Root canal treatment in primary teeth: a review

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Although preventive measures have reduced caries, premature loss of pulpally involved primary teeth remains a common problem. The resultant mesial drift of the permanent teeth frequently leads to malocclusion. Retention of the pulpally involved primary tooth to preserve arch space is preferable to space maintenance if the tooth can be restored to normal function and is free of pathology.

Additional reasons to preserve the integrity of the primary dentition are to (1) aid in mastication, (2) preserve a pulpally involved primary tooth in the absence of a succedaneous tooth, (3) prevent aberrant tongue habits, (4) prevent possible speech problems, (5) maintain esthetics, (6) prevent the psychological effects associated with early tooth loss, and (7) maintain normal eruption time of the succedaneous teeth. Premature loss of the primary tooth may lead to accelerated or delayed eruption of the succedaneous tooth depending upon development of the permanent tooth.[1]

Because of high failure rate, pulp capping is not recommended for carious exposures in primary teeth.[2,3] Other than mechanical exposure in a healthy tooth, all pulp exposures in primary teeth should be treated with pulpotomy, pulpectomy, or extraction.

In primary teeth, the formocresol pulpotomy is a well documented and accepted procedure with a success rate of over 90%.[4,5] However, in order to achieve this success rate, the treatment must be confined to teeth which are judged clinically to have inflammation only in the coronal pulp.

Contraindications for the formocresol pulpotomy are: (1) teeth with history of spontaneous pain, (2) pain on percussion due to periapical involvement, (3) suppuration in the canals, (4) the presence of a parulis or sinus tract, (5) hemorrhage which cannot be controlled in five minutes after extirpation of the coronal pulp, (6) evidence of periapical or furcal pathology, and (7) presence of necrotic pulp in the chamber. Pulpally involved primary teeth with any of the above symptoms are candidates for root canal therapy or extraction.

Root Canal Anatomy and Morphological Changes in the Primary Teeth

Before beginning root canal therapy, the clinician should understand the morphologic changes that continually occur within primary teeth and be familiar with the basic differences between primary and permanent root canal anatomy. The root canals of anterior primary teeth are relatively simple, have few irregularities, and are easily treated endodontically. Conversely, the root canal systems found in posterior primary teeth frequently contain many ramifications and deltas between canals making thorough debridement quite difficult.[6,7]

Generally, there is only one canal present in each root of the primary molars when the formation of the roots has been completed (Figure 1a). The primary tooth root will begin to resorb as soon as the root length is completed. This resorption causes the position of the apical foramen to change continually. Simultaneously, secondary dentin is deposited within the root canal system.[7-9]

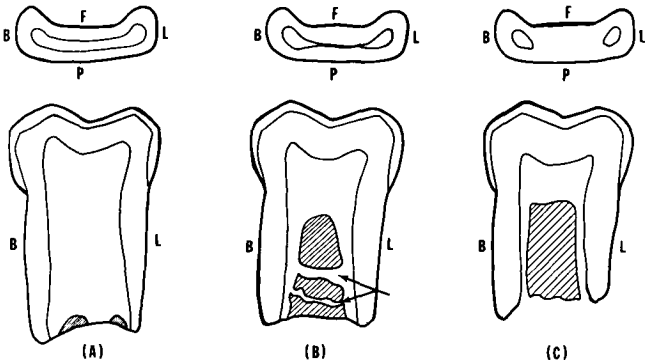

Figure 1. Cross section (top) and sagittal section (bottom) of the mesial root of the primary mandibular molar, B (buccal), L (lingual), F (furcal), and P (proximal) views. (A) Initial formation of the root with only one canal present. (B) As the tooth develops, there is deposition of secondary dentin (lined areas) within the root canal system and continual resorption of the root apex. Small fins and connecting branches develop between canals (arrows). (C) During late development of the tooth the canals are completely divided as the roots continue to resorb.

This deposition produces variations and alterations in the number and size of the root canals, as well as many small connecting branches or fins between the facial and lingual aspects of the canals (Figure 1b). Continued deposition of dentin within the root will divide it into separate canals (Figure 1c). In addition, accessory canals, lateral canals, and apical ramifications of the pulp may be found in 10–20% of primary molars.[7,10]

The maxillary primary molars may have two to five canals, with the palatal root usually rounder and longer than the two facial roots. In the mesiofacial root, two canals occur in approximately 75% of the primary maxillary first molars and 85–95% of primary maxillary second molars.[7,10]

Fusion of the palatal and distofacial roots occurs in approximately one-third of the primary maxillary first molars and occasionally in the primary maxillary second molars.

The primary mandibular first and second molars usually have three canals which generally correspond to the external root canal anatomy. Two to five canals occasionally may be found. Approximately 75% of the mesial roots in primary first molars contain two canals; whereas in primary second molars, 85% of the mesial roots contain two canals. Only 25% of the distal roots in either tooth contain more than one canal.[7,10]

Differences Between Root Canal Instrumentation and Obturation in Primary and Permanent Teeth

Primary teeth are smaller in all dimensions than the corresponding permanent teeth. The thickness of enamel and dentin coronal to the pulp chamber is also thinner in a primary tooth. The distance from the occlusal surface to the floor of the pulp chamber is much shorter than in the permanent tooth. Because of this, care must be taken when making an access opening into the pulp chamber to prevent perforation through the floor into the furcation area (Figure 2).

Primary molar roots are widely divergent and curved to allow for the development of the succedaneous tooth. During instrumentation these curves increase the chance of perforation of the apical portion of the root or the coronal one-third of the canal into the furcation. Precurving all instruments is recommended to reduce the possibility of perforation. In addition, flaring of the canal should be kept to a minimum because of the thin dentin walls of the roots. Intracanal use of rotary instruments is contraindicated for the same reason.

The variation of the root canal system in primary molars makes it difficult to remove completely necrotic tissue by instrumentation. Profuse irrigation with 5.25% sodium hypochlorite (NaOCl) is recommended strongly over a two-appointment period to help dissolve necrotic tissue left behind by routine instrumentation.[11–13]

Placement of root canal instruments and filling materials beyond the radiographic apex must be avoided to prevent possible damage to the permanent tooth bud, just beneath the primary tooth. If signs of resorption are visible radiographically at the apex, it is advisable to establish the working length of the endodontic instruments 2–3 mm short of the radiographic apex. For maximum accuracy when measuring canal length, use the long-cone paralleling radiographic technique.

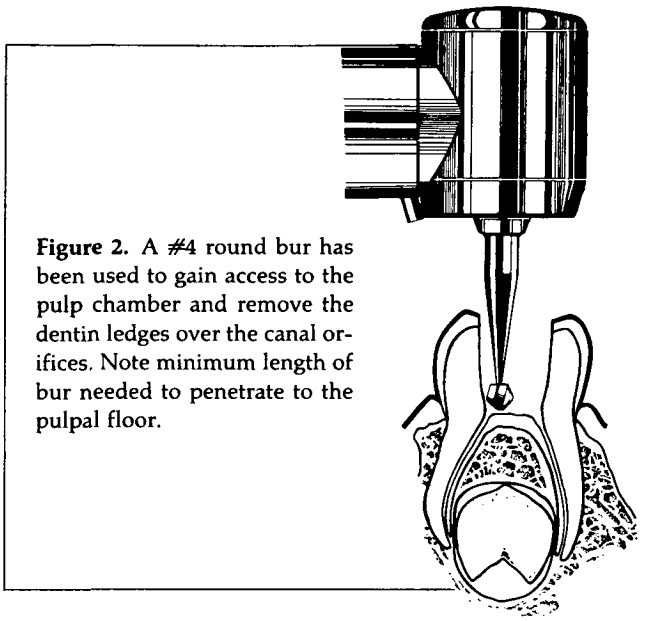

Figure 2. A #4 round bur has been used to gain access to the pulp chamber and remove the dentin ledges over the canal orifices. Note minimum length of bur needed to penetrate to the pulpal floor.

Root canal filling materials used to obturate primary root canals must be absorbable so as not to interfere with the eruption of the permanent tooth. Gutta percha is contraindicated as primary root canal filler, except where there is no succedaneous tooth.

Pulpectomy and Instrumentation

The following are contraindications to root canal therapy for primary teeth: (1) a nonrestorable tooth, (2) a tooth with a mechanical or carious perforation of the floor of the pulp chamber, (3) pathologic root resorption involving more than one-third of the root, (4) pathologic loss of bone support resulting in loss of the normal periodontal attachment, (5) the presence of a dentigerous or follicular cyst, and (6) radiographically visible internal root resorption. If the internal resorption can be seen radiographically, it probably has perforated the thin dentin adjacent to the furcation. This is important because of the short distance from the furcation to the oral cavity. That enables the inflammatory process inside the tooth to communicate with the oral cavity resulting in loss of the periodontal attachment and, ultimately, further resorption and loss of the tooth.

Anterior Teeth

Access and instrumentation of the primary anterior root canals is relatively simple because of the uncomplicated canal systems. The tooth is anesthetized, rubber dam placed and the canals are cleaned and shaped in the same manner as the corresponding permanent teeth.

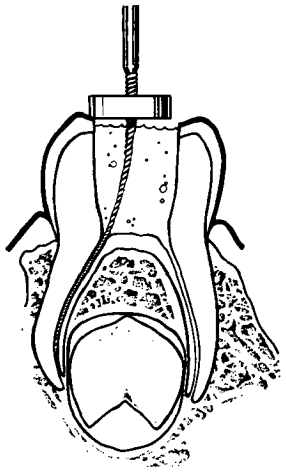

Figure 3. A small diameter file is curved and placed into the canal, 1–2 mm from the radiographic apex.

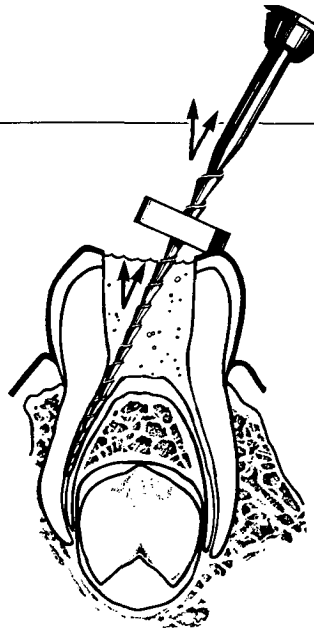

Figure 4. Hedstrom files are used in a rasping motion to flair the coronal one-half of the canal.

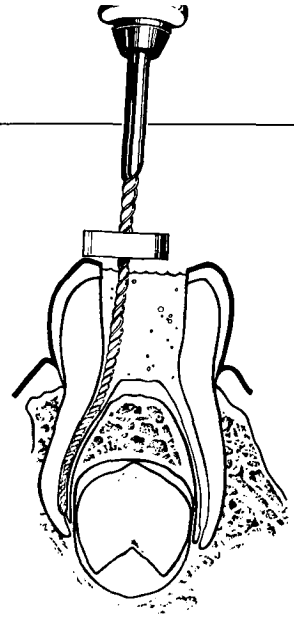

Figure 5. The canal is instrumented to a minimum final file size of 30–35, developing a positive apical stop 2–3 mm from the radiographic apex.

Primary Molars

After administering anesthesia and placing the rubber dam, an access opening to the pulp chamber is made in the same manner as in the permanent teeth. Care must be taken not to perforate the pulpal floor. A #4 round bur is used to gain access to the pulp chamber and remove the dentin ledges hindering direct line access to the canal orifices (Figure 2). A double-ended endodontic explorer is used to identify each of the canals. Before instrumentation the pulp chamber should be copiously irrigated with sodium hypochlorite.

A trial length is obtained by measuring the tooth on the preoperative radiograph and subtracting 1–2 mm. A small diameter file is placed into the canal to the trial length and another exposure taken from which the working length is determined (Figure 3). Whenever possible, all radiographs should be taken utilizing the paralleling technique in order to minimize distortions. The working length should be 1–2 mm short of the radiographic apex ideally. If obvious signs of root resorption are present, it may be necessary to further shorten the working length by an additional 1–2 mm in order to avoid overextension of the instruments into the periapical tissues. Once the working length has been established, the canals are thoroughly cleaned. If hemorrhage is encountered after the pulp tissue has been removed, this is an indication that root resorption likely has occurred and the working length should be shortened 2–3 mm from the radiographic apex. One should not attempt to instrument to the apex as this would force contaminants and toxic by-products into the periapical tissues, thereby causing possible injury to the underlying permanent tooth bud.

To aid in access to the canals, Hedstrom files may be used to flair the canal orifices (Figure 4). Because Hedstrom files quickly open the canal orifice and eliminate pulp tissue they must be used with caution. Instrumentation with Hedstrom files is always directed toward the areas of the greatest bulk and away from the furcation area (Figure 4 arrows) to prevent stripping and perforation of the furcal position of the thin root canal system. Instrumentation with standard files is performed in much the same manner as is done to prepare a canal to receive gutta percha, creating an apical stop 2–3 mm from the apex. The canals should be enlarged several sizes beyond the size of the first file that fits snugly into the canal to a minimum final size of 30–35 (Figure 5).

During instrumentation the canals should be irrigated frequently with sodium hypochlorite to aid in debridement.[12] After the canals have been debrided thoroughly and instrumentation is complete, the canals again are irrigated copiously with sodium hypochlorite and dried with sterile paper points. A sterile cotton pellet is placed into the chamber and the tooth is sealed temporarily, or if an intracanal medicament is used, it is placed on a cotton pellet and blotted dry before application (Figure 6). Either single or double temporary seals can be used.

While it may be necessary to anesthetize the gingiva in order to place the rubber dam, the use of anesthesia rarely is indicated during the obturation appointment. The patient's response can help determine when the filling material approaches the apical foramen. The filling material in primary teeth must be absorbable so that it will resorb with the roots and not interfere with the eruption of the permanent tooth. The filling material of choice is Zinc oxide eugenol (ZOE) without a catalyst to insure adequate working time during obturation. The ZOE is mixed to a very stiff consistency and carried to

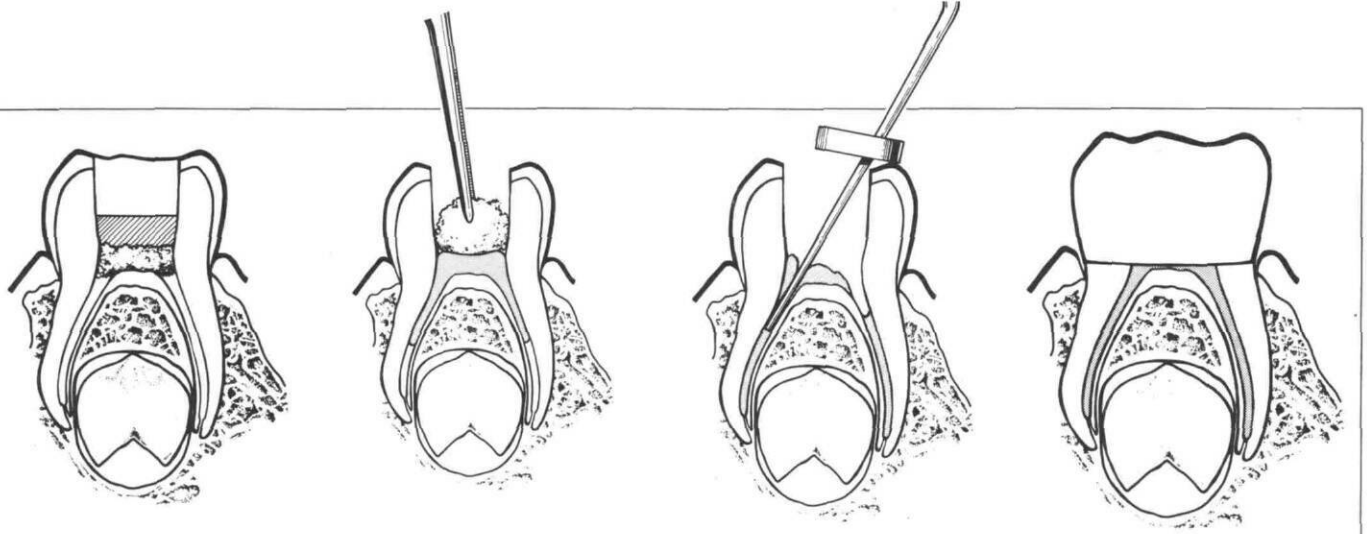

Figure 6. Sterile cotton is placed and intra-appointment double temporary seal is placed.

Figure 7. A cotton pellet is used as a plunger to force the ZOE down the canals.

Figure 8. If needed, an endodontic plugger is used to insure placement of the filling material to the apical end of the canal.

Figure 9. Final endodontic fill with stainless steel crown restoration.

the canal with a plastic instrument.

After ZOE is placed in the chamber, a cotton pellet is used as a plunger within the pulp chamber to force the filling material down the canals (Figure 7). The cotton is removed and a #5-7 endodontic plugger or lentula can be used to push the ZOE to the apex (Figure 8). The addition of zinc oxide powder to the pulp chamber will aid in condensation of the ZOE paste. Adequacy of the filling procedure is determined by radiographs. The endodontic pressure syringe also has been found to be effective in placing ZOE into root canals or primary teeth.[14,15] Small amounts of ZOE which may have been forced inadvertently into the periapical tissues are left alone since they are absorbable.

The main problem with all paste filling materials is the inability of the clinician to control adequately the flow of the paste, thereby increasing the chance of forcing the material into the periapical tissues. Certain points should be remembered to minimize the extrusion of ZOE past the apex: (1) an apical stop should be developed 2-3 mm from the radiographic apex (Figure 5), (2) measurement stops should be placed on all endodontic instruments and pluggers for effective measurement control (Figures 3, 4, 5, and 8), and (3) radiographs should be taken during the fill procedure to verify the depth of filling material.

Once the canals have been obturated, the chamber and access opening is filled with a fast-setting temporary cement. The tooth then is restored permanently. In primary anterior teeth, a composite resin is recommended to restore the lingual access opening. In primary molars, stainless steel crowns are recommended to prevent possible fractures (Figure 9). Although we have described a two-step pulpectomy procedure most primary teeth can be instrumented and obturated during a single appointment. Primary teeth which have received root canal therapy should be evaluated at periodic intervals (i.e., six months to one year). This recall is important to check for success of the treatment and to intercept any problems associated with a failing root canal.

A primary tooth in which endodontic treatment has been successful will be asymptomatic, firm in the alveolus, and free of pathosis. The primary tooth should resorb normally and in no way interfere with the formation or eruption of the permanent tooth. During recall if there is any evidence of swelling, ankylosis, periapical or furcal pathosis, or the presence of a sinus tract, extraction is recommended.

The success rate of pulpectomies in primary teeth is extremely high, particularly if the selection criteria mentioned above are followed. Studies have reported success rates of 95 and 99%.[16,17] Many of the arguments advanced against root canal treatment of primary teeth are fallacious. The claim that endodontic treatment is more

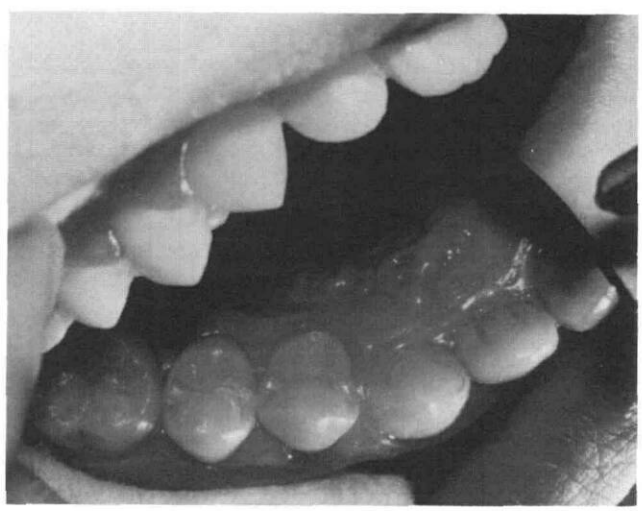

Figure 10. Clinical photograph of erupted permanent teeth. Although some space had been lost due to caries, adequate space was available for eruption of the permanent premolars. Note that the permanent first premolar is free of any defects.

expensive than space maintainers cannot be substantiated when one considers the follow-up necessary in an appliance of this nature. Additionally, fear of creating coronal defects has not been demonstrated clinically in the erupted succedaneous tooth (Figure 10).

The opinions or assertions contained herein are the private views of the authors and are not to be construed as official or as reflecting the views of the Department of the Army or the Department of Defense.

The authors wish to thank: Dr. Steve Guy for his review and comments of this manuscript; Mr. Vernon Posey for his valuable contribution and expertise as a medical illustrator; and Ms. Marilyn Robson for her assistance in the preparation of this manuscript.

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Quotable Quotes

Community water fluoridation and individual use of fluorides have brought about a marked reduction in the prevalence of dental caries in the United States during the past 35 years. There is evidence that the prevalence of caries is declining in communities with unfluoridated water as well as in those with fluoridated water. This phenomenon may be related to an increase of fluoride in the food chain, especially from the use of fluoridated water in food processing, increased use of infant formulas with measurable fluoride content, and even unintentional ingestion of fluoride dentifrices. This trend should encourage re-evaluation of research priorities and previously accepted standards for optimal fluoride use.

From: Leverett, D. H. Fluorides and the Changing Prevalence of Dental Caries, Science 217: 26-30, 2 July 1982.