009. A similar search strategy was also applied by using EMBASE, Web of Science, and the Cochrane Database and manual searches, including journals, conference proceedings, reference lists, other reviews, and unpublished studies. No language restriction was applied to the search. One hundred twenty-five studies were subjected to preliminary analysis. Titles and abstracts, where available, were scanned, and the relevance of each study to the endodontic outcome of fractured instrument was determined. Where information from the title and abstract was not adequate in determining the article's relevance, the article was automatically included in subsequent analysis. One hundred eight were excluded from the list, and the 17 remaining articles were subjected to stricter exclusion criteria.

Inclusion and Exclusion

The full texts of the remaining articles were then obtained and reviewed, and the inclusion criteria (Table 2) were applied. Reference lists from identified articles were scanned to identify other potentially relevant preceding articles (a backward search), from which 1 more article was identified (27).

TABLE 2. Inclusion and Exclusion Criteria Used in the Analysis

Inclusion criteria	
1	Subjects had a noncontributory medical history.
2	Subjects presented with mature teeth and radiographic evidence of a fractured instrument fragment such as a file (carbon steel, SS, or rotary NiTi), Gates-Glidden drill, lentulo spiral, spreader, or paste filler retained in the root canal.
3	Follow-up of at least 1 year.
4	Both clinical and radiographic examinations were completed for all patients, and the outcome was based on clearly defined criteria.
5	Case-control studies (the highest feasible level of evidence).
6	Data are accessible.
Exclusion criteria	
1	No result in terms of healing.
2	No specified observation period, or
3	Follow-up less than 1 year.
4	No specified criteria for evaluating outcome.
5	Not a case-control study.

Data Extraction

A systematic data extraction sheet was constructed. All aspects of treatment that could potentially affect the study outcomes were identified and included in the data sheet. The data in all included studies were extracted in the same fashion. The appraisal step was performed in a standardized manner by using quality assessment checklists (CASP, Public Health Resource Unit, England, 2006) that included items such as the study's design and analysis and identified the deficiencies that might arise from bias. This step was performed by 2 independent reviewers for better reliability of the results. Any disagreements were resolved by discussion.

Meta-analysis

Between-study heterogeneity was assessed by using the standard χ^2 test or Q statistic. The principal measure of treatment effect (healing) was risk difference, which for the purpose of this study is given as the difference in outcome (healing) between fractured instrument cases and control cases. Risk difference is a measure of the association between treatment (a risk of fractured instrument cases) and outcome. Risk differences of included studies were combined as generic inverse variance data type (RevMan 4.2.10; The Cochrane Collaboration's Information Management System, <http://www.cc-ims.net>, last accessed August 7, 2009), taking into account the separate tracking of healing and failure (developing or persistent periapical disease). The fixed effects model for combining study estimates was used, and an overall estimate was produced (28). The level of statistical significance was set at .05.

Results

Impact on Prognosis

Included and Excluded Studies. Two case-control studies met our inclusion criteria (Table 3: Crump and Natkin, 1970 and Spili et al, 2005). Fifteen studies that investigated some aspect of fractured instrument cases were excluded for various reasons (Table 3).