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# Anticipated and experienced pain associated with endodontic therapy

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**P**ain and factors associated with pain perception are important to both the clinician and patient. For many patients, fear of dental pain and avoidance of dentistry are synonymous.<sup>1</sup>

Moreover, clinicians report that managing some patients' pain and distress can be a frustrating task.<sup>2</sup> It has been acknowledged for many years that human pain perception is made up of multiple dimensions, including a sensory aspect and an emotional/affective quality aspect.<sup>3</sup>

Researchers have shown that some "pain" stimuli are associated with high levels of emotionality/affect (for example, cancer pain), whereas other "pain" stimuli can produce relatively low levels of emotional distress (for example, labor pain).<sup>4</sup> These findings indicate that people can experience very different emotional responses to very similar levels of stimuli intensity, depending on their perception of the event.<sup>5</sup> Assessment of clinical pain response requires the use of measurement scales designed to capture the different dimensions of pain perception.<sup>6</sup>

Price<sup>7</sup> describes the sensory dimension of pain as comprising the location, quality and intensity of the pain sensation, as well as other spatial and temporal characteristics. The emotional/affective dimension includes the interpretation of the meaning of the pain stimuli in rela-

Dentists seem to underestimate the amount of pain their patients experience during endodontic therapy.

**Background.** The authors compared the levels of anticipated and experienced pain of patients who received endodontic therapy, or ET, with selected patient and dental characteristics.

**Methods.** Sensory and affective pain outcome measures (pain and unpleasantness) were evaluated by 333 adult patients immediately before and after dental school faculty or residents performed ET. Dentists provided clinical evaluations and a pulpal diagnosis for each tooth and then rated the level of their patients' pain during treatment.

**Results.** Before ET, 43 percent of all patients anticipated high outcome levels, yet only 22 percent experienced high pain levels, and only 18 percent experienced high unpleasantness levels. Outcome levels did not differ by tooth type, pulpal diagnosis, ET history or dental care attendance. Women were significantly more likely to anticipate higher pain and unpleasantness levels than were men. Experienced outcome levels, however, did not differ by sex. Anticipated and experienced outcome levels significantly decreased with increasing age. Dentists' evaluation of their patients' pain levels correlated more highly for female than for male patients.

**Conclusions.** Pain experienced during ET often is less than anticipated. Younger people anticipate and experience higher pain levels. Women are more likely than men to anticipate, but not necessarily experience, higher pain levels. Dentists are more closely attuned to the pain experiences of their female patients.

**Clinical Implications.** Practitioners could better prepare younger patients and female patients for ET and improve pain communication with male patients. Findings suggest that patients perceive each ET experience as new, implying that dentists should manage patients who have had ET in the past as carefully as those receiving ET for the first time.



tionship to one's desire or expectation to avoid harm. While these two dimensions are highly correlated, evidence suggests that the mechanisms that underlie these dimensions are related but distinct, and both should be considered carefully when assessing clinical pain perceptions.<sup>8</sup>

It often is assumed that aging results in loss of pain sensitivity. Although some efforts have been made to study the effects of aging on pain perceptions, the results are not conclusive. Experimental studies of acute pain responses do not show significant age-related alteration in the pain perceptions of healthy elderly subjects.<sup>9</sup> It has been proposed that differences in acute pain responses between younger and older patients<sup>10</sup> may be a result of changes in pathophysiology (for example, neural conductivity) rather than changes in the pain perception itself.<sup>11,12</sup> It is not clear, however, from the literature whether these changes in pathophysiology influence both affective pain and sensory intensity in the elderly.

New evidence suggests that there are differences in pain perceptions between men and women.<sup>13,14</sup> Although, most studies suggest that women have greater pain sensitivity than men, there are inconsistencies in the literature.<sup>15</sup> These inconsistencies suggest that the type of pain stimuli may influence perceived pain differences between men and women.<sup>16</sup> In addition, the influence of aging on these reported sex differences has yet to be clarified.

The purpose of our study was to investigate the influence of dental patients' age, sex and dental characteristics among on both the affective and sensory components of the pain perception.

## METHODS

A total of 336 adult patients scheduled for endodontic therapy, or ET, to be performed by endodontic faculty or residents at the University of Iowa College of Dentistry were contacted by telephone to participate in this study. Only three (less than 1 percent) of those contacted refused, resulting in a final sample size of 333. Unwillingness to commit the extra time was the reason given for refusal. The patients primarily were white and generally were middle and upper-middle class, though their precise income statuses were unavailable. (Less than 1 percent of the patients were Asian or African-American, which was consistent with this clinic population). All patients received a \$75 credit toward their ET costs in exchange for their participation.

The sample included 53 percent regular and 47 percent episodic care-seekers. Regular care-seekers, defined as those who reported a dental visit in the past 12 months, reported scheduling at least one annual visit or categorized themselves as regular care seekers. Episodic care-seekers were those who failed to meet these criteria. Both types of care-seekers were distributed equally over the experimental conditions. The University of Iowa Institutional Review Board approved this study.

Patients arrived 30 minutes before their dental appointments to receive individual instruction and to complete a pretreatment pain and stress assessment questionnaire. Each patient assessed his or her sensory pain level at two time points: before treatment, when patients predicted the pain level they anticipated would occur during ET, and immediately after treatment, when patients assessed the pain they actually experienced during ET. They assessed both the sensory (pain intensity) and affective (procedural unpleasantness) aspects of their pain using a self-administered 100-point visual analog scale, or VAS.<sup>17</sup> Four outcome or dependent variables—anticipated sensory pain, experienced sensory pain, anticipated affective unpleasantness, experienced unpleasantness—were based on the following requests:

- Describe the pain (unpleasantness) you anticipate experiencing during this ET.
- Describe the pain (unpleasantness) you just experienced during this ET.

In addition to the pain scales, the state and trait subscales of the State-Trait Anxiety Inventory<sup>18</sup> and the Iowa Dental Control Index<sup>19</sup> were included to evaluate the patient's stress associated with the ET experience. These two subscales measure the desire for and feeling of personal control in a dental setting and were administered only before dental treatment. In the State-Trait Anxiety Inventory, state is a measure of the control level for that day, and trait is a measure that is more generalized to all life situations. We considered these behavior intervention variables to be control variables for this study.

All of the dentists were endodontic faculty members or residents. Each practitioner was asked to evaluate the patient's reaction to mastication, palpation, percussion and thermal stimulation, as well as provide a pulpal diagnosis for each tooth. Dentists also rated the level of pain they perceived their patient to have experienced during the ET.

**ANALYSES**

We analyzed the data using statistical software (PC SAS System for Windows, Version 8.0, SAS Institute, Cary, N.C.). We used frequency distributions and contingency table analyses to describe and compare important demographic and dental variables with patient-reported pain variables (significance level,  $\alpha = .05$ ). Anticipated and experienced pain variables were analyzed first as continuous variables and then were dichotomized into high or low categories according to the sample distribution and previous literature reports on VAS.<sup>17</sup> We used statistical regression modeling techniques, linear regression for continuous outcome variables and logistic regression for dichotomous outcome variables to identify important relationships between dental variables and perceived pain, while controlling for the behavior intervention variables that were part of the study design. A summary of the results on a behavioral intervention using sensory focus techniques with this study population has been reported.<sup>6</sup> Controlling for these intervention variables through regression techniques allowed the analyses to focus on the relationships between pain and the dental and demographic variables of interest.

We dichotomized age as younger than 50 years and 50 years and older for use as a predictor variable in the logistic regression analysis and to compare with previous studies. We used the four outcome or dependent variables described previously. The factors or independent variables we considered in the analyses were patient's age, sex, dental care-seeking behavior, previous ET experience, report of pain at appointment arrival, pulpal diagnoses and tooth type, as well as the dentist's assessment of patient discomfort.

**RESULTS**

The 333 patients in the sample ranged in age from 18 to 82 (mean, 45.29 years), and 61 percent were women. There were comparable numbers of men and women throughout the age range in this sample population. Seventy-nine percent of the patients reported having ET, and 14 percent reported having had four or more teeth endodontically treated. Sixty-seven percent of treated teeth were molars; 21 percent were premolars, 7 percent were incisors, and 5 percent were canines (Figure 1). Forty-six percent of the treated teeth were diagnosed as necrotic, 31 percent with irreversible pulpitis, 2 percent with reversible pulpitis, 7 percent with normal pulp, and 14 percent with no diagnosis.

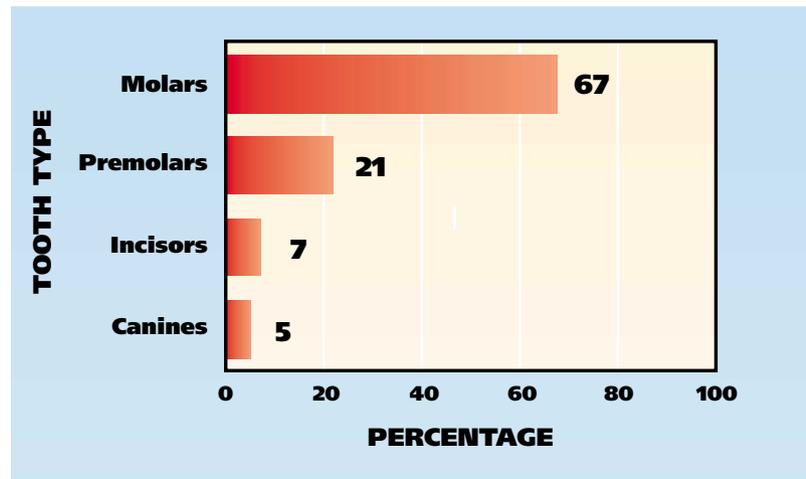


Figure 1. Distribution of treated teeth by tooth type.

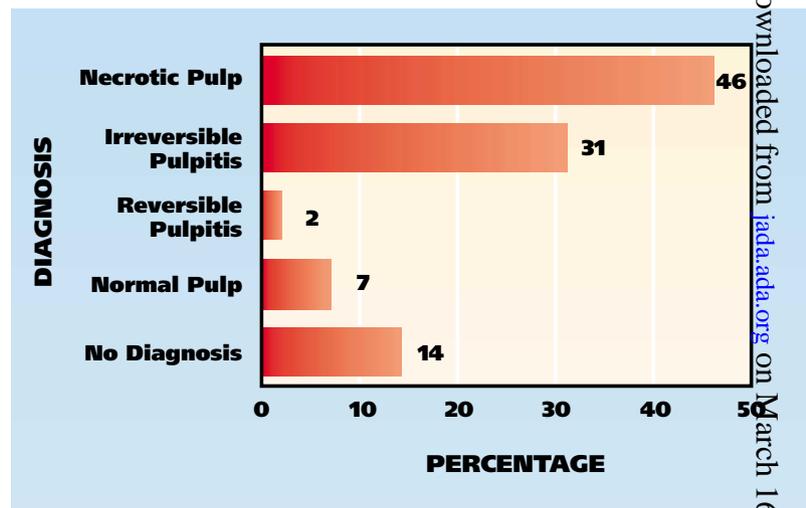


Figure 2. Distribution of treated teeth by diagnosis.

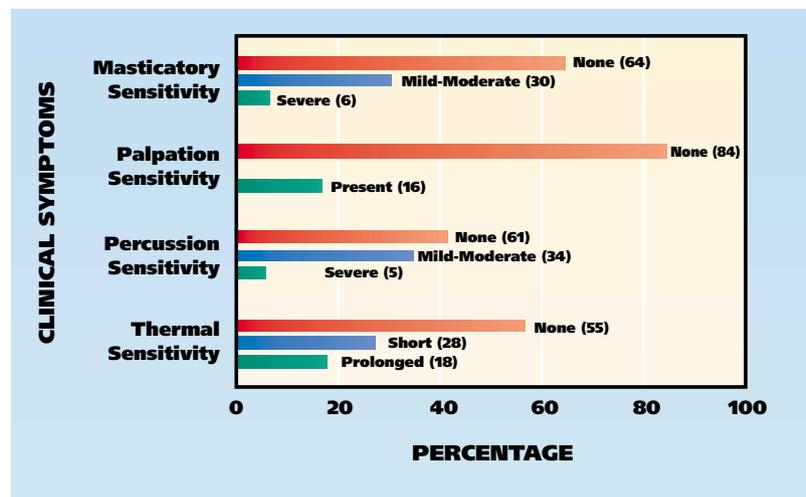


Figure 3. Distribution of clinical symptoms.

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TABLE 1

**PAIN PERCEPTION VARIABLE DESCRIPTION (N = 333).\***

PERCEPTION VARIABLE	MEAN	MEDIAN	STANDARD DEVIATION	RANGE	25TH PERCENTILE	75TH PERCENTILE
Anticipated Pain	38.3	30.0	23.2	2.5-100	20.0	55.0
Anticipated Unpleasantness	36.6	31.2	25.0	0-100	15.0	55.0
Experienced Pain	22.7	17.5	19.9	0-92.5	7.5	33.8
Experienced Unpleasantness	19.9	10.0	22.7	0-97.5	2.5	30.0

\*Values are based on the visual analog scale (range, 0-100).

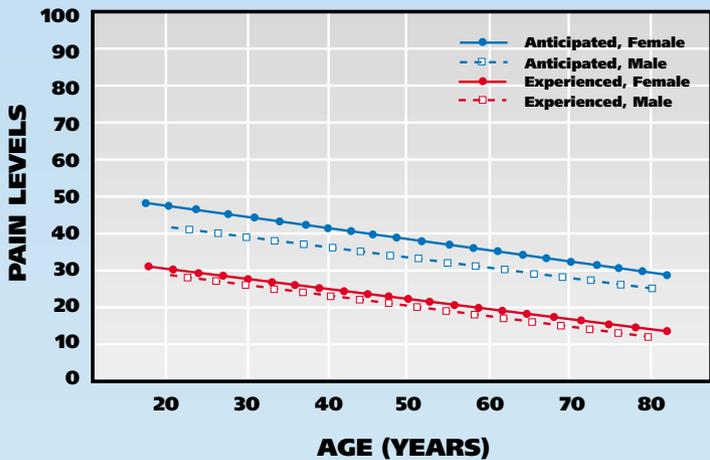


Figure 4. Anticipated vs. experienced pain associated with endodontic therapy.

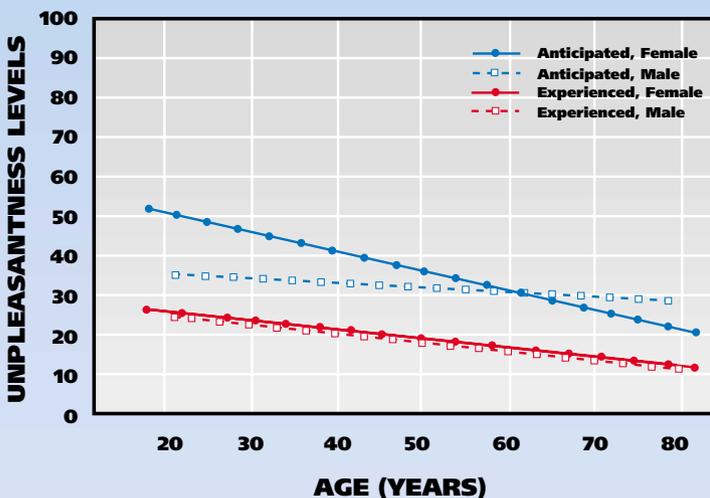


Figure 5. Anticipated vs. experienced unpleasantness associated with endodontic therapy.

pititis and 7 percent as normal, while 14 percent of the teeth were not given a specific diagnosis (Figure 2). We made normal pulp diagnoses for teeth scheduled for elective ET for dental restorative needs. We also reviewed charts in an attempt to determine the diagnoses for the 14 percent of teeth that were not given a specific diagnosis by the study's dentists. Chart entries, however, did not support a confident diagnosis determination. Results did not differ when analyses were performed with and without this group. Therefore, the people for whom the dentists did not provide a definitive diagnosis were not excluded from the study. The dentists' clinical assessments are summarized in Figure 3. They found that the most severe clinical symptoms were experienced by less than 20 percent of the study population.

Twenty percent of the patients reported to their appointments in pain. The reported length of time the patients were in pain ranged from less than one week to more than one year, with an average of one month. Regular patients were more likely to exhibit pain than were episodic patients ( $P = .042$ ). Although more women reported pain at appointment arrival than did men (24 percent vs. 15 percent), men were more likely to report having pain for a longer period compared with women ( $P = .035$ ).

The outcome variable responses based on the VAS are summarized in Table 1. Anticipated values were consistently higher than the experienced values, which indicated that patients actually experienced less pain and unpleasantness than they anticipated. Figure 4 illustrates the predicted values of anticipated and experienced sensory pain by age and sex from linear regression modeling. Anticipated and experienced pain decreased significantly with increasing age (both values,  $P < .001$ ). Women had significantly higher

TABLE 2

FREQUENCY DISTRIBUTIONS AND ODDS RATIOS FOR SENSORY PAIN.						
INDEPENDENT VARIABLE	ANTICIPATED PAIN N (%)		ODDS RATIO (95% CONFIDENCE INTERVAL)	EXPERIENCED PAIN N (%)		ODDS RATIO (95% CONFIDENCE INTERVAL)
	High (≥ 40)	Low (< 40)		High (≥ 40)	Low (< 40)	
<b>Total</b>	145 (43.7)	187 (56.3)	—	72 (22.6)	261 (78.4)	—
<b>Age (Years)</b> <b>&lt; 50</b> <b>50 and older</b>	106 (73.1) 39 (26.9)	103 (55.1) 84 (44.9)	1.0* 0.45* (0.28-0.71)*	57 (79.2) 15 (20.8)	153 (58.6) 108 (41.4)	1.0* 0.37* (0.20-0.68)*
<b>Sex</b> <b>Male</b> <b>Female</b>	45 (31.0) 100 (69.0)	84 (44.9) 103 (55.1)	1.0* 1.80* (1.14-2.85)*	27 (37.5) 45 (62.5)	103 (39.5) 158 (60.5)	1.0 1.08 (0.63-1.9)
<b>Previous Endodontic Therapy</b> <b>No</b> <b>Yes</b>	34 (23.4) 111 (76.6)	35 (18.7) 152 (81.3)	1.0 0.75 (0.44-1.29)	19 (26.4) 53 (73.6)	50 (19.2) 211 (80.8)	1.0 0.64 (0.34-1.19)
<b>Current Pain</b> <b>No</b> <b>Yes</b>	111 (76.5) 34 (23.4)	153 (81.8) 34 (18.2)	1.0 1.38 (0.80-2.35)	56 (77.8) 16 (22.2)	209 (80.1) 52 (19.9)	1.0 1.13 (0.60-2.14)
<b>Pulpal Diagnosis</b> <b>Normal</b> <b>Reversible</b> <b>Irreversible</b> <b>Necrotic</b> <b>Undetermined</b>	6 (4.6) 3 (2.3) 45 (34.1) 51 (38.6) 27 (20.4)	15 (8.6) 2 (1.2) 50 (28.7) 89 (51.2) 18 (10.3)	1.0 3.78 NS† 2.21 NS 1.42 NS 3.68 NS	4 (5.9) 1 (1.5) 28 (41.2) 23 (33.8) 12 (17.6)	17 (7.1) 4 (1.7) 68 (28.4) 117 (49.0) 33 (13.8)	1.0 0.97 NS 1.71 NS 0.82 NS 1.42 NS
<b>Molar</b> <b>No</b> <b>Yes</b>	43 (29.7) 102 (70.3)	66 (35.7) 119 (64.3)	1.0 1.30 (0.81-2.07)	22 (30.6) 50 (69.4)	87 (33.6) 172 (66.4)	1.0 1.14 (0.64-2.00)
<b>Dental Visit</b> <b>Regular</b> <b>Episodic</b>	71 (49.0) 74 (51.0)	108 (57.8) 79 (42.2)	1.0 1.44 (0.93-2.23)	35 (48.6) 37 (51.4)	144 (55.2) 117 (44.8)	1.0 1.34 (0.79-2.27)
<b>Anticipated Pain</b> <b>Low &lt; 40</b> <b>High ≥ 40</b>	— —	— —	— —	30 (41.7) 42 (58.3)	157 (60.4) 103 (39.6)	1.0* 2.20* (1.23-3.57)*
<b>Anticipated Unpleasantness</b> <b>Low &lt; 40</b> <b>High ≥ 40</b>	31 (21.4) 114 (78.6)	157 (84.0) 30 (16.0)	1.0* 19.72* (11.2-34.7)*	28 (38.9) 44 (61.1)	160 (61.5) 100 (38.5)	1.0* 2.47* (1.44-4.24)*

\* Significant finding.  
† NS: Nonsignificant confidence interval omitted because of space constraints.

anticipated pain levels than men ( $P < .05$ ), but there was no difference in experienced pain levels by sex. Figure 5 shows that the predicted values from linear modeling for experienced unpleasantness are nearly identical to that of experienced pain with a decrease in level with increasing age ( $P = .008$ ) and no difference by sex. Overall, anticipated levels of unpleasantness decreased with increasing age ( $P = .039$ ) but the levels decreased more sharply for women and remained nearly static for men. Younger women anticipated higher levels of unpleasantness, and the levels

decreased more sharply with age for older women anticipating lower levels of unpleasantness than for older men.

Table 2 summarizes the logistic regression analyses of anticipated and experienced pain with the adjusted independent variables. Anticipated values were missing for one patient. A total of 145 patients (43.7 percent) anticipated high levels of pain, but only 72 patients (22.6 percent) experienced high pain levels. Logistic analyses duplicated the findings from the linear regression analyses: female patients and younger patients

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were more likely to anticipate higher pain levels; younger patients also experienced higher pain levels, but there was no difference in experienced pain by sex. Surprisingly, sensory pain levels did not differ by tooth type, pulpal diagnosis, ET history or episodic/regular dental attendance. Not surprisingly, we found that anticipated measures of pain and unpleasantness measures were significantly associated with experienced pain measures. Analyses of anticipated and experienced unpleasantness yielded nearly identical results with the exception that there was no significant difference in anticipated or experienced unpleasantness by age or sex. Therefore, the logistic analyses results for unpleasantness were not repeated in tabular form.

According to the dentists' rating of their patient's pain during ET (scale ranged from 1 = no pain to 7 = extreme pain), 22 percent of patients received a rating of 1 or no pain, 45 percent received a rating of 2, 17 percent received a rating of 3, 7 percent received a rating of 4, 8 percent received a rating of 5, 1 percent received a rating of 6, and none of the dentists perceived their patients to have experienced extreme pain. The Kendall  $\tau$  correlation between the patients' rating of the pain they experienced and the dentists' rating of their pain experiences was low to moderate at 0.384. Dentists' ratings of their patients' pain were more highly correlated among female patients (0.445) than among male patients (0.292;  $P = .01$ ). There was no significant difference by dentists' sex.

**DISCUSSION**

Dentists have understood the clinical importance of patients' perception of pain for many years. Our findings that anticipated pain and unpleasantness were consistently higher than the levels experienced by patients may reflect good patient pain management during the ET procedure.

Recent experimental data based on directed pain stimuli found that negative anticipation produces anxiety that may amplify the patient's subsequent pain report.<sup>20</sup> Rhudy and colleagues,<sup>20</sup> therefore, suggested that a priori anxiety management is good practice. Our study sought to provide further information as to patient and dental characteristics to better guide the practi-

tioner in targeting patients with greatest need of a priori management.

**Tooth type.** The clinical dentist may be most interested in the lack of significant association of the measured dental factors with the patients' reports of pain. Tooth type was not significantly associated with anticipated or experienced dental procedure pain. We investigated this aspect by individual tooth type and by comparing molars and nonmolars. Previously, tooth type has been reported to have no association with endodontic interappointment pain<sup>21</sup> or postobturation pain.<sup>22</sup> The posterior teeth located in the mandibular arch, however, have been reported to be significantly associated with higher levels of endodontic

pain.<sup>22</sup> Yesilsoy and colleagues<sup>22</sup> felt that their findings corroborated the impression held by many clinicians that mandibular posterior teeth have more postobturation pain than do maxillary anterior teeth. This difference may be related biologically to a greater number of canals and high frequency of bifurcated root canals in mandibular posterior teeth.<sup>23</sup> However, Yesilsoy and colleagues also considered that student dentists in their study could have more difficulty treating mandibular posterior teeth. Since teeth were recorded by type only, the study could not address pain difference by arch location.

**Pulpal diagnosis.** Patients' anticipated and experienced pain and unpleasantness also were not associated with the tooth's pulpal diagnosis. Harrison and colleagues<sup>21,24</sup> similarly reported no association with interappointment or postobturation pain and tooth diagnosis. These findings may not be surprising since the goal of the dental diagnosis is related to the prognosis of the tooth, and the patients' pain reports are only one factor in the diagnosis. Patients' pain reports, on the other hand, are personal and multifactorial, and they represent a composite of their experience, to most of which the dentist is not privy.<sup>7</sup> Thus, it is important for dentists to recognize that patients are the experts on their pain and that pain expression is a legitimate report for the biology and psychology of a person.

**ET history.** We were particularly interested in the finding that previous ET experience was not associated with anticipated or experienced pain

The authors' findings that anticipated pain and unpleasantness were consistently higher than the levels experienced by patients may reflect good patient pain management during endodontic therapy.

levels. One possible explanation for the lack of association of pain and previous ET experience is that patients may perceive each ET as a unique experience; patients receiving the procedure for the first time have general anxiety but a lack of specific experience. Accepting this explanation would indicate that dentists should prepare patients who have had multiple ETs as carefully as they prepare patients who are receiving a first ET.

Before this study, we hypothesized that patients who had received ET before would have experience to replace the “fear of the unknown” and, therefore, have lower levels of anticipated pain and unpleasantness. Of course this hypothesis is based on the biased assumption that the previous experience would have been more positive than the “fear of the unknown.” It is possible that some patients had very negative previous ET experiences that negatively affected their pain perceptions. If the mean pain levels of those with very positive and very negative previous experiences were similar to the mean pain levels of those with and without a “fear of the unknown dental procedure,” then the resulting statistical interpretation would be a nonsignificant association. Unfortunately, we did not evaluate the patients’ perception of their previous ET experiences and cannot further investigate this possibility in this study population.

Current experimental pain research suggests that in this case, the term “fear of the unknown” is stated more correctly as “anxiety of the unknown.” Research in this area defines “fear” as the immediate alarm reaction to a present threat that is characterized by the impulse to escape, sympathetic system arousal and pain analgesia.<sup>20,25</sup> In contrast, anxiety is considered a future-oriented emotion that is characterized by the apprehension of potential threats and results in muscle tension and hyperalgesia or exaggerated pain response.<sup>20,25</sup> Most dental patients come to the clinic to meet an appointment scheduled days or weeks in advance. They have had time to develop anxiety around the future-oriented dental appointment. This interpretation also may explain, in part, why there was no difference in pain report by patients with regular and episodic dental visits. Since all of these patients were scheduled for ET, they all had time to develop

anxiety related to the planned procedure. It may be that dental visit patterns may reflect a more general attitude toward dental care rather than to a specific planned procedure. Our pain questions specifically targeted this ET procedure and not dental treatment in general and, therefore, may have reduced the differences in the patients’ responses.

Overall, 20 percent of the total sample reported to their appointment in pain. In addition, patients’ reported length of time in pain ranged from less than one week to more than one year with an average of one month. Although the anticipated levels of pain and unpleasantness were higher than those experienced, these

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 .....

patients’ pain levels were comparable to those derived in laboratory pain experiments that produce hyperresponsiveness to pain stimuli.<sup>26</sup> We were surprised, however, by our finding that patients reporting pain when coming in for care did not perceive their anticipated or experienced pain levels differently from patients not

reporting in pain. In fact, there were no associations of appointment pain presentation with any of the dental measures except dental attendance.

**Dental care attendance.** Regular patients were more likely to present in current pain than were episodic patients, another counterintuitive finding. Analgesic use before the appointment could be related to these findings. One could argue that episodic patients may use analgesics more frequently than do regular patients to postpone the dental visit, while regular patients may seek care more readily and postpone medication use until recommended by a professional. Unfortunately, this study did not record patients’ prior use of analgesics. The lack of association of pain at appointment and the study outcomes did indicate that the analgesic information was not important to the primary outcomes in this study.

**Sex differences.** Sex differences in pain reports with women reporting more pain than men have been documented previously,<sup>14</sup> but discrepancies do exist in the literature.<sup>27,28</sup> These results indicated that women had significantly higher anticipated pain levels than did men, but women did not differ from men on the pain reported after ET. Additionally, there was an interesting relationship with age and sex. Younger women anticipated higher levels of unpleasant-

ness, and the levels decreased more sharply with age, with older women anticipating lower levels of unpleasantness than older men. Women anticipated more sensory pain than men, but younger women largely drove this effect. That is, younger women anticipated more pain and unpleasantness than did men, whereas the differences between older men and women were not significant. Thus, younger women may be more at risk of experiencing pain during subsequent treatment because of the greater autonomic arousal. Such sex-age-related differences in pain and unpleasantness might offer one explanation for the discrepant findings in previous pain literature.

**Age.** Despite the sex differences, these results did show an overall decrease in anticipated and experienced pain and unpleasantness across the age span. Clinicians should be aware that there are no conclusive data that progressive loss of sensitivity to nociceptive stimuli occurs with age.<sup>29</sup> Thus, the age-related decrease in pain is not thought to be attributable to changes in the physiological pain system. In addition, the number of prior ET experiences was not related to either anticipated or experienced pain, suggesting that prior experience with ET could not account for this age effect. There is some evidence that stoicism increases with age and potentially accounts for lower pain reports<sup>30</sup> until the final months of life, in which pain reports increase.<sup>31</sup>

**Dentists' perceptions.** These dentists generally underestimated their patients' pain levels and exhibited a low-to-moderate correlation of their assessment of patient pain and patient report of pain. These findings are similar to previous studies of physicians' and nurses' perceptions of patient pain.<sup>27</sup> Previous literature also supports evidence that women and men receive differential care for similar pain problems.<sup>27,32-34</sup> Sex differences in presentation to the clinical situation may be related to these differences in care. Women seem to be more expressive of pain, whereas men tend to minimize symptoms. Women are more worried about pain, whereas men are more embarrassed by pain.<sup>35</sup> Studies of specific noxious stimuli and brain activity indicate that women are better able to discriminate between levels of stimuli compared with men.<sup>36</sup> These differences may be related to differences in

cortical brain activity. It has been shown that while both sexes have similar bilateral activation of the premotor cortex and several contralateral structures, females have a greater activation of the contralateral insula and thalamus than do males.<sup>37</sup> While the specific relationship of these differences is not yet understood, it is tempting to postulate that this greater activation may be related to greater pain expression among women.

In a comprehensive review of sex variation and clinical pain, Unruh<sup>27</sup> suggested that sex differences in health care utilization for pain care begin in childhood. Day-care workers, parents and school officials often encourage definitive care among girls more commonly than among boys. In adulthood, however, the women seem less likely to receive analgesia because increased complaints

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 .....

among women are perceived by nurses and physicians to be an exaggeration or dramatization of pain, resulting in less pain treatment.<sup>32</sup> In our study, male and female dentists both perceived that women had higher levels of pain than men, and their perception, while still an underestimation, was more highly correlated with the female patients' pain reports than the male patients' pain reports. Although we did not measure postoperative pain recommendations,

the ET model may not show the sex differences found in other clinical models since postoperative endodontic care often is fairly standard within a single clinical setting. These results do support previous beliefs that men may be minimizing pain and may be less likely to express their discomfort during the procedure. Dentists also may be more attuned to the expression of pain exhibited by female patients and may need to be more attentive to more subtle signs of discomfort from male patients.

**Patients' perceptions.** All studies of pain depend on the patient's perception of the entire event. This model targets the ET experience in general. While this is a relatively standard treatment procedure, it is true that aspects within the treatment could differ by aspects not measured in this study such as local anesthetic administration or rubber dam clamp placement. Studies of pain in areas of medical treatment have found that patients tend to remember their peak pain experienced.<sup>38,39</sup> Therefore, it is reasonable to assume

that dental patients would behave similarly. It could be that pain evaluated in this study would be remembered pain from the local injection and not from actual obturation. This study methodology evaluated the entire ET event and did not allow further breakdown into specific aspects of the ET. More specific procedure delineation could be of interest in future investigations.

Another aspect of the study event that could have affected patient perception is the dental school clinic environment. Bias could be argued to go in either direction. Patients could be less apprehensive because they are confident about receiving treatment in a dental education environment or they could be more apprehensive because of their concern about the clinicians' experience. Since providers in this study were either endodontic faculty or graduate students, we considered the latter possibility. There was no difference in level of patient perception by faculty or graduate student status. One also could argue that there could be a difference in patient apprehension in this study compared with general practice, since all the providers were endodontists or graduate endodontic students and not general dentists. While previous ET, experience did not alter these results, we did not ask patients to evaluate any previous experience. Among those who did have previous ET, we do not know whether a generalist or a specialist provided the treatment. Any generalization of these results to other settings should be made with caution. However, if one argues that patients would be less apprehensive receiving care from an endodontist rather than a general dentist, then these results may underestimate the patient's level of anticipated pain or unpleasantness in general practice.

## CONCLUSION

Based on the results of this study, we found that pain experienced during ET often is less than anticipated. Tooth diagnosis is not related to the amount of pain and unpleasantness patients anticipate or experience with ET. Younger people anticipate and experience higher levels of pain than do older people. Women are more likely to anticipate but do not experience higher levels of pain compared with men. Dentists seem to underestimate the amount of pain their patients experience during ET. However, both male and female dentists are more closely attuned to the pain experience of their female patients than their male patients. Practitioners may choose to pre-

pare younger patients and female patients better for ET and improve pain communication with male patients.

This study suggests that each ET is perceived as a new experience by patients. Therefore, regular patients and those with previous experience with ET should be prepared for treatment as thoroughly as episodic patients and patients receiving their first ET. ■



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1. Freeman R. The role of memory on the dentally anxious patient's response to dental treatment. *Ir J Psychological Med* 1991;8(2):110-5.
2. Lindsay SJ, Jackson C. Fear of routine dental treatment in adults: its nature and management. *Psychol Health* 1993;8:135-53.
3. Price DD. Psychological and neural mechanisms of pain. New York: Raven; 1988:2-70.
4. Price DD, Harkins SW, Baker C. Sensory-affective relationships among different types of clinical pain and experimental pain. *Pain* 1987;28:297-307.
5. Gracely RH, Kwilosz DM. The Descriptor Differential Scale: applying psychophysical principles to clinical pain assessment. *Pain* 1988;35:279-88.
6. Logan HL, Baron RS, Kohout F. Sensory focus as therapeutic treatments for acute pain. *Psychosom Med* 1995;57:475-84.
7. Price DD. Psychological mechanisms of pain and analgesia. Seattle: IASP Press; 1999.
8. Rainville P, Hofbauer RK, Paus T, Duncan GH, Bushnell MC, Price DD. Cerebral mechanisms of hypnotic induction and suggestion. *J Cogn Neurosci* 1999;11(1):110-25.
9. Harkins SW, Price DD, Bush FM, Small RE. Geriatric pain. In: Wall PD, Melzack R, eds. *Textbook of pain*. 3rd ed. London: Churchill Livingstone; 1994:769-84.
10. Lasch H, Castell DO, Castell JA. Evidence for diminished visceral pain with aging: studies using graded intraesophageal balloon distension. *Am J Physiol* 1997;272(1 Pt 1):G1-3.
11. Harkins SW, Kwentus J, Price DD. Pain and suffering in the elderly. In: Bonica JJ, ed. *The management of pain*. 2nd ed. Philadelphia: Lea & Febiger; 1990:552-9.
12. Heft MW, Cooper BY, O'Brien KK, Hemp E, O'Brien R. Aging effects on the perception of noxious and non-noxious thermal stimuli applied to the face. *Aging (Milano)* 1996;8(1):35-41.
13. Riley JL III, Robinson ME, Wise EA, Myers CD, Fillingim RB. Sex differences in the perception of noxious experimental stimuli: a meta-analysis. *Pain* 1998;74:181-7.
14. Unruh AM, Ritchie J, Merskey H. Does gender affect appraisal of pain and pain coping strategies? *Clin J Pain* 1999;15:31-40.
15. Eli I, Bar-Tal Y, Zvu F, Korff E. Effect of biological sex differences on the perception of acute pain stimulation in the dental setting. *Pain Res Manage* 1996;1(4):201-6.
16. Fillingim RB, Maixner W, Kincaid S, Silva S. Sex differences in temporal summation but not sensory-discriminative processing of thermal pain. *Pain* 1998;75:121-7.
17. Price DD, McGrath PA, Rafi A, Buckingham B. The validation of visual analogue scales as ratio scale measures for chronic and experimental pain. *Pain* 1983;17:45-56.
18. Logan H, Baron RS, Keely K, et al. Desired and felt control as mediators of stress in a dental setting. *Health Psychol* 1991;10:352-9.
19. Spielberger CD. *State-trait anxiety inventory*. Palo Alto, Calif:

Consulting Psychologists Press; 1983.

20. Rhudy JL, Meagher MW. Fear and anxiety: divergent effects on human pain thresholds. *Pain* 2000;84:65-75.

21. Harrison JW, Baumgartner JC, Svec TA. Incidence of pain associated with clinical factors during and after root canal therapy, Part 1: interappointment pain. *J Endod* 1983;9(9):384-7.

22. Yesilsoy C, Koren LZ, Morse DR, Rankow H, Bolanos OR, Furst ML. Post-endodontic obturation pain: a comparative evaluation. *Quintessence Int* 1988;19(6):431-8.

23. Cohen S, Burns RC. *Pathways of the pulp*. 6th ed. St. Louis: Mosby-Year Book; 1994:100-55.

24. Harrison JW, Baumgartner JC, Svec TA. Incidence of pain associated with clinical factors during and after root canal therapy, Part 2: postobturation pain. *J Endod* 1983;9(10):434-8.

25. Barlow DH, Chorpita BF, Turovsky J. Fear, panic, anxiety, and disorders of emotion. In: Hope DA, ed. *Perspectives on anxiety, panic, fear: Current theory and research in motivation—Nebraska symposium on motivation*, 43. Lincoln, Neb.: University of Nebraska Press; 1996: 251-328.

26. Duncan GH, Bushnell MC, Lavigne GJ. Comparison of verbal and visual analogue scales for measuring the intensity and unpleasantness of experimental pain. *Pain* 1989;37(3):295-303.

27. Unruh AM. Gender variations in clinical pain experience. *Pain* 1996;65(2):123-67.

28. MacEntee MI, Stolar E, Glick N. Influence of age and gender on oral health and related behaviour in an independent elderly population. *Community Dent Oral Epidemiol* 1993;21:234-9.

29. Walco GA, Harkins SW. *Lifespan developmental approaches to*

pain. In: Gatchel RJ, Turk DC, eds. *Psychosocial factors in pain*. New York: Guilford Press; 1999:107-7.

30. Gibson SJ, Katz B, Corran TM, Farrell MJ, Helme RD. Pain in older persons. *Disabil Rehabil* 1994;16:127-39.

31. Thomas MR, Roy R. *The changing nature of pain complaints over the lifespan*. New York: Plenum; 1999:153.

32. McDonald DD. Gender and ethnic stereotyping and narcotic analgesic administration. *Res Nurs Health* 1994;17(1):45-9.

33. Calderone K. The influence of gender on the frequency of pain and sedative medication administered to postoperative patients. *Sex Roles* 1990;23:713-25.

34. Cleeland CS, Gonin R, Hatfield AK, et al. Pain and its treatment in outpatients with metastatic cancer. *N Engl J Med* 1994;330:592-6.

35. Klonoff EA, Landrine H. Sex roles, occupational roles, and symptom-reporting: a test of competing hypotheses on sex differences. *J Behav Med* 1992;15:355-64.

36. Feine JS, Bushnell MC, Miron D, Duncan GH. Sex differences in the perception of noxious heat stimuli. *Pain* 1991;44(3):255-62.

37. Paulson PE, Minoshima S, Morrow TJ, Casey KL. Gender differences in pain perception and patterns of cerebral activation during noxious heat stimulation in humans. *Pain* 1998;76:223-9.

38. Williams DA. Acute pain (with special emphasis on painful medical procedures). In: Gatchel RJ, Turk DC, eds. *Psychosocial factors in pain*. New York: Guilford Press; 1999:151-63.

39. Redelmeier DA, Kahneman D. Patients' memories of painful medical treatments: real-time and retrospective evaluations of two minimally invasive procedures. *Pain* 1996;66(1):3-8.