Relationship between Postendodontic Pain, Tooth Diagnostic Factors, and Apical Patency

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Abstract

This study compares the incidence, degree, and length of postoperative pain in 300 endodontically treated teeth, with and without apical patency, in relation to some diagnostic factors (vitality, presence of preoperative pain, group, and mandible of treated tooth). Of the questionnaires received back, apical patency was maintained during shaping procedures with a #10 K-file in one group (n = 115) and not in the other (n = 121). There was significantly less postendodontic pain when apical patency was maintained in nonvital teeth. If pain appeared, its duration was longer when apical patency was maintained in teeth with previous pain or located in the mandible. Maintenance of apical patency does not increase the incidence, degree, or duration of postoperative pain when considering all variables together. *(J Endod 2009;35:189–192)*

Key Words

Apical patency, postendodontic pain, postoperative pain

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Accumulation of soft tissue remnants or of dentinal debris in the apical region is a common event that can cause blockage of root canal, normally in its apical third. This can be avoided if patency of the apical foramen during the shaping procedure is granted (1). Currently, maintaining apical patency is recommended during shaping and cleaning endodontic procedures (2, 3).

Apical patency is a technique in which the apical portion of the canal is maintained free of debris by recapitulation with a small file through the apical foramen (4, 5). This technique allows prevention of blockage (6–9). The most predictable method is to regularly use a so-called patency file during cleaning and shaping procedures. This file can be defined as a small flexible K-file, which is passively moved through the apical constriction without widening it (10). The files used to obtain patency are often the same files initially used to negotiate canals (11).

Other advantages of this procedure are that it minimizes the risk of loss of length, reduces canal transportation and other accidents such as ledges (10), eases irrigation in the apical third of the canal (12), allows maintenance of the anatomy of the apical constriction (6), and improves the tactile sense of the clinician during apical shaping (10).

One of the alleged reasons for not using apical patency is the possible extrusion of debris through the apical foramen, a condition classically related with postoperative pain. In fact, the patency concept is controversial to some practitioners (13). Some think that the repeated pass of patency files, even of small ones, through the apex can cause by itself a periapical acute inflammatory response (9) and severe postoperative pain (13).

This procedure is taught in 50% of U. S. dental schools. In the other half, this technique is not taught, arguing that apical patency might increase the displacement of debris and subsequently irritate the periodontal ligament without producing a better healing (9). However, Tsesis et al. (14) found that maintaining apical patency did not reduce apical transportation or have an effect on loss of working length in curved root canals.

Other authors stated that maintaining apical patency would not cause more postoperative problems, providing it is satisfactorily made (9), and that its benefits exceed the possible injury it might cause (6) because it is intended exclusively to prevent dentinal chips being compacted into the apical region and forming a plug that can interfere with maintaining working length (15).

We have not found any published research assessing the incidence of postendodontic pain when apical patency was maintained in relation to when it was not. The purpose of this prospective study was to assess whether maintaining apical patency might influence the incidence, degree, or duration of postoperative pain, considering different tooth diagnostic factors such as pulpal status, preoperative pain, or the position or group of the teeth to be treated.

Materials and Methods

This research was conducted with the approval of the Ethics Committee of Clinical Research of Saint Carlos Hospital-Madrid.

Three hundred endodontic treatments were performed in uniradicular, biradicular, and multiradicular teeth by one endodontist, all of them in single visits. All patients were informed of the aims and design of the study, and written authorizations were obtained before their inclusion.

Exclusion criteria were the need for retreatment, pregnancy, failure to obtain patient's authorization, and the presence of accidents or complications during treatment (calcified canals, impossibility of achieving apical patency in any canal).

The following data were collected in clinical records. Pulpal vitality status (vital/nonvital) was assessed through thermic stimulation with ethyl chloride spray. This status was rechecked by testing the presence of bleeding during the endodontic access. If the thermic stimulation was positive and there was bleeding during endodontic access, the tooth was considered as vital and as nonvital if the stimulation was negative or there was no bleeding. The presence or absence of preoperative pain (yes/no) was noted. We asked the patients whether they had pain the days before the appointment. Group of teeth (posterior/anterior) and position (superior/inferior) were also collected.

Patients were given local anesthetics (lidocaine hydrochloride and epinephrine 1:80,000; Xilonibsa, Inibsa, Spain). The standard treatment procedure consisted of the following steps. Access was obtained by using 014 round carbide and Endo Z burs (Dentsply International, York, PA), with high-speed and water refrigeration at all moments. Full rubber dam was placed in the tooth to be treated. GLYDE (Dentsply Maillefer, Ballaigues, Switzerland) lubricant was placed at the entrance of the canals. Negotiation was done with a #10 file. Determination of working length was made with Root ZX apex locator (J Morita Europe GVBH, Frankfurt, Germany), with radiographic confirmation. Pulpal chamber was blot-dried with a cotton pellet. Lubricant was placed at the entrance of canals (ie, measurements were made along moist canals). A #10 file clamped to Root ZX apex locator was used to measure working length. Repetition of measurement was made with #12 and #15 files. If there was no agreement between measures obtained by using the 3 files, the measure that was dissimilar was reassessed. If disagreement persisted, the measure delivered with the thicker file was selected. Working length was confirmed with an intraoral periapical radiograph. In case of disagreement between radiographic and electronic measurements, the latter was selected. Shaping was done with Gates-Glidden (Dentsply Maillefer) and K-flexofile (Dentsply Maillefer). Master apical files ranged from #20–#30 in narrow and from #25–#40 in wide canals. After shaping of coronal and mid thirds, working length was confirmed by using apex locator. Cleaning with 5% NaOCl was performed during all procedures. AH-Plus sealer (Dentsply Maillefer) was deposited in canal by using an impregnated master cone twice. The #15 gutta-percha cones (Dentsply Maillefer) were laterally condensed with #20 nickel-titanium spreaders (Dentsply Maillefer) 1 mm short of working length.

Patients were randomly assigned to 1 of 2 groups: patency (P) and no patency (NP). In group P (initial n = 150), apical patency was maintained throughout shaping and cleaning procedures by using a #10 K-file between each instrument. In group NP (initial n = 150), all efforts were made to avoid surpassing the working length at all times during treatment.

TABLE 1. Chi-Square Test Results in Analysis of Incidence of Postoperative Pain (outcomes: yes/no)

Diagnostic factor	Condition	n	*P* value
Previous status	Vital	145	.47
	Nonvital	91	.03
Preoperative pain	Yes	76	.29
	No	160	.054
Group	Posterior	152	.07
	Anterior	84	.59
Position	Upper	121	.64
	Lower	115	.08

TABLE 2. Trend Test Results in Analysis of Degree of Postoperative Pain (outcomes: mild/moderate/severe)

Diagnostic factor	Condition	n	*P* value
Previous status	Vital	79	.36
	Nonvital	43	.39
Preoperative pain	Yes	44	.503
	No	78	.52
Group	Posterior	89	.37
	Anterior	33	.45
Position	Upper	63	.82
	Lower	59	.16

Patients were informed of the possible occurrence of pain for days after treatment and were given a questionnaire to be completed and returned. In it, they would record the presence or absence of postendodontic pain, its duration and level of discomfort rated as follows: mild pain: any discomfort of any duration that does not require treatment; moderate pain: pain that requires and is relieved with analgesics; and severe pain: any pain that is not relieved with treatment (analgesics).

Two hundred thirty-six of the 300 questionnaires were returned properly answered. Of these, 121 belonged to P group and 115 to NP group.

Results of groups P and NP related to incidence (yes/no), degree (mild, moderate, severe), and length (days) of postoperative pain were compared, attending to diagnostic factors: status of tooth (vital/nonvital), presence or absence of preoperative pain, group of teeth (posterior or anterior), or position (superior, inferior).

Results were analyzed with the χ^2 test for the incidence of pain, the trend test for its degree, and Mann-Whitney *U* test for its duration (SPSS 15 for Windows; SPSS Inc, Chicago, IL).

Results

Results are shown in Tables 1, 2, and 3.

Previous Vital Status

Differences were not statistically significant between P and NP groups regarding degree or duration of pain.

Incidence of postoperative pain differences was not statistically significant except in the group of nonvital teeth, where incidence was significantly lower ($P = .03$) when apical patency was maintained (Table 1).

Odds ratio was 2.53 (95% confidence interval [CI], 1.03–3.70). Odds of postendodontic pain in nonvital teeth in which apical patency was not maintained (NP) were between 1.03 and 3.70 times higher than in P group, in which patency was maintained.

Presence of Preoperative Pain

Differences were not statistically significant between P and NP groups regarding incidence or degree of postoperative pain.

TABLE 3. Mann-Whitney *U* Test in Analysis of Duration of Postoperative Pain (outcome: days)

Diagnostic factor	Condition	n	*P* value
Previous status	Vital	79	.48
	Nonvital	43	.89
Preoperative pain	Yes	44	.006
	No	78	.36
Group	Posterior	89	.22
	Anterior	33	.42
Position	Upper	63	.09
	Lower	59	.016

In cases with reported presence of preoperative pain, days of presence of postendodontic pain were significantly more ($P = .006$; Table 3) when apical patency was maintained. With a 95% CI, postoperative pain was between 0.47 and 3.19 days longer if apical patency was maintained, in patients who had experienced pain before treatment.

Group of Teeth

There were no statistically significant differences between P and NP groups regarding incidence, degree, or duration of postoperative pain when anterior teeth were compared with posterior.

Postendodontic Pain Related to the Arch

In upper teeth, differences between P and NP groups were not statistically significant regarding incidence, degree, or duration of postoperative pain.

In lower teeth, postoperative pain was significantly longer ($P = .016$; Table 3) if apical patency was maintained. In this group of teeth with a 95% CI, pain was between 0.08 and 2.63 days longer if apical patency was maintained.

Discussion

One of the main problems in studying pain is the patient's subjective evaluation and its measurement. For this reason, design of the questionnaire is critical and must ensure that it will be fully understood by patients and easily interpreted by researchers.

In this report, a simple verbal categorization was used in the feedback form with 3 categories: mild, moderate, and severe. These categories were straightforwardly understood by patients and were defined by the presence or absence of the need for analgesic treatment and by the relief it produced. However, subjectivity remained in the decision of whether to have analgesic treatment.

In this study, accurate determination of working length was also essential. It was determined with an electronic apex locator and later confirmed with a radiograph. Root ZX locator was used because its accuracy has been confirmed in vitro (16) and in vivo (17–19). As proposed by Herrera et al. (20), electronic measurement was repeated after mid and coronal shaping.

When radiologic and electronic root canal measurements are combined, sometimes results do not coincide. In the event of discrepancy between both measurements, the electronically determined value should be preferred (21–23), as in this study.

Another central factor is the definition of the file to be used in the patency protocol. There is not an explicit description other than the #10 or #15 file used to negotiate canals (24). In the report by Cailleteau and Mullaney (9) on teaching of patency in U.S. dental schools, the size of the instrument used to maintain the opening in the apical foramen varied. The #10 file was used by 42%, 33% used #15 file, and 25% used the #20 file. We systematically used a #10 diameter file to maintain apical patency in this study. Using high diameters for this purpose can cause injury of periapical tissues, difficult control in filling technique, and extrusion of important amounts of infected debris; all of these effects increase the incidence of postendodontic pain and put the result of the treatment at risk. Goldberg and Masson (8) observed that if a #20 file is used as a patency file, the chance of transporting apical foramen reaches 56.6%.

Forcing of endodontic instruments beyond the apical foramen can extrude a variety of irritants to the periapical tissue, which can increase incidence and degree of pain (25). One study showed a significantly higher incidence of pain if during the shaping procedure, instruments were forced beyond the apical foramen instead of maintaining them 1.5 or 2 mm short from the radiographic apex (26). Although it is difficult to compare their results with ours because there is no overinstrumentation in our protocol but a patency preservation in some cases, our data differ in that in nonvital teeth, patency cases show less postoperative pain when compared with nonpatency cases ($P = .03$), probably because debris or microorganisms in the apex irritate more periapical tissue than a small file that passively moves through apical foramen, which is wider than the 0.12 mm of diameter at d1 of a #10 file, the patency file used in our research. In our study, apical patency was maintained with a 10 file passively moved 1 mm beyond working length, whereas in the cited report it is unclear how much farther from the apical foramen the instruments were forced, or which diameters of files were used. In addition, in our report all cases were treated by the same highly experienced endodontist, whereas in the other report patients were treated by undergraduate students.

However, apical patency does not seem to be related to postendodontic pain in vital teeth. It is in this group of teeth in which agreement is lower between clinicians; one possible explanation is that this technique is not as damaging to periapical tissues as its critics believe. Fox et al. (27) did not find statistically significant differences in the establishment of postoperative pain with controlled overinstrumentations, a positively more aggressive technique than just maintaining apical patency.

Moreover, Torabinejad et al. (28) found that unintentional overextension of files, which can happen while determining working length, does not affect the incidence of postoperative pain. Probably they used a methodology similar to ours, because likely they used only fine files to determine the working length. This supports the idea that these are the only files that should invade the periapex. This report supports our findings in that periapical overextension does not necessarily cause postoperative pain. However, it differs from our study in that the authors did not try to maintain apical patency during all the shaping procedure, but overextension of files through apical foramen was limited to working length determination.

In a different type of research, Siqueira et al. (29) found low incidence of flare-ups after shaping and cleaning 627 nonvital teeth or teeth with previous endodontic treatment if apical patency was maintained. They stated that maintenance of apical patency does not seem to influence postoperative pain. This was not assessed in our study. In our report, flare-ups were not evaluated, only postoperative pain, and patency #10 files were not forced farther than 1 mm beyond working length, including necrotic teeth with periapical radiolucencies.

In conclusion, when vitality of teeth is considered, the incidence of postendodontic pain is lower in nonvital teeth when apical patency is maintained, with an odds ratio of 3.1 (95% CI, 1.1–8.8), and the duration is longer in lower teeth (95% CI, 0.08–2.6 days).

When preclinical symptoms are considered, duration of pain is longer in teeth with previous pain when apical patency is maintained (95% CI, 0.5–3.2 days).

From our data, it can be concluded that maintaining apical patency by using a #10 K-file can compensate for the eventual longer duration of postoperative pain in certain cases.

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