# Pulp Therapy in Primary Teeth - Profile of teaching in Brazilian Dental Schools

Anieli Dossa Bergoli * / Robert Eliot Primosch ** / Fernando Borba de Araujo *** / Thiago Machado Ardenghi **** / Luciano Casagrande *****

*This study investigates the profile of teaching primary tooth pulp therapy practiced by Brazilian dental schools. A multiple-choice questionnaire was sent by e-mail to 191 dental schools in Brazil, addressed to the pediatric dentistry Chairperson. The two-part survey consisting of multiple-choice questions regarding specific materials and techniques on pulp therapies, moreover, hypothetical clinical scenarios were presented so that the respondents could guide the treatment approach. The questionnaires were returned by 46.5% of the dental schools. Ninety-five percent of surveyed schools teach IPT for the treatment of deep carious lesions in dentin and indicate the calcium hydroxide as capping material (59,3%). The direct pulp capping is taught by 68.7% of schools and calcium hydroxide (97%) was the capping material most indicated. Pulpotomy is taught in 98.7% of schools and formocresol (1:5 dilution) was the medicament of choice (50%). All schools taught pulpectomy and Iodoform paste was the filling material preferred (55%). The results showed a lack of consensus in certain modalities and techniques for primary tooth pulp therapy taught by Brazilian dental schools.*

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## INTRODUCTION

Despite the decreasing caries prevalence observed in the world population over the years, epidemiological study shows that in Brazil, it still represents a public health problem that affects children at early ages.[1] Frequently, primary teeth are affected by extensive carious lesions, which require procedures that involve indirect or direct pulpal intervention. The preservation rather than extraction of primary teeth has many benefits, including the maintenance of arch integrity, space preservation, masticatory function as well as the esthetic and psychological benefit to the growing child.[2]

The dental schools currently teach several techniques and materials for pulp therapy in primary teeth. In United States, a survey of all predoctoral pediatric dental programs investigated the teaching philosophies for pulp therapy in primary teeth. The results showed differences related to the techniques and materials used, as well as therapies employed under certain hypothetical clinical scenarios.[3] The American Academy of Pediatric Dentistry (AAPD) has established guidelines for pulp therapy in primary teeth, although no consensus on the standard of care was reached.[15]

In 2008, Dunston and Coll reproduced the survey on primary pulp therapy in North American dental schools. The survey was sent to all 56 US dental school pediatric dentistry departments and to the Diplomates of the American Board of Pediatric Dentistry. The results showed that disagreements continue among dental educators and Diplomates concerning what primary tooth pulp therapy to use for a certain clinical scenario.[4]

A survey performed in Ireland and the UK found a wide variation in the teaching of clinical management of all pulp therapy modalities for primary teeth, although the majority of respondents adhered to publish guidelines.[2]

The current pediatric dentistry literature shows wide discordances about the materials and techniques used for

* Anieli Dossa Bergoli, DDS, Private clinical practice, Cruz Alta-RS, Brazil.
** Robert Eliot Primosch, DDS, MS, MEd, Professor, Department of Pediatric Dentistry, College of Dentistry, University of Florida, Gainesville, Florida, USA.
*** Fernando Borba de Araujo, DDS, MS, PhD, Associate Professor, Department of Pediatric Dentistry, School of Dentistry, Federal University of Rio Grande do Sul, Porto Alegre-Brazil.
**** Thiago Machado Ardenghi, DDS, MS, PhD, Associate Professor, Department of Pediatric Dentistry, School of Dentistry, Federal University of Santa Maria-Brazil.
***** Luciano Casagrande, DDS, MS, PhD, Associate Professor, Department of Pediatric Dentistry, School of Dentistry, Franciscan University Center, Santa Maria-Brazil.

Send all correspondence to: Luciano Casagrande, School of Dentistry, Franciscan University Center (UNIFRA), Andradas 1614, Santa Maria, RS; ZIP: 97010-032, Brazil

Phone: (55)32201200
Fax: (55)32226484

E-mail: lucianocasagrande@hotmail.com
lucianocasagrande@unifra.br

primary tooth pulp therapy. Considering that in Brazil there are nearly 200 schools of dentistry, this study aimed to investigate the profile of teaching primary tooth pulp therapy practiced by Brazilian dental schools.

## METHOD

A questionnaire, closely adapted from Primosch *et al*[3] was sent by e-mail to the 191 Brazilian dental schools registered in the Ministry of Education and Culture (MEC), addressed to those responsible for teaching pulp therapy in primary teeth, with an enclosed cover letter explaining the purpose of the survey. Participants were instructed to respond as to their practice of teaching undergraduate dental students, leaving aside personal philosophies and opinions. Definitions of the pulp therapy procedures used such as Indirect Pulp Treatment, Direct pulp capping, Pulpotomy etc, were included in the survey. The project of this study and the consent forms were reviewed and approved by the ethics committee of Franciscan University Center, Santa Maria, Brazil.

The multiple choice questionnaire was divided into two parts: the first consisted of questions about specific materials and techniques indicated for primary teeth pulp therapy; and the second part, clinical scenarios were presented to establish which pulp therapies would be employed under certain hypothetical clinical scenarios.

Faculties were instructed to return the questionnaires enclosed with the participation consent form to the e-mail source address. Questionnaires were sent up to four times, at intervals of one month (first sending) and one week (after the first sending). The tabulation of results and the response rate were performed using the STATA 10.0 statistics program. The results were analyzed descriptively.

## RESULTS

A total of 89 (46.5%) from 191 dental schools (25/45 public and 58/146 private) returned the questionnaires. Of these, 83 (93.25%) completed the survey, and the other six (6.75%) reported that currently there was no pediatric dentistry faculty, since the school was recently established. The survey instructed that only one answer be given for each question, however, those respondents who reported more than one answer per question were included in the overall frequency response. Ninety-five percent of surveyed schools teach indirect pulp treatment (IPT) for the treatment of deep carious lesions in dentin in their undergraduate programs. The most cited pulp capping material was calcium hydroxide (54/91), followed by glass ionomer cement (28/91). The majority of the schools indicated one-appointment for indirect pulp treatment (98%).

The direct pulp capping was taught by 68.7% of schools and calcium hydroxide (97%) was the capping material most indicated, followed by glass ionomer cement (3%). Pulpotomy was taught in 98.7% of schools and formocresol (1:5 dilution) remained the medicament of choice for pulpotomy procedure (50%), recommended to be left for five minutes (92.5%). Zinc oxide and eugenol was the most common filling material for a pulpotomy procedure (54.2%), followed by glass ionomer cement (18.1%) and calcium hydroxide (12.8%).

All participating schools taught pulpectomy and advised the students to perform the instrumentation of the root canals by the manual method. Table 1 shows the results for the irrigation solutions used in cases of biopulpectomy and necropulpectomy.

Table 2 shows the preference for the materials recommended for root canal filling. Iodoform paste obtained the preference between the filling materials (55%), followed by calcium hydroxide paste (14.6%) and ZOE paste (12.3%). The number of sessions needed to complete the pulpectomy intervention is shown in Table 3. Immediate radiographic examination after the treatment was selected by 87.9% of the respondents.

**Table 1.** Irrigation solutions used in primary tooth pulpectomy.

| N=83 Solutions | Biopulpectomy n (%) | Necropulpectomy n(%) |
|---|---|---|
| Sodium hypochlorite 0.5% | 23 (24,5) | 36 (36) |
| Sodium hypochlorite 1% | 23 (24,5) | 39 (39) |
| Sodium hypochlorite 5.25% | 4 (4,3) | 0 (0) |
| Saline solution | 35 (37,2) | 10 (10) |
| Other | 9 (9,5) | 15 (15) |
| Total | 94 (100) | 100 (100) |

**Table 2.** Results regarding root canal fillers indicated for pulpectomy.

| N=83 Obturation | Frequency (n) | Percentage (%) |
|---|---|---|
| Paste ZOE with or without formocresol | 11 | 12.3 |
| Iodoform paste | 49 | 55.0 |
| Calcium hydroxide | 13 | 14.6 |
| Others | 16 | 18.1 |
| Total | 89 | 100.0 |

**Table 3.** Number of pulpectomy appointments.

| N=83 Appointments | Biopulpectomy n (%) | Necropulpectomy n(%) |
|---|---|---|
| 1 | 62 (73,8) | 23 (27) |
| 2 or more | 22 (26,2) | 62 (73) |
| Total | 84 (100) | 85 (100) |

## DISCUSSION

Preliminary surveys performed in the U.S. and Europe showed that there was no consensus on the teaching pulp therapy in primary teeth.[2,3,4] In Brazil, despite having one of the largest concentrations of dental schools in the world, only one study of 27 predoctoral pediatric dentistry programs had been published.[5]

Approximately 95% of respondents indicated that the indirect pulp treatment (IPT) is taught in your degree

program. This is corroborated by scientific evidence, which show high rates of success of this treatment.[6,7,8,9] However, even with the evidences supporting this procedure, 5% have not included this treatment in their teaching program.

According to the AAPD, the IPT is a procedure performed in a tooth with a deep carious lesion adjacent to the pulp.[15] In this technique, the caries near the pulp is left in place to avoid pulp tissue exposure and is covered with a biocompatible material. However, when asked about the possibility of avoiding a pulp exposure when the partial caries removal is performed, 15.8% of respondents taught to remove all demineralized dentin and perform a pulpotomy.

Studies have shown that the IPT had better rates of clinical and radiographic success rates after long time follow-up, when compared with others vital pulp therapies, such as formocresol pulpotomy.[6,8,9,10] According to Coll, during a pulpotomy procedure, there was a risk of increasing the contamination of the remaining pulp tissue with dentin chips or bacterias, which reduced the potential repair and the success rate of pulpotomy.[10]

**Table 4.** Results regarding clinical cases scenarios presented in the survey.

| Part II – Clinical Cases Scenarios |
|---|
| A) For the following scenarios (1-6), the tooth in question is a mandibular primary second molar and the patient is 5 years old. |
| 1) A student is performing deep caries removal. There is still caries present in the preparation, but if removed in its entirety, a minimal pulp exposure is imminent. What do you instruct the student to do next?<br>(65/82) Terminate caries removal and perform an indirect pulp treatment.<br>(13/82) Continue to remove all caries and, if the pulp exposed, initiate a pulpotomy procedure.<br>(3/82) Continue to remove all caries and, if the pulp exposed, initiate a pulpectomy procedure.<br>(1/82) Other |
| 2) You check a student s preparation and verify that he-she has removed all the caries. A few moments later, the patient bites down while the student is smoothing the walls of the prep with a high speed handpiece. Upon evaluation you note that there is a small bur hole in the pulpar floor of the prep. The pulp is exposed but not hemorrhagic. What do you instruct the student to do next?<br>(43/81) Direct pulp cap<br>(34/81) Pulpotomy<br>(3/81) Pulpectomy<br>(1/81) Other |
| 3) The student is excavating caries and a carious pulp exposure occurs. The radiograph reveals no pathologic root resorption nor obvious furcal or apical lucencies. There are no signs of a draining fistula or mobility. What do you instruct the student to do next?<br>(8/82) Direct pulp cap<br>(64/82) Pulpotomy<br>(10/82) Pulpectomy |
| 4) Three years following pulpotomy treatment, a periapical radiograph in this 8-years-old reveals pathologic root resosption (2/3), but the primary second molar has no negative clinical signs or symptoms. What is your recommendation for continued care?<br>(53/81) Observation only<br>(0/81) Pulpotomy<br>(11/81) Pulpectomy<br>(17/81) Extraction and space maintenance |
| 5) During a pulpotomy procedure, the amputated radicular pulp tissue is very hemorrhagic. Even after medicament application, hemostatis is difficult to achieve. Upon inspection of the tooth, you see that the pulp chamber is adequately unroofed and there is no evidence of coronal pulp tissue tags. The radicular pulp appears hyperemic to you. What do you instruct the student to do next?<br>(8/83) Seal a medicated pellet into the pulp chamber and reappoint for a pulpectomy procedure.<br>(75/83) Initiate a pulpectomy procedure<br>(0/83) Extraction and space maintenance |
| 6) A student s patient presents with a draining fistula associated with a large carious lesion, which is restorable. Radiograph reveals a small furcal lucency, but no pathologic root resorption, mobility or percussion sensitivity. What do you instruct the student to do next?<br>(0/82) Pulpotomy<br>(77/82) Pulpectomy<br>(5/82) Extraction and space maintenance |
| B) The following scenarios (7-9), the tooth in question is an intact, discolored (gray) maxillary primary central incisor and the patient is 3 years old. There are no other clinical signs or symptoms. Mother reports that the patient bumped the tooth in an accident 3 months ago. |
| 7) The patient presents for recall. The radiograph shows no signs of pathology. What do you instruct the student to do next?<br>(78/83) Observe until further signs or symptoms develop.<br>(2/83) Pulpectomy<br>(3/83) Composite resin restoration |
| 8) The patient presents for recall. The radiograph reveals a 2-mm, poorly defined apical lucency. All other findings as above. What do you instruct the student to do next?<br>(64/83) Pulpectomy<br>(0/83) Extraction<br>(19/83) Observe until further signs or symptoms develop. |
| 9) The patient presents for recall. The radiograph reveals a 2-mm, poorly defined apical lucency, and a labial parulis associated with the tooth. All other findings as above. What do you instruct the student to do next?<br>(79/82) Extraction<br>(3/82) Pulpectomy |
| 10) The following scenario, the tooth in question is maxillary primary central incisor in a 3 year-old patient.<br>Patient presents extensive fracture involving dentin with exposure pulp tissue, occurred less than 1 hour ago. Soft tissue are intact, the tooth is in it natural position, and is only slightly mobile. Periapical radiograph is normal, except for the fracture. What do you instruct the student to do next?<br>(24/83) Pulpotomy<br>(34/83) Pulpectomy<br>(21/83) Direct pulp cap<br>(4/83) Partial pulpotomy<br>(0/83) Extraction |

The majority of respondents (98%) indicated one appointment for IPT procedure. This result was consistent with scientific evidence showing that the reopening of the treated tooth was not necessary[8,11,12], as the remaining dentin becomes dark, hard, and less infected, with non-progression of the lesion under the restoration.[11,13] There was a clear preference for teaching calcium hydroxide as a capping material for IPT, followed by glass ionomer cement. A variety of capping materials had been indicated for the IPT, but evidence had shown that independent of capping material, the cavity sealing as well as the caries activity control was more relevant to a successful treatment outcome .[7,11,14]

The direct pulp capping (DPC) is taught by 68.7% of dental schools. This treatment is indicated for small mechanical or traumatic pulp exposure[15,16] however, it seemed that the selected therapy did not reflect the DPC indications, since 41.9% taught pulpotomy upon the occurrence of an accidental pulp exposure.

When asked about the clinical procedure taught for a pulpal exposure in the presence of adjacent caries lesion, 78% performed a pulpotomy, following the AAPD and Brazilian Association of Pediatric Dentistry guidelines.[15,16] However, 9.7% of teachers still taught direct pulp capping for this clinical scenario, even if reports had showed that its use was decreasing, especially in cases of deep carious lesions, reflecting the preference for the IPT that avoids pulp exposure and a more complex approach.[16]

Even with the scientific evidence demonstrating the disadvantages of using diluted formocresol (1/5),[6,8,9] the present survey results indicated that it was still the medicament most used in pulpotomy.[3,4] Previous study with 27 Brazilian dental schools showed that 63% indicated use of the diluted formocresol (1/5) for pulpotomy.[5] In the present study, there was an observed reduction in the teaching indications for formocresol in the pulpotomy technique, but the prevalence was still high (50%). Studies comparing formocresol pulpotomy with others materials such as MTA, calcium hydroxide and ferric sulfate, showed that there was a superiority of these materials, which did not induce undesirable responses such as early exfoliation and damage to the succedaneous permanent teeth.[17,18,19,20,21] Studies have showed the superiority of pulpotomy with formocresol when compared to calcium hydroxide,[20,22] especially in the clinical and radiographic outcome. But the failure of calcium hydroxide pulpotomy is more related to the difficulty in establishing the health status of the pulp than the material selection itself.[22]

One of the problems concerning the use of formocresol is the fixation of pulp tissue that masks the symptoms, suggesting clinical success.[18] However, this fixated tissue stimulates a chronic inflammation that leads to degeneration and resorption.[21] Despite all this evidence, the formocresol is still widely used, both in Brazil and in the U.S.

The buffered saline irrigation solution was more commonly taught for vital pulp irrigating, even without supporting evidence for its use in irrigation canals. In contrast, 4% of schools taught sodium hypochlorite at a full concentration (5.25%), even if the infection of the canal in cases of irreversible pulpitis was lower or even non-existent.

The solution used in most cases of necrotic pulp was sodium hypochlorite 1% (39%). However, against all evidences and guidelines for the instrumentation of an infected canal, 10% of schools advocated the use of buffered saline solution. A recent study showed that sodium hypochlorite 1% was able to completely remove the remaining pulp, even in areas not instrumented and the 0.5% solution was not as efficient in removing all organic content.[23]

The iodoform paste was the most cited filling material among the Brazilian schools (55%), followed by calcium hydroxide (14.6%) and zinc oxide and eugenol paste (10.1%). Kramer *et al* also observed a teaching preference for the iodoform paste (48%), but calcium hydroxide was one of the least common canal fillings used for pulpectomy.[5] The iodoform paste has good tissue tolerance, is absorbed and reduces the inflammatory reaction[24] moreover, studies have demonstrated a high bactericidal potential.[25,26] In the U.S., the preference for ZOE paste was lower than in 1997, but still remained the preference.[4] This decreasing trend was attributed to the possibility that the paste did not absorb completely. In addition, the ZOE paste has a limited antibacterial effect and may cause adverse reaction in the periapical tissues in cases of leakage at the apex.[27]

The present survey results showed that 87.9% of the respondents indicated radiographic examination immediately after the pulpectomy and then in periodic evaluations. The AAPD guidelines recommended periodic radiographic control for all pulp therapies.[15] In the clinical scenario that presented pathological resorption after three years of a pulpotomy, 65.4% opted for preservation, instead of performing a pulpectomy or extraction, which are the AAPD guidelines' orientations for pulp therapy of primary teeth in cases of pathological root resorption.[15,16]

More than 90% of the respondents, when asked about the clinical approach towards pulp tissue with excessive bleeding hemorrhagic pulp, started immediately a pulpectomy. According to 94% of respondents, pulpectomy was the best clinical approach for a tooth with periapical lesion and draining fistula. This treatment is still recommended for primary teeth showing periapical or furcation lesions, since no risk for damage to the permanent tooth germ was present. According to previous Brazilian study, 90% of schools also recommended the pulpectomy in primary teeth with pulp necrosis.[5]

Overall, the results of the present survey revealed a divergence in teaching recommendations for primary tooth pulp therapy in Brazilian dental schools. It is possible to speculate that the lack of clinical randomized controlled studies concerning specific primary tooth pulp therapies contributed to a wide range of preferences currently taught by pediatric dentistry programs in Brazil, despite evidence of worldwide standardization of teaching guidelines towards more conservative pulp therapy techniques.

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