Root Canal Therapy Reduces Multiple Dimensions of Pain: A National Dental Practice-based Research Network Study

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Abstract

Introduction: Initial orthograde root canal therapy (RCT) is used to treat dentoalveolar pathosis. The effect RCT has on pain intensity has been frequently reported, but the effect on other dimensions of pain has not. Also, the lack of large prospective studies involving diverse groups of patients and practitioners who are not involved in data collection suggest that there are multiple opportunities for bias to be introduced when these data are systematically aggregated. **Methods:** This prospective observational study assessed pain intensity, duration, and its interference with daily activities among RCT patients. Sixty-two practitioners (46 general dentists and 16 endodontists) in the National Dental Practice-Based Research Network enrolled patients requiring RCT. Patient-reported data were collected before, immediately after, and 1 week after treatment using the Graded Chronic Pain Scale. **Results:** The enrollment of 708 patients was completed over 6 months with 655 patients (93%) providing 1-week follow-up data. Before treatment, patients reported a mean (±standard deviation) worst pain intensity of 5.3 ± 3.8 (0–10 scale), 50% had "severe" pain (≥7), and mean days in pain and days pain interfered with activities were 3.6 ± 2.7 and 0.5 ± 1.2, respectively. After treatment, patients reported a mean worst pain intensity of 3.0 ± 3.2, 19% had "severe" pain, and mean days in pain and days with pain interference were 2.1 ± 2.4 and 0.4 ± 1.1, respectively. All changes were statistically significant ($P < .0001$). **Conclusions:** RCT is an effective treatment for patients experiencing pain, significantly reducing pain intensity, duration, and related interference. Further research is needed to reduce the proportion of patients experiencing "severe" postoperative pain. *(J Endod 2014;40:1738–1745)*

Key Words

Endodontics, evidence-based dentistry, quality of care, pain, pain measurement, postoperative pain, research, root canal

Initial orthograde root canal therapy (RCT) is a common dental procedure with estimates suggesting that more than 15 million are performed each year in the United States (1). Often RCT is used to address a patient's complaint of tooth pain (2). RCT has been shown to be effective at addressing tooth-related disease, with 79%–95% of technically measured outcomes being deemed successful (3, 4).

With pain as the outcome of interest, many researchers have used measures that combine subjective patient reports with behavioral actions and clinician-based observations (5). For example, endodontic flare-up has been defined as "pain or swelling or a combination of both" occurring within "a few hours to a few days after … treatment" and includes "… disruption of the patient's lifestyle, such that the patient initiates contact with the dentist" (6). Although this outcome captures important information regarding practice-related burden, it does not adequately capture patient-centered experiences, which is the most desirable outcome to measure in dentistry (7) and is standard in pain-related research (8).

There have been a number of studies that have reported on change in pain intensity associated with RCT (9–13) as well as several reviews (5, 14). These studies include the use of a variety of pain intensity measures and post-treatment time points, thus providing robust results on this topic. Taken at face value, this would suggest that further research on the topic is not needed, but the studies within this body of literature have multiple limitations that inhibit the generalizability of the results to community practice. Examples of these limitations include small numbers of patients (15), single-site designs (16), studies conducted in an academic institutional setting (12), care provided by a limited number of dentists (17), analyses that include more than 1 endodontic procedure per person (9), subjective data collected by the treatment provider (18), and ambiguous reporting of study methodologies (19). Because aggregating data from multiple studies with limitations have the potential to introduce significant biases (20, 21), there is the need to perform large well-conducted prospective observational studies to address clinically meaningful outcomes to ascertain more accurate estimates of the effects of RCT. Furthermore, it is uncertain how other aspects of the pain experience are affected by RCT. Specifically, although multiple studies have reported on the effect that

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RCT has on the duration of pain after treatment, no studies have compared the effect RCT has on pain duration and interference in daily living by measuring these pain-related factors before and after treatment using standard methods. Measuring multiple dimensions of the pain experience provides greater insight about the problem (22) and provides corroborating evidence of the effect RCT has on the condition of interest. For these reasons, we conducted a large multisite prospective observational study in a practice-based setting to assess the direction and magnitude of change from the preoperative to postoperative period in pain intensity, pain duration, and pain-related interference in daily living associated with RCT.

Methods

Brief Overview of the Study

This research was conducted within the National Dental Practice-Based Research Network (23, 24); details are provided at http://nationaldentalpbrn.org/. The study methods have been previously reported (25), and pertinent points are presented later, conforming to STROBE guidelines. In brief, this prospective observational study included 62 member dentists (46 general practitioners [GPs] and 16 endodontic specialists [ESs]) from 5 geographic regions: Alabama/Mississippi, Florida/Georgia, Minnesota, Oregon/Washington, and Denmark/Sweden. Participating dentists from the network volunteered to conduct this study in their practices. Project staff met with each dentist to explain the study protocol. Dentists enrolled their patients seeking dental care over a 6-month period. Ethical review board approval from each region as well as the University of Minnesota was obtained before initiation of this research. Informed consent was obtained from patients, and study procedures were in accordance with institutional oversight.

Patient Eligibility and Recruitment

Dentists approached consecutive eligible patients for participation in this study. Inclusion criteria were as follows:

1. Patient age 19–70 years
2. Having a permanent tooth requiring RCT

Exclusion criteria were the following:

1. Iatrogenic pulpal exposure (ie, cases of carious pulp exposure were included)
2. A patient previously enrolled in this study (ie, each patient could contribute only 1 tooth to the study)
3. Previous endodontic treatment that could make it uncertain whether pain was associated with the prior treatment or the study treatment
4. Obvious cognitive impairments (eg, prior stroke with communication deficits, dementia, or mental disability)
5. The inability to read, understand, and complete the baseline patient questionnaire provided in English (or 1 of 2 Scandinavian languages in Denmark/Sweden)
6. Anticipated lack of availability to provide 6-month follow-up information

Participation was voluntary, and refusal to participate did not impact care.

Data Collection

Data collection occurred at different times:

1. Immediately before initiation of treatment to assess the preoperative state
2. Immediately after treatment to assess the intraoperative experience
3. 1 week after treatment to assess the postoperative state

The Graded Chronic Pain Scale was used to measure pain intensity using a 0 (no pain) to 10 (pain as bad as could be) rating scale as well as pain-related interference with daily activities using a 0 (no interference) to 10 (unable to carry on any activities) rating scale and days in the past week kept from usual activities (26). The original instrument was modified with the recall period being 1 week to make the preoperative and postoperative durations equal for comparison purposes.

All data were collected by confidential paper-based, standardized questionnaires. Patients completed preoperative questionnaires in the dental office and were placed in a sealed envelope by the patient to conceal their responses from the practitioner and others in the dental office. The patients' together with the practitioners' questionnaires were submitted by the dental office to each regional coordinator at least on a weekly basis. The 1-week postoperative questionnaires were completed by patients away from the dental office and mailed to each regional coordinator. Data collection forms are available at http://nationaldentalpbrn.org/peer-reviewed-publications.php. In addition to the pain-related outcome measures listed previously, these questionnaires collected information about patient, tooth, and procedure characteristics.

Statistical Procedures

Descriptive statistics (means, standard deviations [SDs], frequencies, and proportions) were used to examine characteristics of the study population overall (Table 1). Changes in tooth pain intensity, days with tooth pain, and interference in daily life were determined based on the postoperative minus the preoperative measure; thus, positive values correspond to an increase in pain (days) over time and negative values with a decrease in pain (days) over time. Only patients reporting both preoperative and postoperative data were included in these calculations. When more than 1 appointment was required to complete the RCT, the highest measure of pain intensity or number of days or level of interference reported across the appointments was assigned for the postoperative measure; taking medication for pain during the week after RCT was set to "yes" if taken after any of the appointments. For pain ratings, the significance of the pre- to postoperative change was assessed using the 1-sample paired t test. Because this test assumes that the change is normally distributed, a nonparametric analog (signed rank test) was applied to the ranked data for confirmatory purposes to ensure that the results were not an artifact of the analysis method (data not shown). The McNemar test was used to assess the significance of the change for binary-scaled measures, such as whether or not a patient was taking medications for tooth pain. This approach takes into account that the proportions are not derived from independent samples, which introduces possible correlations between the pre- and postoperative measures.

All analyses were performed using the SAS software system, version 9.2 (SAS Institute, Cary, NC). An alpha of 0.05 was used to assess statistical significance. No imputation for missing values was undertaken.

Results

Patient, Tooth, and Procedure Characteristics

The study sample consisted of 708 patients, of which 655 (93%) provided 1-week postoperative data. The mean ($\pm$ SD) age was 47.8 $\pm$ 13.0, with a range of 19–70 years (Table 1). Females made up 59% of the patients. The majority of participants were white (91%), college educated (51%), had annual household incomes of $\geq$\$30,000 (84%), and had dental insurance (81%). Fifty-nine percent of the treated teeth were maxillary, and 89% were posterior.