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Pulpectomy phase of non-surgical root canal therapy

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INTRODUCTION

The purpose of this paper is to elaborate on pulpectomy as a treatment modality. It will present the objectives of therapy and techniques useful in achieving those objectives.

BACKGROUND

Pulpectomy is the surgical removal of all pulp tissue from the root canal system (1). Regardless of the indication for this procedure, it is incumbent upon the practitioner to assure that this goal is met. If this is accomplished, the remainder of the endodontic therapy will be easier, and post-operative pain and complications will be minimized.

PULPECTOMY – Treatment Considerations

Anesthesia

It is essential to eliminate any sensation from the tooth being treated prior to endodontic therapy. While it is true that some necrotic teeth can be treated without anesthesia, placement of rubber dam clamps and instrumentation beyond the apex (patency filing) normally make the use of local anesthetic desirable. This is typically achieved through simple infiltration for maxillary teeth or regional blocks for mandibular teeth. However, when a patient presents with an acutely symptomatic tooth, profound anesthesia is often complicated and cannot be achieved by simple means. This may be due to a localized decrease in tissue pH, making the anesthetic less effective (2). Other factors that can make the attainment of profound anesthesia difficult include accessory nerve innervation, sodium-resistant (TTX) nerve channels, and anxious patients (3,4). When these situations are encountered, consideration should be given to supplemental anesthetic techniques. Wider regional blocks, such as the Gow-Gates, Akinosi, Posterior Superior Alveolar, high tuberosity and Division II blocks, are available. Intraosseous techniques, such as the Stabident®, X-tip® and PDL injection offer other methods of producing anesthesia, and have been proven to greatly enhance anesthesia when other techniques have been deficient (5). As a last resort, intrapulpal injection will allow the practitioner to proceed with treatment. This should be performed through a small opening into the pulp. As such, anesthesia is achieved via pressure. Because the effect of the intrapulpal injection is relatively brief, removal of the majority of the pulp should then be rapid.

Isolation/ Access

One of the tenets of root canal therapy is maintaining as sterile an environment as possible. Therefore, isolation with a rubber dam is the standard of care. The only reason suitable for not placing a dam prior to the initiation of access is if the dam will obscure the accurate direction of cutting into the tooth, and hence increase the risk of perforation during access. Once access is made and canals are located, the rubber dam must be placed before instrumentation proceeds. Optimal seal around the tooth must be provided. One study showed that bacterial leakage still occurred around 53% of adequately placed dams. This was reduced to 20% with adhesive placment over the junction of the dam and tooth (6).

Access into the root canal system is normally influenced by conservation of tooth structure, but enlargement of the access opening is required, even to the point of encroaching into cusps, when straight line entry into *all* canals cannot be gained by conservative opening. If endodontic therapy is compromised because of insufficient access, even the best subsequent restoration of the tooth will be for naught. Further, it is much more difficult working through a "mousehole" than through an adequate access opening. It is also necessary to remove all carious dentin and leaking restorations. Once straight-line access has been achieved, identification of all canal orifices must be made. The maximum number of canals for that particular tooth should be pursued until it can be accurately determined that the additional canals do not exist (for example, 4-canaled maxillary and mandibular molars, 2-canaled premolars, and 2-canaled mandibular anterior teeth). Adjuncts to identification of canals include angled radiographs (essential to all endodontic therapy), small files (sizes .06 and .08), NaOCl "bubble tests", methylene blue dye, fluorescein sodium ophthalmic dye, long-shanked burs, and ultrasonic troughing. It should be noted that the latter two are aggressive procedures and should be used judiciously. Magnification and illumination, including the Dental Operating Microscope, is often required.

Instrumentation

Pulpectomies should extend to the desired working length. Morphological studies of teeth reveal that the apical constriction lies approximately .52 to .72 mm from the radiographic apex (7,8). Obtaining accurate working lengths is essential to permit mechanical debridement of vital or necrotic tissue, and to keep the apical constriction intact. A useful tool, in addition to necessary straight and angled radiographs, is the electronic apex locator. Skilled use of these devices can aid in the faster placement of files nearer to the appropriate working lengths, as well as potential identification of canals which have a portal of exit considerably shorter than the "radiographic length".

Early flaring of the coronal portion of the canal will allow easier instrumentation of the apical one third of the canal, and allow irrigating solutions to reach the apical third of the canal. Instrumentation of the canal should progress to at least a size #25 file. This will ensure that most pulpal tissue is removed. Care, however, must be taken to not place larger instruments beyond the working length, as this will destroy the constriction. Accurate determination of working length from radiographs, and appropriate integration of apex locators will help prevent such an error. Generally, files should be pre-curved before placing them into a canal.

It is worth noting that many endodontists, in fact, desire referring dentists to *not* instrument to or near the apical constriction. Instead, they prefer *pulpotomy* procedures when emergency endodontic therapy is indicated. If instrumentation of vital canals is sought, though, this can be efficiently accomplished with the use of barbed broaches. In this manner, the pulp can often be rapidly removed with minimal or no alteration of the dentinal walls. Much of the decision may be based on the skill level of the operator and/or the amount of time available. If adequate pulpectomy cannot be performed, pulpotomy may then be desirable. It is important to communicate with the endodontist concerning their preferences, if referral is planned.

It is essential that appropriate radiographs be taken throughout the pulpectomy procedure. In addition to multiple pre-operative radiographs, a mini-

mum of a film with a file in place <1 mm from the working length is necessary to ensure proper debridement. When adequate working lengths are not reached, even the smallest portions of remaining pulp tissue can initiate post-operative complications. A patency film, and an apex locator, is desirable to determine if the canal portal of exit is not coincident with the radiographic foramen (thus changing working length determination). Wherever possible, patency filing should be performed with a size 15 or smaller file, as this is the only way to absolutely determine the portal of exit, and to prevent debris build-up and canal blockage short of the apical constriction.

It is also important to chemically debride residual tissue not accessible by mechanical means. Close inspection of root canal morphology shows that fins, isthmuses and oval-shaped canals are the norm and not the exception (9). Irrigation with 5.25% NaOCl has been shown to dissolve both vital and necrotic tissue (10,11). It is important to note, though, that effective irrigation is only possible when the solution is able to reach within a few millimeters of working length. A side-vented small-gauge irrigation needle is recommended. This should be measured and stoppered to the desired working length, and solution placed passively into the canal to prevent expression beyond the foramen and subsequent hypochlorite accident.

Other adjuncts to debridement of the canal system are the sonic and ultrasonic instruments. Passively running a small file or tip, without touching the canal wall, serves to energize irrigant solution within the canal, producing a phenomena known as acoustic streaming (12). This further debrides tissue in those areas that are inaccessible to mechanical instrumentation. Research has demonstrated that three minutes of passive sonication in each canal is effective in removing debris in the apical third of the canal system (13).

Intracanal Medication

Currently, the most beneficial intracanal medicament is calcium hydroxide ($Ca(OH)_2$). It may be delivered in a variety of ways, either as pure powder, premixed paste, or as a chairside mixed paste. Its primary mode of action is its antibacterial effect, although it is also capable of dissolving tissue (14,15). Antibacterial actions may be especially beneficial in necrotic cases where it is believed that bacteria are incompletely removed through chemomechanical debridement. Conversely, in vital cases, when a clean operating field is maintained, additional antibacterial action may be of little benefit. Studies have shown that $Ca(OH)_2$ cannot be completely removed from the canal and may have adverse effects on the set of eugenol-based sealers (16,17). Regardless, when $Ca(OH)_2$ is used, every attempt should be made to place it as far apically into the canal as possible. Its antibacterial and dissolution properties are only seen where it touches tissue. It should, however, not be injected under pressure.

Prescriptive Medications

Antibiotics: The routine use of antibiotics following pulpectomy cannot be justified (18). Only in cases with systemic manifestation of infection, or swelling into fascial planes accompanied by lymphandenopathy, should antibiotic therapy be prescribed. Usually, removal of the etiology (irreversibly inflamed or necrotic pulp tissue) will suffice. When antibiotics are indicated, adequate clinical doses must be prescribed, and the patient should be educated on the necessity of completing the dose schedule.

Analgesics: Many analgesics are available that will provide pain relief. Acetaminophen (APAP) has been shown to be very effective in the management of mild to moderate post-operative discomfort (19). In fact, many patients will not require any pharmacological intervention. Some will infrequently experience moderate to severe discomfort. Anti-inflammatory analgesics (ASAs and NSAIDs) are particularly useful when a greater range of discomfort is possible. Finally, in a small percentage of cases, narcotic medications may be beneficial in the alleviation of pain. Because they do not act peripherally, though, they are most effective when used in conjunction with one of the previously mentioned analgesics.

Recently, a *flexible analgesic strategy* was proposed. This strategy states that the patient's anticipated level of pain should be determined based on presenting symptoms, pulpal status, history of tolerance to pain, difficulty of the procedure, and other factors, and should be classified as mild, moderate or severe. For mild pain, an effective dose of nonnarcotic analgesic should be prescribed. If this is insufficient, or moderate pain is anticipated, a nonnarcotic-narcotic combination should be given. If the patient is still experiencing pain, the amount of the nonnarcotic analgesic component can be increased to maximally safe doses (e.g., 1000 mg of APAP q6h), or alternating regimens of APAP and the nonnarcotic-narcotic combination can be recommended (20).

SUMMARY

Pulpectomy as a treatment modality requires the practitioner to consider many aspects of dental care. Careful pre-operative assessment of the pulpal status and the morphology of the tooth are necessary to devise a maximally effective plan to safely and accurately access into the root canal system. Every attempt should be made to remove as much of the pulp and diseased dentin from that system via chemomechanical debridement. Various adjuncts are available which can enhance the practitioner's ability to do so. Intracanal medication should be placed when it is believed that significant residual bacteria remain following instrumentation. Finally, prescriptive medication should be given for infection (when indicated) and for pain management (of sufficient strength) to ensure that the patient does not require additional emergency treatment prior to the scheduled completion of the root canal therapy. It cannot be overemphasized that removal of the etiology is the most important factor in providing successful pulpectomy therapy.

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