Impact of a Biological Barrier in Pulpectomies of Primary Molars

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Abstract

Purpose: The purpose of this in vitro study was to determine whether placement of a resorbable collagen barrier at the apical one third of the root canal could prevent extrusion of pulpectomy filling material.

Methods: Twenty-five extracted primary mandibular second molars, with at least two thirds of root length remaining, were used. The apical third of each root was covered with utility wax, and teeth were embedded in acrylic. Carious tooth structure was removed, crowns were reduced to a flat surface, and canals were accessed and preflared. Working lengths were established by reducing file lengths 2 mm short of the anatomic apex. Cleaning and shaping was performed using hand and rotary files, and canals were irrigated with sodium hypochlorite and dried with paper points. CollaCote was randomly packed into 1 of 2 prepared canals, and obturation was performed with Vitapex. Postoperative radiographs were independently evaluated for the presence of overfilling, and data were statistically analyzed using chi-square analysis.

Results: Overfilling was observed in 16% (4/25) of the CollaCote treated canals and in 42% (10/24) of canals when no barriers were used (P=.047).

Conclusion: The application of CollaCote at the apical one third of the canals did not completely prevent, but did significantly decrease, the risk for overfilling in primary molars. (Pediatr Dent 2006;28:506-510)

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When advanced pulpal degeneration (hyperemic radicular pulp after pulpotomy or from a necrotic pulp) affects a primary tooth, 2 possible treatment options are available: pulpectomy or extraction. The ultimate goal of a pulpectomy procedure is to: (1) maintain arch length; (2) preserve occlusal function; and (3) promote eruption guidance for the permanent teeth.[1] Moskovitz et al[2] listed the following conditions as contraindications to pulpectomy: (1) nonrestorable crown; (2) perforation of pulpal floor; (3) radiographic evidence of severe internal or external resorption; (4) periradicular radiolucencies involving the permanent tooth follicle; (5) extreme tooth mobility and/or reduced bone support; (6) less than two thirds root length remaining; (7) underlying dentigerous or follicular cyst; and (8) medically compromised children.

The pulpectomy technique involves:

1. excavating the carious tissue;
2. accessing the pulpal chamber;
3. amputating remaining coronal pulp tissue; and
4. extirpating all the radicular pulp utilizing either broaches or handfiles.

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Rotary instrumentation has also been advocated for primary teeth.[3] Due to the relatively uncertain location of the anatomical apex,[4] working length has been traditionally established by adjusting the stops on the handfiles 1 mm to 2 mm short of the radiographic apex.[5] The use of electronic apex locators, however, is currently being advocated for clinical implementation of endodontics in primary teeth.[6] The canals are then instrumented and organic material is removed from the canal until reaching a standardized file size (typically a minimum of 30-35 for primary molars) or until the file snuggly fits into the canal.[5] During instrumentation, the canal(s) should be irrigated periodically to aid in debris removal. Sterile water is an ideal irrigant for primary teeth, although sodium hypochlorite may be used with precaution to avoid damage to the periapical tissues and to the developing succedaneous tooth.[7]

Once thoroughly instrumented and irrigated, the canals are dried with paper points and prepared to receive the filling material. Zinc oxide eugenol, Vitapex (Diadent Group International), Maisto's paste (Inodon, Porto Alegre, Brazil), Endoflas (Sanlor Laboratories, Miami Beach, FL), and Kri Paste (Pharmachemia AG., CH-8053, Zurich, Switzerland) are examples of resorbable materials indicated for root canal therapy in the primary dentition.[8-14] Delivery of the filling

material can be performed using: (1) a lentulo spiral; (2) an endodontic plugger; or (3) commercial pressure syringes.[15] Regardless of the filling technique used, clinical studies have demonstrated an association of increased failure rates with overfilling of the obturation paste.[1,2,11,13]

The application of the resorbable biological barrier at the apical level is a very common technique after root canal therapy of immature, nonvital permanent teeth.[16] This technique creates a supportive structure upon which restorative materials such as gutta percha can be compacted against. The clinical applications of this concept are promising, as evidenced by the current usage of these artificial barriers in procedures such as apexification of immature permanent teeth and perforative and resorptive defect repairs in mature permanent teeth. CollaCote (ZimmerDental, Austin, TX), Emdogain (Biora, Inc., Chicago, IL) and MTA (mineral trioxide aggregate; Dentsply/Tulsa Dental, Tulsa, OK) are materials currently being used to treat bone defects associated with endodontic treatment complications. These materials act as an interface between restorative materials and biological tissues.[16]

With this concept in mind, it seems logical that the placement of a resorbable biological barrier short of the root's apex level could prevent material overfill and, subsequently, increase pulpectomy success. Thus, the purpose of this in vitro study was to determine if placement of an absorbable collagen barrier (CollaCote) would prevent or diminish the extravasation of root canal filling material during primary molars pulpectomies.

Methods

The study was reviewed and approved by the Institutional Review Board at the University of Florida.Twenty-five primary mandibular second molars—extracted for orthodontic reasons, dentoalveolar abscesses, or questionable crown restorability—were collected. To be included in the study, teeth needed to have at least two thirds of the root length remaining and no signs of internal or advanced external resorption. These teeth were selected due to:

1. ease of radiographic visualization; and
2. exhibition of less variability in the length of the canals and number of canals per root.[17]

The collected teeth were:

1. initially stored in a 10% formalin solution;
2. later cleaned of all tissue remains by hand scaling;
3. pumice polished; and
4. stored in distilled water until preparation.

Using a size no. 6 round carbide bur in a slow-speed handpiece, all carious tooth structure was removed. With a tapered diamond bur in a high-speed handpiece, the crown was reduced to a flat surface at the cementoenamel junction level. The pulpal chamber was then completely unroofed and cleared of all remaining pulpal tissues via slow-speed instrumentation. The location and number of root canals was then recorded. The coronal one third of each canal was then preflared using a Gates-Glidden instrument. Studies in permanent teeth have shown that preflaring the coronal one third improves tactile sensitivity, which aids in selecting the appropriate initial file size based on the accurate determination of apical diameter.[18]

After preflaring the coronal one third of the root canal space, the initial file size was determined visually by finding the file that bound snuggly at the apex without being overextended. Each canal's length was determined by advancing a size no. 10 hand file to the apical foramina (direct visualization of the file's tip) and then adjusting the silicone stop flush with the coronal tooth structure. The length was then measured on a standard endodontic ruler and working length was established at 2 mm short of the apex. To allow evaluation of overfilling, the apical third of each root was covered by a ball of utility wax and the tooth was then suspended vertically in a dappen dish leaving 2 mm to 3 mm of space between the wax and the bottom of the bowl. Pink acrylic was then poured into the dish, submerging the apical two thirds of the root.[19]

When determining canal length, all canals were measured. To avoid image superposition after obturation, however, only 1 mesial and 1 distal canal on each tooth were chosen to be instrumented. Typically, the 2 selected canals were of exact or similar lengths to aid in the predictability of canal instrumentation. The canals were cleaned and shaped using the Aseptico electric handpiece (Woodinville, Wash) at a constant torque and speed of 350 rpms using the Pro-taper rotary file series (Dentsply International, York, Pa). The size no. 30 file was selected as the largest rotary file to be used in this study to prevent overinstrumentation and subsequent apical perforation. Once the canals were cleaned and shaped, a size no. 30 hand-file was reinserted to working length to:

1. assess the shaping of the canal;
2. approximate the master apical file; and
3. assess the degree of apical flaring further required.

Generally, we attempted to increase the apical one third 2 to 3 file sizes larger than the initial instrument. This is part of a concept known as the tuning guideline.[20] A regimen of copious irrigation with sodium hypochlorite following each file was maintained throughout canal instrumentation. Those canals in which a no. 30 file matched the final working length with little or no resistance were enlarged 2 to 3 file sizes larger to ensure adequate cleaning and shaping of the apical one third. At the end of cleaning and shaping, canals were dried with paper points and radiographs were taken.

A silicone stop cone was placed on an endodontic plugger (Dentsply Caulk, Milford, Del) and set to the final working length of the canal. The plugger was then inserted into the canal to ensure that it could reach the final working length with little or no resistance. If the plugger would not advance to final working length, the canal was reinstrumented until the plugger passively reached final working length. The canal into which the barrier was to be placed was randomly selected by the flip of a coin. A 2-mm square piece of CollaCote was then placed into the canal and condensed to the final working length via the endodontic plugger.

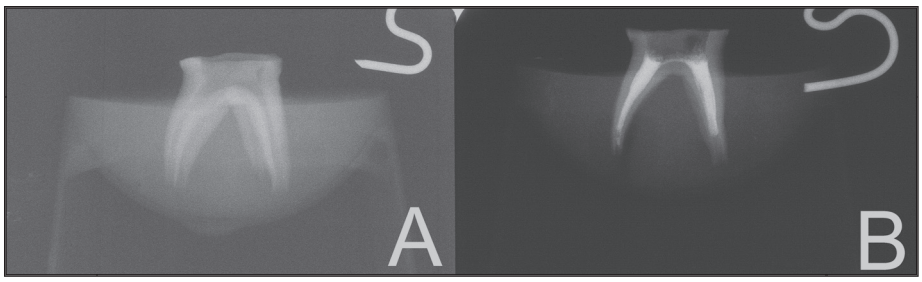

Figure 1a. Preoperative view of tooth no. T.
Figure 1b. Postoperative view: CollaCote was inserted in the mesiolingual canal.

Table 1. Overfilling of Pulpectomy Studies in Primary Teeth

Author	Material	Filling technique	Total
Primosch et al[1]	ZOE	Lentulo spiral	15/104 (14%)
Coll & Sadrian[11]	ZOE	Lentulo spiral	26/81 (32%)
Özalp et al[26]	Vitapex	Pressure syringe	7/20 (35%)
Moskovitz et al[2]	Endoflas	Lentulo spiral	76/139 (55%)
Fuks et al[13]	Endoflas	Lentulo spiral	31/55 (56%)

The canals were then obturated with Vitapex by a pressure syringe delivery system. The excess coronal filling material was then removed and the postoperative radiograph obtained.

All radiographs were scanned using a slide scanner (HP Scanjet 8200 series, Hewlett-Packard) at a 300 dpi resolution, saved in a JPEG format, placed into a PowerPoint presentation, and viewed on a 17" computer monitor. For every scanned radiograph, contrast and brightness were always adjusted—keeping the image at an optimal reading level. Two independent and calibrated evaluators, blinded to the location of the biological barrier, assessed the pre- and postoperative radiographs for the presence of overfilling of the obturation material. In case of disagreement, the case was discussed and consensus obtained. Calibration was obtained after observation and score verification of 10 prepared samples (not included in the study). Data collected was analyzed using chi-square.

Results

Forty-nine canals in 25 teeth were evaluated. One canal was excluded from the analysis due to lateral extravasation of the paste on the mid-cervical third of the root, not allowing accurate visualization of the apical area. CollaCote was placed in 17 mesial and 8 distal canals. Overfilling was observed in 4/25 (16%) of the CollaCote-treated canals and in 10/24 (42%) of the canals when the barrier was not present (Figure 1). This difference was statistically significant with the Pearson's chi-square analysis (P=.047). Sixteen of 25 teeth exhibited 3 canals (64%), while the remaining 9 teeth had 4 canals (36%). The variation in length between the buccal and lingual canals at the same root varied between 0 mm and 3.5 mm.

Discussion

The concept of using collagen to promote healing after pulp exposures or as an apical barrier is not novel.[16,21,22] Fuks et al[21] used Zyderm as a pulp dressing medicament after pulpotomies in baboons. In that study, collagen-containing Zyderm in the form of a gel consistently resulted in pulpal necrosis.[21] Zyderm is currently used in skin cosmetic surgeries as an injectable collagen implant. CollaCote, however, is a soft, white, pliable, biocompatible sponge obtained from bovine collagen. It is indicated for application to moist or bleeding clean oral wounds created during dental surgery to control bleeding and protect the wound's surface from further injury. CollaCote is widely used in endodontic therapy (surgical and nonsurgical). When left inside a periapical defect, for example, CollaCote gradually resorbs, providing a scaffold for bone deposition and growth.[16]

The combined handfile and rotary instrumentation technique was utilized in this study for several reasons. It has been suggested that rotary instrumentation results in a more consistently dense fill due to the rotary files ability to uniformly debride the canal walls.[3] Boon et al[18] suggested that rotary instrumentation prepares the canals to a larger size, thereby: (1) allowing for greater apical enlargement; (2) creating less apical transportation; and (3) providing better canal shape than traditional hand-filing.

As demonstrated in other studies,[3,23] it also significantly reduces instrumentation time. This fact directly correlates to less chair time, making pulpectomies more cost effective for the practitioner and providing a positive impact on the child's behavior. Drawbacks to the use of a rotary system are:

1. initial costs of the rotary system;
2. replacement of rotary files; and
3. development of technique skills necessary to perform the procedure.[3]

A novel aspect of this study was the incorporation of the apical gauging concept. This concept itself is very simple and widely applied in modern endodontic therapy: After the final working length is established, the clinician determines the initial size of the apical terminus before he or she initiates cleaning and shaping. Using hand files incrementally in size, the one that snuggly fits to its gauged canal diameter is selected as the initial instrument. Subsequently, the operator, based on this initial size, can make a wise and secure decision of how large this apical diameter can be safely enlarged to. The authors recognize that clinical experience and perhaps the use of new generation apex locators can provide a secure method to obtain the information needed prior to canal obturation.

Roots undergoing resorption present a greater challenge when applying the concept of apical gauging. Physiological and pathological resorptive processes change the position of the apical foramen almost continuously. As a primary tooth begins to resorb, dentin is deposited within the canal and the number, size, and shape of the root canals change.[5] Radiographic apex and actual location of anatomical apical foramina in a primary tooth can be quite different. Clinical studies have examined these differences, and it has been found that radiographic means of tooth length measurements are typically longer than actual tooth length.[24] The means of measuring root canals lengths are very controversial in primary teeth. Some authors are suggesting usage of electronic apex locators to detect the real state of root canal length in primary molars due to their complex anatomy and uneven state of resorption.[6,24] In agreement with Rimondini and Baroni,[5] the authors also verified significant differences in root canal lengths when 2 canals were present in the same root.

Despite the outcome (success/failure) and the obturation technique used (lentulo spiral/pressure syringe), overfilling of the obturation material is a very common finding when pulpectomies are performed in primary teeth (Table 1). The authors' overfilling results (42%) were within the range of those clinical studies. Whenever the barrier was present, however, a significant decrease was observed. Vitapex was used in this study due to its operator friendly, antibacterial, and resorbable properties. Although overfilling has been reported with this syringe delivery system, extrusion of the paste apparently did not affect the treatment's outcome.[25,26] More clinical studies with large sample sizes and extended recall periods are necessary for definite conclusions about this material.

Some limitations were observed in this study. Due to limited tactile sensitivity of the endodontic pluggers, it was often difficult to determine if the barrier was completely seated to the desired working length. Another limitation was that the amount of the CollaCote inserted into the canals was standardized (a single 2 mm x 2 mm piece per canal).

The status of the periradicular tissues also needs to be carefully evaluated before the placement of any resorbable or nonresorbable apical barrier. The timing of its placement can be postponed to a more appropriate time to allow for a more suitable environment, but it is beyond this study's purpose to discuss this issue.

In summary, this study introduced a novel concept to improve the outcome of pulpectomies of primary teeth. Although the results were very promising, extrapolation of the technique to the clinical environment should be carefully made.

Conclusion

The presence of a biological barrier did not completely prevent, but did significantly decrease, the risk of overfilling when pulpectomies were performed in primary molars. More research is necessary before this technique can be applied clinically.

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Abstract of the Scientific Literature

Parental Influences on Children's Oral Health Behavior

Health-related practices of family members are known to derive from the norms, values, and goals of the family. The aim of this study was to determine if there are differences between oral health-knowledge, attitudes beliefs and behaviors of children and their parents. Additionally this study investigated the family related factors associated with a child's oral health related behaviors. A questionnaire was distributed independently to 1,691 11- and 12- year old children and their parents containing questions concerning oral health-related knowledge, attitudes, beliefs and behaviors using a 4-point Likert scale. This study found that parents of children who reported good oral health related behaviors had better oral health knowledge and were better educated than less well informed parents. Predictors of a child's poor reported oral health behaviors were male gender, parent's frequent intake of carious foods, infrequent use of xylitol gum, and child's poor oral health knowledge. The study concluded that parents' behaviors, but not attitudes, were associated with their children's oral health behavior. The oral health knowledge of the children and parents seemed to be associated with the children's oral health related behaviors.

Comments: This interesting article highlights the importance of educating parents in good oral health practices. When developing preventive plans for high caries risk children, the pediatric dentist may wish to consider consulting with the parents' dentist for reinforcement of the preventive education message **EKM**.

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