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Calcium Hydroxide as an Intracanal Medication: Effect on Posttreatment Pain

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Calcium hydroxide is advocated as an intracanal medication for various purposes, including prevention of posttreatment symptoms. This study assessed whether calcium hydroxide had a pain-controlling effect at different times when compared with no intracanal medication. One hundred forty patients participated. Conditions diagnosed were pulp/periapical pathosis with or without symptoms. At least partial cleaning and shaping was completed. At random, either $Ca(OH)_2$ plus H_2O paste or a dry cotton pellet was placed in the canals of half the teeth, respectively. All teeth were temporized with Intermediate Restorative Material. Patients assessed posttreatment pain up to 48 h as none, mild, moderate, or severe. The pain levels in each test group [$Ca(OH)_2$ versus cotton pellet] at each time period were compared statistically with a multiple-regression analysis. There was no significant difference in posttreatment pain between the two groups at any time period or with any diagnosis or symptom. The use of calcium hydroxide as an intracanal medication was unrelated to the incidence and/or severity of posttreatment pain.

Currently calcium hydroxide ($Ca(OH)_2$) is used as an intracanal medication. Its use has increased as the other traditional medications (e.g. phenolics and aldehydes) have declined in popularity for a number of good reasons. Of course, using a medication requires more than a single appointment to complete treatment. Although there have not been specific recommendations as to when $Ca(OH)_2$ should be placed, the general indication is with pulpal necrosis. Necrosis usually involves intracanal bacteria if periradicular pathosis is evident radiographically. One suggested method of reducing intracanal bacteria is to use $Ca(OH)_2$, which shows antimicrobial properties (1, 2).

Calcium hydroxide has been promoted for intracanal placement for other endodontic conditions, including apexification, apexogenesis, after trauma to prevent or resolve external resorption, and with routine root canal treatment. Several benefits have been proposed when used as an intracanal medication during root canal treatment (3). The one presumed advantage of $Ca(OH)_2$ over other types of medications is its antimicrobial properties attributed to its alkalinity (4). Several well-controlled studies, both in vivo and in vitro, have shown intracanal reduction of microbial populations, or at least inhibition of bacterial proliferation (5), both short-term and long-term (1, 6, 7). $Ca(OH)_2$ also alters bacterial cell walls and denatures a potent endotoxin (8), lipopolysaccharide, thereby rendering it less antigenic (9).

Of clinical interest, and certainly related to the biological response to $Ca(OH)_2$ when used as an intracanal medication, is the relationship to pain after an appointment. It has been suggested (10) that it has pain-preventive properties because of its antimicrobial or tissue-altering effects. Some dispute this and have reasoned that $Ca(OH)_2$ may initiate or increase pain by inducing or increasing inflammation (11). The one study (12) on $Ca(OH)_2$ as related to pain (flare-ups) found no difference between formocresol, steroids, or $Ca(OH)_2$ as to incidence. However this study (12) did not include a comparison (control) of a no medication group; therefore, whether all three decreased or all three had an adverse effect could not be determined. The question of whether $Ca(OH)_2$ indeed has an effect on interappointment pain remains unresolved. The objective of our study was to test whether there is such a relationship, that is to determine if intracanal $Ca(OH)_2$ has an effect on posttreatment symptoms at different time periods.

MATERIALS AND METHODS

Materials

One hundred forty patients receiving root canal treatment were studied: 56% female, 44% male, with a mean age of 38 years. All patients read and signed an approved form giving their consent to participate in the study. The subjects were divided into two test groups: one received intracanal $Ca(OH)_2$; the other group had only a cotton pellet placed in the chamber. Assignment to the two groups was at random and was equal (70 per group). Diagnostically, of the 140 patients, 31% had vital pulps and 69% necrotic pulps. These were divided approximately equally between the two groups. As to presence/absence of periradicular pathosis, approximately half of each group was represented in each category. Regarding patient symptoms on presentation, 27% in the calcium hydroxide group had significant (moderate-to-severe) pain, whereas 33% in the cotton pellet group presented with significant

pain. Therefore, there were approximately equally representative numbers in all categories in both treatment groups.

The calcium hydroxide mixture was prepared by mixing the pure powder (USP) with a 2.5% methylcellulose solution. This produced a paste that could be expressed from a syringe into the canal space with ease and, after compaction with a paper point, fill the canal completely as verified radiographically. The comparison group was a dry sterile cotton pellet placed in the chamber.

Methods

Cleaning and shaping was approached in a similar manner but with variations as necessary for each case. The apical seat or stop was enlarged to at least a #25 master apical file. Step-back preparation was performed on each canal using 2.5% sodium hypochlorite irrigant. After cleaning and shaping, the final irrigation was followed by drying with paper points.

In the $Ca(OH)_2$ group the paste was introduced with a small-gauge, disposable needle into all canals. Then a sterile paper point was used to press the medication into the apical region of the canal followed by placement of more $Ca(OH)_2$ paste. A dry, sterile, cotton pellet was placed in the chamber followed by an Intermediate Restorative Material temporary. In the comparison group the canals were left empty after drying; a cotton pellet was placed in the chamber followed by a temporary Intermediate Restorative Material.

Each patient was given a self-addressed, stamped postcard at the conclusion of the appointment with instructions on recording his or her evaluation of the incidence and level of discomfort according to their perception. At least a part of their perception would be based on the use or nonuse of an analgesic (type not specified), and if used, its effectiveness. Patients were not instructed to self-administer analgesics. If they chose not to do so, they were still to rate their pain perception. The four pain categories were as follows:

1. No Pain
2. Mild pain: discomfort that required no analgesic
3. Moderate pain: discomfort that required but was controlled by analgesics
4. Severe pain: required, but uncontrolled by, analgesics

The pain ratings were at intervals of 4, 24, and 48 h after treatment.

Evaluation

The two groups, according to the three posttreatment time periods, were tallied as to the number of responses at each pain level at each interval. Comparisons were made by subjecting the collected data to a multiple-regression analysis. Significance was deemed to be at a 0.05 level or less.

RESULTS

There were no significant differences in posttreatment pain between the $Ca(OH)_2$ and the dry cotton pellet groups. The variables of demographics, diagnosis, radiographic findings, and pretreatment symptoms did not impact the outcome when comparing the two groups. The data also demonstrated that there were no differences ($p > 0.05$) in pain incidence or pain levels between the calcium hydroxide and the dry cotton pellet only at any of the three postoperative time periods.

There was a decrease in pain at each successive time period for the 140 patients. At 4-h posttreatment, 30% reported moderate-to-severe pain, whereas at 24 h 16%, and by 48 h only 8% of patients indicated significant pain.

DISCUSSION

The most important findings in our study were that intracanal $Ca(OH)_2$ did not decrease or increase posttreatment pain. This is consistent with clinical trials that tested other intracanal medications and also showed no relationship to pain after an endodontic procedure (13). The one exception is corticosteroid paste, which when placed in canals, showed a decrease in low levels of pain postoperatively (14).

The antimicrobial activity of calcium hydroxide, according to our findings, would apparently be unrelated to patient symptoms posttreatment. As reviewed in the "Introduction," $Ca(OH)_2$ is generally effective against bacteria (2, 9) and will detoxify lipopolysaccharides (8, 9). According to our findings, at least through a 48-h period, this microbial control did not relate to patient symptoms during that time period.

Other proposed actions of $Ca(OH)_2$ on tissues also do not apparently correspond to symptoms. It has been demonstrated that $Ca(OH)_2$ is unlikely to cause significant alteration of tissue remnants within the pulp space (15). Interestingly, it was shown (16) that, after time, in an animal model system with induced pulp necrosis/periapical pathosis, intracanal $Ca(OH)_2$ was related to a reduction in inflammation, presumably through antimicrobial action. If this were true in the human clinical situation, this reduction in inflammation is unrelated to symptoms, according to our findings. Available calcium ions have been shown to alter (inhibit) nerve activity (17); again, this action must be clinically insignificant.

Always an interesting finding is the number of patients experiencing symptoms after an endodontic procedure; ours was no exception. Thirty percent of patients reported significant (moderate-to-severe) pain levels. Postappointment, the numbers dropped until only 8% indicated significant pain at 48 h. Again, this is consistent with others who have reported such a decrease in symptoms (13).

Although we used the designation of moderate-to-severe pain, most of those in the severe category would not qualify as flare-ups (postappointment emergency). It would have been interesting to compare flare-up incidences between the two groups, as was done in the Trope study (12). However, the number of flare-ups in our patients was too low to make meaningful comparisons. That we had few flare-ups is consistent with other carefully controlled clinical studies (18, 19).

As indicated by our data, $Ca(OH)_2$ as an intracanal medication is not useful to prevent or reduce postoperative pain. This further reinforces that most local treatment measures (other than those specifically directed at pain relief in an emergency situation) will do little to reduce the incidence and severity of posttreatment symptoms.

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