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Frequency, Impact, and Predictors of Persistent Pain Following Root Canal Treatment: A National Dental PBRN Study

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Abstract

Root canal treatment (RCT) is commonly performed surgery and persistent pain is known to occur, but little is known about how these patients are affected by this pain. While biopsychosocial mechanisms are thought to be associated with the development of such pain, similar to persistent pain following surgery in other body sites, little is known about the baseline predictors for persistent pain. We assessed the frequency of persistent pain 6 months following RCT, measured the impact this pain had on patients, and determined predictive factors for persistent tooth pain in a multi-center prospective cohort study conducted within the National Dental Practice-Based Research Network. Of 708 patients enrolled, 651 (91.9%) provided follow-up data, with 65 (10.0%) meeting criteria for pain 6 months following RCT. On average, these patients reported their pain as mild to moderate in intensity, present for about 10 days in the preceding month, and

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minimally interfered with daily activities. After adjusting for type of dental practitioner and patient age, gender and household income, pain duration over the week prior to RCT significantly increased the risk of developing persistent pain (odds ratio [OR]=1.19 per 1 day increase in pain duration, 95% confidence interval [CI]: 1.07–1.33), whereas optimism about the procedure reduced the risk (OR=0.39, 95% CI: 0.22–0.67). Our data suggest that persistent pain following RCT is fairly common, but generally does not have a large impact on those experiencing it. Furthermore, patient age and gender did not predict persistent pain, while pre-operative pain duration and the patient's expectation did.

Keywords

Risk Factors; Endodontics; Tooth; Evidence-Based Dentistry; Observational Study; Patient Outcome; Facial Pain; Postoperative Pain; Chronic Pain

INTRODUCTION

Pain persisting in a bodily region following surgical treatment has been well documented and is associated with further suffering, reduced quality of life, and disability [12,17]. Root canal treatment (RCT), a surgery that involves the distal aspect of the second and third branches of the trigeminal nerve innervating teeth, is one of the most commonly performed surgeries with approximately 16 million people in the United States receiving RCT each year [3]. This is significant because it has been estimated that at least 5% of patients experience persistent tooth pain after RCT [22,27].

It is known that persistent pain degrades quality of life and function in general [9], as well as following surgery [17], among those experiencing it, but the impact of persistent pain following RCT has not been reported.

While persistent tooth pain following RCT may be related to the presence of endodontic lesions [31], infection [26], incomplete/complete root fracture [5], or surgical complications [30], many cases do not have discernible causes upon follow-up evaluation [21,27]. Therefore, it is plausible to consider predisposing factors that could contribute to the presence of persistent pain, some of which have recently been elucidated for other regions of the body after surgery, such as the presence or level of pre-surgical pain and psychosocial factors [4,6,16,23].

Studies investigating predictors for the development of persistent pain following RCT have identified several factors. These include: the presence of pre-operative tooth pain, particularly if the pain lasted for more than 3 months [24]; pain experienced with percussion of the tooth [24]; having a pre-existing chronic pain disorder [24]; history of painful treatment in the orofacial region [24]; and female gender [24], while non-Hispanic/Latino ethnicity [27] and diagnoses of pulpitis without periapical pathosis [27] were protective. However, both of these studies assessed outcomes greater than one year after surgery, therefore, it is uncertain whether the same factors would be associated with the development of persistent pain over a shorter period of time following RCT, a time period when

interventions could be applied to potentially reduce the likelihood of long-term persistent pain.

Identification of factors related to the development of persistent pain within the first year following RCT may assist clinicians in identifying high-risk patients and, therefore, better inform the healthcare decision-making process. In addition, an improved understanding of the underlying mechanism(s) leading to persistent pain following RCT could assist in developing interventions to prevent or reduce these adverse outcomes, while at the same time improving our understanding whether endodontic pain mechanisms are similar to those of other bodily pain. Building upon previous knowledge, using a multi-site prospective observational cohort of patients receiving RCT, we sought to: 1) determine the frequency of persistent pain among patients 6 months following RCT; 2) assess the impact this persistent pain had on the individual experiencing it; and 3) identify pre-operatively assessed factors associated with reporting persistent pain.

METHODS

Brief Overview of the Study

This research was conducted within the National Dental Practice-Based Research Network [7,8]; details of the Network are provided at <http://nationaldentalpbrn.org/>. Human subjects approval from each geographic region, and the University of Minnesota, was obtained prior to initiation of this research.

Study Design and Setting

This prospective observational study included data collection from 62 member dentists (46 general practitioners [GP] and 16 endodontic specialists [ES]) from five geographic regions: Alabama/Mississippi, Florida/Georgia, Minnesota, Oregon/Washington, and Denmark/Sweden). Dentists enrolled their patients over a 6-month period. Informed consent was obtained from patients and study procedures were conducted in accordance with institutional oversight. Project staff met with each dentist to explain the study protocol. Data collection occurred: 1) immediately before initiation of treatment to assess the pre-operative state; 2) immediately following treatment to assess the intra-operative experience; and 3) one week, three months and six months following treatment to assess the post-operative state. The study methods have been previously reported in greater detail elsewhere [20].

Patient Eligibility and Recruitment

Dentists approached consecutive eligible patients for participation in this study. Inclusion criteria were: i) patient age 19–70 years; and ii) permanent tooth requiring RCT. Exclusion criteria were: i) iatrogenic pulpal exposure (*i.e.*, cases of carious pulp exposure were included); ii) patient previously enrolled in this study (*i.e.*, each patient could contribute only 1 tooth to the study); iii) previous endodontic treatment that could make it uncertain whether pain was associated with the prior treatment or the study treatment; iv) obvious cognitive impairments (*e.g.*, prior stroke with communication deficits, dementia, mental disability); v) inability to read, understand, and complete the baseline patient questionnaire provided in English or one of two Scandinavian languages (Swedish and Danish); and vi)

anticipated lack of availability to provide 6-month follow-up information. Participation was voluntary and lack of participation did not impact care.

Measurement of Predictive Factors

Prior research suggests many factors can play a role in post-operative pain, some being specific to RCT [13] and others related to surgery, in general [10]. For descriptive purposes, the variables from this study were grouped into 12 domains: geographic region and practitioner specialty status, demographics (age, gender, race), socio-economic status (household income, education, dental insurance status), baseline pain intensity (present, worst and average pain intensity), baseline pain qualities (participant's self-report of their perception of their pain, such as dull, sharp, aching, or throbbing, etc.), baseline pain sensitivity (*i.e.*, pain duration, pain in more than one area of the body), baseline pain interference (self-reported interference with different activities of life), psychological characteristics (*i.e.*, fear of appointment, expected treatment outcome), systemic health characteristics (smoking history, history of diabetes or high blood sugar), pulpal endodontic diagnoses (necrotic pulp or asymptomatic or symptomatic pulpitis), apical endodontic diagnosis (symptomatic or asymptomatic apical periodontitis, acute or chronic apical abscess), and tooth characteristics (*i.e.*, tooth tender to percussion or biting pressure, tooth responds to cold testing, etc.); for a full list of variables assessed, see supplemental data in Table S1. The individual factors investigated as potential predictors were collected before initiation of RCT from both patients and dentists; copies of the study questionnaires are available online <http://nationaldentalpbrn.org/peer-reviewed-publications.php>.

Measure of Persistent Pain

Questions from the Graded Chronic Pain Scale (GCPS) were used to measure pain intensity using a 0 (no pain) to 10 (pain as bad as could be) rating scale [29]. The primary outcome of postoperative pain occurring at 6 months was coded as present if pain was experienced for one or more days in the past month and average pain intensity in the past month was reported to be one or higher at the 6-month study visit. Follow up on patients was independent of the care patients received and assessment of the outcome was performed irrespective of care received after obturation was completed, such as extraction of the treated teeth.

Measure of Additional Care Following RCT

Questions concerning additional care received were asked at 3- and 6-months after obturation, each with a 3 month recall timeframe. Information obtained from the 3- and 6-month post-operative time points were combined to create a series of summary measures of additional care received to manage pain associated with the tooth that received RCT. No attempt was made to impute data when such patients had missing 3-month data, thereby potentially underreporting care received.

Statistical Procedures

Descriptive statistics were used to describe patient- and tooth-related characteristics, as well as characteristics of pain experienced following RCT. For continuous-scaled characteristics

this included the mean and standard deviation (SD), and for categorical-scaled measures this included frequencies and proportions; in addition, the median, range, and 25th and 75th percentiles were reported for pain characteristics. P-values for associations of continuous-scaled measures were obtained using the Student's t-test; categorical-scaled care measures with pain at 6 months following RCT were determined using Fisher's exact test.

Bivariate associations of putative predictors with pain experienced six months post-operative were used as the basis for screening variables for possible inclusion in multivariable logistic regression modeling; the Student's t-test was used for continuous-scaled measures and Fisher's exact test for categorical-scaled measures. Variables associated with 6-month post-operative pain at an alpha ≤0.10 level were considered as possible candidates for inclusion in the logistic regression modeling. Certain covariates were forced into the model, regardless of the significance of their association with the outcome, to adjust for potential bias that they might otherwise introduce to the analyses if not included (*i.e.*, dentist specialty training, patient age, patient gender).

Logistic regression modeling yielded adjusted odds ratios (ORs) and 95% confidence intervals (CIs) for assessing the strength of associations of potential predictors with the outcome of interest. A series of models were fit to the data to build the final model, starting with forward selection to identify variables that contributed significantly to the model. Modeling using backward elimination was then employed to assess model stability and serve as a validation step. Both modeling approaches were carried out with and without the forced variables used for adjustment purposes. A model was then fit to the data including only the final covariates selected to maximize the sample size for parameter estimation and assessing model fit. The fit of the final model to the data was assessed using the Hosmer-Lemeshow test. No imputation for missing values was undertaken. All analyses were performed using the SAS software system, version 9.3.

RESULTS

Of the 708 patients enrolled, 6-month data was collected from 651 (91.9%); the 57 patients that did not complete the 6-month survey were excluded from the analysis. A brief description of the characteristics of the patients included in the study analyses is included in Table 1, while an assessment of differences in baseline characteristics between patients included and excluded from the analyses is presented in detail within supplemental data Table S2. There were some differences between included and excluded patients, but those differences are not likely to have introduced significant bias to the results. There were 65 patients (10.0%, 95% CI: 7.8–12.6%) reporting pain at 6 months, defined as pain for ≥1 day in the past month with an average pain intensity of ≥1 on a 0–10 point scale.

Characteristics of pain among those reporting pain at 6 months following RCT are shown in Table 2. Mean (±SD) present and average tooth pain intensity in the last month reported at 6 months were 1.5±1.8 and 2.7±1.8, respectively, but the reported worst tooth pain intensity in the last month rating was 4.0±2.4. When categorizing these ratings on an ordinal pain scale with mild intensity being 1–3/10, moderate intensity being 4–6/10, and severe intensity being 7–10/10 [11], present and average pain were mild in intensity and worst pain was

moderate in intensity (Table 2). The mean (±SD) number of days patients experienced pain in the area of the RCT tooth in the past month was 9.9±10.2 days and the mean number of days that the pain interfered with usual activities was 0.3±1.3 days; however 51.8% of patients had taken some type of medication for pain in the last month, including over-the-counter, prescription, herbal or other medications.

Having pain at 6 months following treatment was significantly associated with receiving additional RCTs ($p<0.001$), with a larger proportion of patients that received additional RCTs experiencing pain (41.9%), compared to those not receiving additional RCTs (8.3%) (Table 3). The mean number of additional RCT appointments was higher among those who experienced pain at 6 months than those who did not ($p=0.01$). A significantly larger proportion of patients that received additional x-rays experienced pain at 6 months (51.4%) than those who did not (7.4%; $p<0.001$). A larger proportion of patients that reported taking medication(s) for pain (prescription, over-the-counter or herbal) and those attending medical doctor appointments experienced pain at 6 months than those who did not (42.6% vs. 4.5%, $p<0.001$ and 52.9% vs. 8.6%, $p<0.001$, respectively). The mean number of medical doctor appointments was higher among those who experienced pain at 6 months than among those who did not ($p=0.01$). Patients who experienced pain at 6 months did not differ from those who did not experience pain with respect to use of chiropractic care and acupuncture or acupressure ($p>0.08$). Seeking other types of alternative, complimentary or non-traditional health therapies was associated with pain at 6 months, with a larger proportion of those that sought this type of care experiencing pain at 6 months than patients not seeking this type of care (30.8% vs. 9.4%, $p=0.03$).

Initial bivariate assessment of the candidate predictors revealed that a number of variables met the threshold for inclusion in the stepwise selection model (*i.e.*, $p\leq0.10$); the candidate predictors that were included in the initial stepwise selection model are bolded in supplemental data Table S1. When multiple characteristics measured the same construct, such as baseline pain intensity or baseline pain interference, it would not be possible to include all of the measures in the modeling due to the correlation this would introduce. In this case, the characteristic that would be easiest to measure in a clinical setting was chosen. Variables with distributional characteristics (*i.e.*, small cell sizes) that would lead to model instability or model failure, such as geographic region or electric pain quality, were not included in the multivariable modeling despite meeting the candidate selection criterion. Lastly, although dentist's training specialty and participant's gender did not meet the selection criteria, these characteristics were nevertheless included in the modeling for adjustment purposes.

When examining the multivariable model, we observed that for each one-day increase in baseline pain duration during the week preceding RCT, the risk of developing pain 6 months postoperative significantly increased by 19% (95% CI: 1.07–1.33) (Table 4). Pain experienced at 6 months was also associated with the patient's baseline expected treatment outcome ($p<0.001$), with those expecting a "very good" outcome being 61% less likely to experience pain at 6 months than those expecting a "fair" to "good" treatment outcome (OR=0.39; 95% CI: 0.22, 0.67). Although household income appeared to make only a borderline significant contribution to the model for predicting pain at 6 months ($p=0.08$), the

likelihood ratio test found that the fit of the model to the data was significantly improved by its inclusion ($p<0.001$).

DISCUSSION

Frequency of Persistent Pain

We found that 10.0% of individuals who receive initial orthograde root canal treatment (RCT), a surgical procedure confined to the tooth, experienced pain at 6 months following the intervention, which is higher than the 5% previously reported [22,27].

Impact of Persistent Pain

Our findings support the notion that persistent pain following RCT introduces increased burden on the patients who experience it. Although we caution that the numbers of patients were quite small, in relative terms, they nonetheless suggest that patients experiencing persistent pain are more likely to have additional radiographs made, receive additional root canal retreatments, seek additional appointments with medical doctors, and take more medications for pain when compared to patients not reporting pain. When considering the direct cost of this additional healthcare, as well as the indirect costs, the population burden of experiencing persistent pain at 6 months could be significant. However, the day-to-day impact of the pain experienced at 6 months in our patients indicates that, in general, pain intensity was mild-to-moderate, present for only about ten days in the previous month, and resulted in little interference with daily activities.

Predictors of Persistent Pain

When examining independent baseline factors associated with persistent pain, only longer duration of pre-treatment pain and less optimism about the outcome of the procedure were significantly associated with the presence of persistent pain measured at 6 months following RCT. The finding that greater number of days of pain in the week prior to treatment was associated with persistent pain following RCT is consistent with a previous study evaluating post-endodontic pain [24]. This is consistent with some studies investigating pain outcomes of other surgical procedures as well [15,28]. Therefore, the underlying pain processes, and duration of pre-treatment pain in particular, should be considered during the consenting process when contemplating RCT and as a potential target for preemptive treatment to avoid persistent pain as an outcome.

Forced Covariates as Adjustors

Dentist training, assumed to be related to technical skill in performing RCT, was forced into the model to adjust for any systematic differences between these groups of care providers. Furthermore, one of the most common reasons why patients are referred for specialty endodontic care is for the management of pain, as well as the expected technically difficult cases, such as calcified canals [1], suggesting that patients who are referred to specialists may be more challenging to treat, and therefore may be more likely to develop persistent pain. Given the differences associated with these groups of care providers, we thought it best to adjust for this covariate to address any residual confounding due to training.

Female patients have been observed to present with persistent dentoalveolar pain more frequently than males [19], and this female predilection is similar to other orofacial pain disorders, such as migraine headaches [25] and temporomandibular disorders [14]. Of the two studies investigating predictors of persistent pain following RCT, one study, conducted in a tertiary referral center, found that the relationship of female gender to persistent pain depended on the covariates included in their model [24] and the other study, conducted in community practices, found that gender was not a significant predictor [27]. Our results, which are from community practices, agree with Vena and colleagues [27], and further support the concept that the development of persistent pain is not significantly influenced by patient gender. This result, as well as findings from other studies, is consistent with outcomes from other surgery, as exemplified by a systematic review and meta-analysis of persistent pain following total knee arthroplasty [15]. Lewis and colleagues observed that only 5 of 21 studies that performed multivariate analyses reported gender as a significant predictor and the effect size for gender across all studies did not meet the threshold for statistical significance.

Patient age is another common adjustor used in predictive analyses. Our results agree with the two other studies on the topic [24,27], suggesting that age does not significantly influence the development of persistent pain following RCT. This is also in agreement with the results from a meta-analysis for total knee arthroplasty [15].

Household income, a measure of socioeconomic status that has previously been associated with increased prevalence of orofacial pain [2], demonstrated a marginal relationship with the outcome in the bivariate analysis. It is possible that a more complete measure of socioeconomic status or the use of a larger sample of patients would demonstrate a significant relationship in the modeling, but this remains to be seen. However, our rationale for accounting for socioeconomic status was because this variable improved the fit of our statistical model.

Limitations

The following limitations should be considered when interpreting our results. First, the set of putative baseline predictors used in the analysis did not include a robust set of psychosocial variables, such as baseline anxiety, catastrophizing, or somatization. Future research assessing post-surgical pain needs to include these variables. Second, while a baseline sample of over 700 patients is not small, the small number of outcomes (n=65) makes it difficult to include more predictors within the model even if using 10 outcome events per predictor rule-of-thumb for modeling [18]. Third, the pain being reported at baseline may not have originated from the tooth that was treated (*e.g.*, reversible pulpitis in adjacent tooth) or was originally non-odontogenic in origin and therefore RCT would not be expected to adequately address this pain. Fourth, there were differences in baseline characteristics between patients providing 6-month data and those not included in the data analysis, which may limit the generalizability of the results. Lastly, the outcome of persistent pain includes all possible causes of pain and is not, in itself, a diagnosis. Clinical evaluations at follow up are needed to derive such diagnoses (*e.g.*, whether the persistent pain is odontogenic,

nonodontogenic, or a combination thereof), which would allow for modeling to predict specific outcomes and more completely inform clinical decision-making.

Conclusions

Our findings suggest that persistent pain 6 months following root canal treatment is not rare and is associated with greater amounts of additional healthcare. However, the impact of that pain on the patient's life is generally quite low. There are many parallels to the study of chronic pain following surgery in other areas of the body, specifically, the finding that baseline pain duration predicted the outcome of persistent pain. Future studies of persistent pain following RCT should focus on improved patient characterization at baseline and at follow up so that specific diagnoses can be derived, as well as an exploration of the temporal relationship of various predictive factors, such as additional interventions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Table 1

Patient- and tooth-related characteristics

Characteristic	Overall N = 651
Patient-Related Characteristics	
Mean (SD) age in years	48.3 (12.9)
Number missing	11
Female gender: n (%)	380 (59.1)
Number missing	8
Race/ethnicity: n (%)	
Non-Hispanic white	564 (88.3)
Other	75 (11.7)
Number missing	12
Highest level of education completed: n (%)	
Less than college degree	304 (47.1)
College degree or more advanced degree	341 (52.9)
Number missing	6
Tooth-Related Characteristics	
Maxillary tooth: n (%)	388 (59.6)
Number missing	0
Posterior tooth: n (%)	585 (89.9)
Molar	404 (69.1)
Premolar	181 (30.9)
Number missing	0
Pulpal endodontic diagnoses: n (%)	
Necrotic pulp	349 (54.1)
Normal pulp or reversible pulpitis	62 (9.6)
Irreversible pulpitis	234 (36.3)
Number missing	6
Apical endodontic diagnoses: n (%)	
Normal apical tissue	149 (24.1)
Symptomatic apical periodontitis	331 (53.6)
Asymptomatic apical periodontitis	40 (6.5)
Acute apical abscess	44 (7.1)
Chronic apical abscess	54 (8.7)
Number missing	33

Table 2

Characteristics of pain experienced 6 months following root canal treatment (n=65)

Pain indicators reported at 6 months after treatment	
Present tooth pain: [1]	
Mean (SD)	1.5 (1.8)
Median	1.0
Range	0 – 6
25th/75th percentile	0/3
Worst tooth pain in past month: [1]	
Mean (SD)	4.0 (2.4)
Median	3.0
Range	1 – 10
25th/75th percentile	2/5
Average tooth pain in past month: [1]	
Mean (SD)	2.7 (1.8)
Median	2.0
Range	1 – 9
25th/75th percentile	1/4
Days in past month experienced pain in area treated with root canal:	
Mean (SD)	9.9 (10.2)
Median	5.0
Range	1 – 30
25th/75th percentile	3/10
In the last month took something for pain, including over-the-counter, prescription, herbal or other medication: n (%)	
Yes	33 (51.8)
No	32 (49.2)
Days in past month kept from usual activities because of tooth pain:	
Mean (SD)	0.3 (1.3)
Median	0
Range	0 – 8
25th/75th percentile	0/0
In past month highest level tooth pain interfered with daily activities: [2]	
Mean (SD)	1.0 (1.5)
Median	0
Range	0 – 6
25th/75th percentile	0/2

[1] Pain intensity measured on scale of 0 (not pain) to 10 (pain as bad as can be).

[2]Interference in daily activities was measured on a scale of 0 to 10, where 0 indicates ‘no interference’ and 10 corresponds to ‘unable to carry on any activities’. This measure captures the highest level of interference reported in any usual activity, including recreational, social and family activities, and ability to work, including housework.

Table 3

Post-operative[1] care sought to manage pain associated with the tooth that received root canal treatment

Care received	Pain at 6 months following RCT: Yes N=65	Pain at 6 months following RCT: No N=586	p-value[2]
Additional Dental Treatments Sought			
One or more additional root canal treatments: n (%)			
Yes	13 (41.9)	18 (58.1)	**<0.001**
No	49 (8.3)	541 (91.7)	
missing	3	27	
Extraction of tooth: n (%)			
Yes	3 (25.0)	9 (75.0)	0.11
No	59 (9.7)	550 (92.6)	
missing	3	27	
Additional x-rays: n (%)			
Yes	19 (51.4)	18 (48.6)	**<0.001**
No	43 (7.4)	541 (92.6)	
missing	3	27	
Medications or Supplements Sought			
Pain medication (prescription/OTC): n (%)			
Yes	40 (42.6)	54 (57.4)	**<0.001**
No	24 (4.5)	508 (95.5)	
missing	1	24	
Antibiotics: n (%)			
Yes	5 (20.0)	20 (80.0)	0.09
No	57 (9.6)	539 (90.4)	
missing	3	27	
Herbal/botanical medications/supplements: n (%)			
Yes	1 (20.0)	4 (80.0)	0.40
No	60 (9.7)	556 (90.3)	
missing	4	26	
Sought Appointment with a Medical Doctor			
One or more appointments sought with medical doctor: n (%)			
Yes	9 (52.9)	8 (47.1)	**<0.001**
No	52 (8.6)	553 (91.4)	
missing	4	25	
Sought Alternative, Complementary or Non-traditional Health Therapies			

Care received	Pain at 6 months following RCT: Yes N=65	Pain at 6 months following RCT: No N=586	p-value[2]
Sought chiropractic care one or more times: n (%)			
Yes	2 (40.0)	3 (60.0)	0.08
No	59 (9.6)	557 (90.4)	
missing	4	60	
Sought acupuncture or acupressure care one or more times: n (%)			
Yes	0 (0.0)	1 (100)	1.00
No	61 (9.9)	558 (90.1)	
missing	4	27	
Sought other alternative/non-traditional care: n (%)			
Yes	4 (30.8)	9 (69.2)	**0.03**
No	57 (9.4)	550 (90.6)	
missing	4	27	

[1] Four of 65 patients experiencing pain at 6 months and 27 of 586 not experiencing pain at 6 months did not complete the 3-month survey. The sample size could be slightly larger for variables that could be constructed from information available from the 6-month visit, such as whether or not additional RCT was performed.

[2] P-values for categorical-scaled care measures were determined using Fisher's exact test; for continuous-scaled measures p-values were obtained using the Student's t-test.

Table 4

Multivariable logistic regression modeling of predictors for experiencing pain 6 months following root canal treatment (n=611)

Covariate	aOR (95% CI)[1]	P-value
Dentist's training specialty:		
General practitioner	1.44 (0.83–2.50)	0.20
Endodontist	1.0 (Ref)	
Patient's gender:		
Male	0.82 (0.45–1.47)	0.49
Female	1.0 (Ref)	
Patient's age (1-year increase)	1.00 (0.98–1.02)	0.94
Patient's pain duration over last week (1-day increase)	1.19 (1.07–1.33)	**0.001**
Patient's expected treatment outcome:		
Very good	0.39 (0.22–0.67)	**<0.001**
Fair to good	1.0 (Ref)	
Patient's household income:		
<$50,000	1.65 (0.94–2.90)	0.08
≥$50,000	1.0 (Ref)	

OR = Odds ratio

CI = Confidence interval

[1] Due to missing values, 611 patients were included in the logistic regression modeling.