Pulp Therapy in Pediatric Patients with Congenital Heart Disease: Survey of American Academy of Pediatric Dentistry Members

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ABSTRACT

Purpose: The purpose of this study was to identify treatment options recommended by American Academy of Pediatric Dentistry (AAPD) members concerning pulp treatment in primary teeth in pediatric patients with congenital heart disease (CHD).
Methods: A web-based survey was sent to all active members of the AAPD. The survey contained radiographs of pulpally involved primary teeth, a description of associated signs/symptoms, and a medical history of the patient who was positive for a type of CHD. Pediatric dentists were requested to report treatment recommendations.
Results: Of the 6,590 surveys sent, 1,493 surveys (23%) were completed. Most respondents preferred to extract the tooth with the clinical presentation of irreversible pulpitis followed by distal shoe space maintenance when the patient presented with a negative medical history. By contrast, approximately half of the respondents elected to extract this tooth without space maintenance for all of the cardiac conditions. By contrast, most respondents elected to perform a pulpotomy in the case of reversible pulpitis regardless of the medical history. Indirect or direct pulp therapy were the least chosen options for both presentations.
Conclusions: The presence of CHD affects treatment decisions in teeth exhibiting irreversible pulpitis with symptomatic apical periodontitis but not in teeth displaying reversible pulpitis with a normal periodontal status. (J Dent Child 2013;80(3):139-44)
Received June 27, 2012; Last Revision October 11, 2012; Revision Accepted November 1, 2012.

KEYWORDS: CONGENITAL HEART DISEASE, PULP, PRIMARY TEETH, INFECTION

The main objective of pulp therapy is to maintain the integrity and health of a tooth affected by caries, traumatic injury, or other causes. It is desirable to retain primary teeth to maintain space and function.[1]

There are 2 methods of treating the involved infected dental pulp for a primary tooth: pulpotomy or pulpectomy. Pulpotomy success rates for primary teeth vary from 83 percent to over 90 percent, depending on the technique utilized. Pulpectomy success rates for primary teeth vary from approximately 79 percent to 100 percent, depending on the technique utilized.[2]

While the American Academy of Pediatric Dentistry (**AAPD**) acknowledges that medical history should be a component of pulp treatment decision making, there are no recommendations related to pulp therapy in a patient with congenital heart disease (**CHD**) of any severity. This finding contrasts with the Australasian Academy of Pediatric Dentistry, which states: "Pulp therapy in primary teeth is contraindicated in children with CHD because, while the success rates for pulp therapy are reasonable, the risk and the severe sequelae associated with bacterial endocarditis make these therapies inappropriate."[3]

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Infective endocarditis is an infection of either the heart's inner lining (endocardium) or the heart valves. It is a serious and sometimes fatal illness.[4] The etiology of endocarditis stems from colonization of microorganisms (bacteria, fungus, virus) in abnormal heart valves or other damaged heart tissue. Bacteria that cause endocarditis are found in the mouth, upper respiratory system, intestinal and urinary tracts, and skin. The most common bacteria associated with endocarditis include *Staphylococcus aureus*, group B streptococci, alpha-hemolytic streptococci (including *Streptococcus mutans*), and enterococci.[5] A brief bacteremia is common after many invasive procedures, including certain surgical and dental procedures.[4]

There are few publications that specifically address pulp therapy of primary teeth in patients with heart disease. Several authors contend that the bacteremia occurring during endodontic treatment often involves organisms belonging to the group viridans Streptococcus, which are most abundant in the oral cavity. They conclude that the incidence or magnitude is not alarming but is comparable to, or less than, most routine dental procedures.[6-9] These same authors, however, argue that any disease for which a bacteremia poses an additional hazard is of concern when endodontic treatment is being considered. Specifically, "a history of infective endocarditis, CHD, rheumatic heart fever, or the presence of an artificial heart valve or other susceptible implants may necessitate implementation of an antibiotic regimen in conjunction with the endodontic procedures. Nevertheless, endodontic procedures in these same patients are not absolutely contraindicated."[6]

According to Johnson et al.,[10] the management of pulpally involved primary or permanent teeth in patients with CHD requires evaluation of the type of heart condition and risk of bacteremia from the planned dental procedure. The authors contend that infective endocarditis is rarely directly linked to dental procedures and the incidence and magnitude of bacteremia when canal instrumentation does not extend into the periapical tissues is low. Most bacteria are eliminated from the blood within 10 minutes.[10-12] Johnson et al.,[10] however, state that endodontic treatment in primary teeth is contraindicated in patients with CHD.

It has been suggested by Ravel,[13] in a nonpeer reviewed newsletter, that, while it is reasonable to perform a pulpotomy in a primary tooth in a patient with mild to severe CHD, a pulpectomy is contraindicated. This practice is based on the premise that a pulpectomy places the patient with CHD at higher risk for infection. Carrotte[14] suggests that the patient's general health should be reviewed to ensure that there are no contraindications to endodontic therapy in primary teeth, such as those with CHD, or patients who are immunocompromised.

Valachovic and Hargreaves[15] cautioned against endodontic treatment in CHD patients after an 8-year-old male with cyanotic CHD developed a brain abscess 3 years after pulpectomy treatment in a primary first molar. They theorized that the accessory canals not debrided during the initial root canal therapy were eventually exposed as physiologic root resorption occurred. These canals contained bacteria, which led to a localized abscess formation and provided a focus of infection for a bacteremia, resulting in a brain abscess.

It is important to recognize that there are no American Heart Association (AHA) guidelines that recommend or discourage pulp treatment in the primary dentition in a patient with CHD.[16] There are also no American Association of Endodontics guidelines that recommend or discourage pulp treatment in the primary or permanent dentition in a child or adult CHD patient.[17]

The alternative treatment for pulpally involved primary teeth requires extraction and possible placement of a space maintainer. Brill[18] recommends caution regarding distal shoe space maintainer placement in patients with cardiac anomalies that require antibiotic prophylaxis prior to dental treatment because of the possibility of associated chronic inflammation or periodontal pathology. One cannot, however, compare the degree of bacteremia that occurs during extraction and the potential chronic source of bacterial accumulation around a space maintainer compared with pulp therapy.[10] There are no published randomized and controlled animal studies or human trials on the incidence of bacteremia after pulp therapy compared with an extraction and the subsequent development of endocarditis in association with CHD.

The purpose of this study was to identify treatment options selected by current AAPD members concerning pulp treatment in primary teeth in pediatric patients with CHD.

METHODS

After receiving approval from the Institutional Review Board of Indiana University, Indianapolis, Ind., a web-based anonymous survey was distributed to all active AAPD members. The membership list was provided by the AAPD for a monetary fee. The survey, which was available for 8 weeks, requested demographic information, including: gender, age, number of years practicing pediatric dentistry, whether or not board certification had been achieved, residency type, practice type, and location of practice.

The survey consisted of 12 clinical scenarios which presented patients with identical dental histories but different health histories. For each scenario, the participant was provided with a diagnosis of acute irreversible pulpitis with symptomatic apical periodontitis for the primary mandibular left second molar and a diagnosis of reversible pulpitis with a normal periodontal status for the primary mandibular right second molar. The same de-identified radiographic images of the primary mandibular left and right second molars (Figures 1 and 2) were provided for each scenario. Both images were taken from the same patient for consistency in diag-

nosis. The patient's health history was positive for the cardiac condition listed in the scenario.

The following cardiac conditions and their descriptions were provided: tetralogy of Fallot (mild cyanotic CHD); hypoplastic left heart (severe cyanotic CHD); pulmonary stenosis (mild acyanotic CHD); mitral valve prolapse with regurgitation (mild acyanotic CHD); and aortic stenosis (severe acyanotic CHD).[19] A control scenario was provided wherein the health history of the patient was negative. Participants were requested to determine their treatment based on the information provided and to indicate the rationale for their decision. Participants were also asked to indicate if treatment philosophy had changed since residency and specify the reasoning for this change.

Frequencies, percentages, and 95 percent confidence intervals were calculated for each survey item. Pearson chi-square tests were used to examine the associations of the demographic variables with the treatment preferences. Cochran-Mantel-Haenszel chi-square tests were used to determine if the treatment preferences differed among medical conditions.

RESULTS

The survey was sent to all current active AAPD members who made their email addresses available on the membership list (N=6,590). Two hundred sixty nine surveys were returned as undeliverable, and 1,493 (23%) completed surveys were received. The demographics of those who responded are summarized in Table 1.

Approximately half (47-56%) of the respondents elected to extract the tooth without space maintenance for all the cardiac conditions (regardless of type or severity) with the clinical presentation of irreversible pulpitis. By contrast, 47 percent of respondents preferred to extract the tooth with distal shoe space maintenance when the patient presented with a negative medical

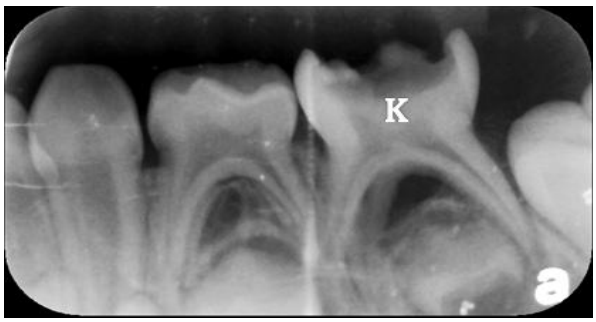

Figure 1. Radiographic image of the primary mandibular left second molar.

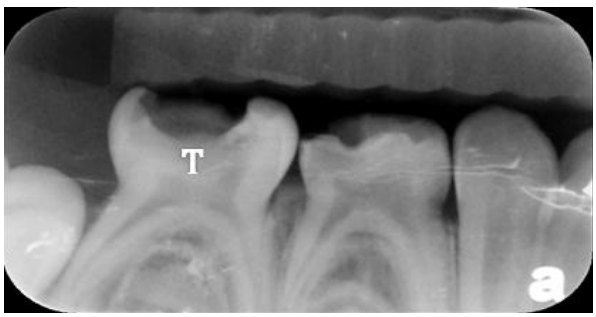

Figure 2. Radiographic image of the primary mandibular right second molar.

Table 1. Demographics of Respondents*

		N	%
Gender	Male	807	54
	Female	679	46
	Total	**1,486**	**100**
Age (yrs)	<30	143	10
	30-39	519	35
	40-49	307	20
	50-59	266	18
	>60	254	17
	Total	**1,489**	**100**
Years as pediatric dentist	0-5	462	31
	6-10	186	12
	11-15	163	11
	16-20	115	8
	>20	466	31
	I am not a pediatric dentist	101	7
	Total	**1,493**	**100**
Board certified	Yes	809	60
	No	545	40
	Total	1,354	100
Type of residency	Hospital	424	30
	Combined (hospital and university)	807	56
	University	147	10
	Other	60	4
	Total	**1,438**	**100**
Type of practice	Private solo practice	506	33
	Private group practice	636	42
	Military practice	16	1
	Public or community health practice	115	8
	Faculty/education	233	15
	Retired	8	1
	Total	**1,514**	**100**
Location of current practice†	District I	209	14
	District II	148	10
	District III	255	18
	District IV	296	21
	District V	239	17
	District VI	278	20
	Total	**1,425**	**100**

** The total number within each reporting section may not equal the 1,493 surveys returned, due to the individual's decision not to respond (gender, age, board certified, type of residency, and location of current practice) or providing multiple answers to a specific demographic (type of practice).*

† Location based on American Academy of Pediatric Dentistry designated district assignments[20].

history ($P<.001$). Indirect or direct pulp therapy were only recommended by <1 percent of respondents (Table 2).

Most respondents elected to perform a pulpotomy (54-59% for the cardiac diagnoses, regardless of type or severity; 65 percent for negative medical history) with a reversible pulpitis. Extraction without space maintenance was more common in patients with cardiac conditions (10-16%) compared with essentially healthy patients (2%, $P<.001$). The least selected option selected was direct pulp therapy (1% for the various cardiac diagnoses, 2% for negative medical history; Table 3).

The most important treatment decision factors by the respondents for the tooth with an irreversible pulpitis were radiographic findings, patient symptoms, and risk of a bacteremia or infection. The least important treatment decision factors were personal preference, philosophy during residency, and space maintenance. The response was similar for the tooth with reversible pulpitis (Figures 3 and 4).

Sixty-six percent of respondents reported that their treatment philosophy had not changed since residency. If treatment philosophy did change, the most common reasons cited were employing more noninvasive methods of space maintenance (ie, reverse band and loop or a removable acrylic prosthesis; 23%) and extraction rather than restore primary teeth (22%) in patients with CHD. Additional reasons for the change in treatment approach included evaluating oral hygiene status more often, con-

Table 2. Treatment of Irreversible Pulpitis*

Cardiac condition (total no. of responding for condition)	Indirect pulp therapy N (%)	Direct pulp therapy N (%)	Pulpotomy N (%)	Pulpectomy N (%)	Extraction without space maintenance N (%)	Extraction with distal shoe space maintenance N (%)	Other (please describe) N (%)
Tetralogy of Fallot (N=1,115)	2 (<1)	1 (<1)	15 (1)	111 (10)	620 (56)	305 (27)	61 (5)
Hypoplastic left heart (N=1,098)	2 (<1)	0 (0)	15 (1)	104 (9)	603 (55)	313 (29)	61 (6)
Pulmonary stenosis (N=1,106)	2 (<1)	0 (0)	16 (1)	134 (12)	525 (47)	369 (33)	60 (5)
Mitral valve prolapse with regurgitation (N=1,109)	2 (<1)	0 (0)	16 (1)	142 (13)	524 (47)	368 (33)	57 (5)
Aortic stenosis (N=1,102)	2 (<1)	1 (<1)	17 (2)	131 (12)	544 (49)	347 (31)	60 (5)
No known medical conditions (N=1,147)	2 (<1)	1 (<1)	25 (2)	264 (23)	269 (23)	536 (47)	50 (4)

** Number of responses within each treatment option may not equal 1,493 due to the individual's decision not to respond.*

Table 3. Treatment of Reversible Pulpitis*

Cardiac condition (total no. of responding for condition)	Indirect pulp therapy N (%)	Direct pulp therapy N (%)	Pulpotomy N (%)	Pulpectomy N (%)	Extraction without space maintenance N (%)	Extraction with distal shoe space maintenance N (%)	Other (please describe) N (%)
Tetralogy of Fallot (N=1,147)	165 (14)	13 (1)	614 (54)	89 (8)	189 (16)	48 (4)	29 (3)
Hypoplastic left heart (N=1,134)	161 (14)	14 (1)	614 (54)	89 (8)	175 (15)	52 (5)	29 (3)
Pulmonary stenosis (N=1,135)	164 (14)	13 (1)	667 (59)	99 (9)	121 (11)	44 (4)	27 (2)
Mitral valve prolapse with regurgitation (N=1,134)	162 (14)	14 (1)	668 (59)	101 (9)	114 (10)	49 (4)	26 (2)
Aortic stenosis (N=1,131)	159 (14)	13 (1)	654 (58)	101 (9)	128 (11)	45 (4)	31 (3)
No known medical conditions (N=1,166)	173 (15)	19 (2)	759 (65)	130 (11)	25 (2)	41 (4)	19 (2)

** Number of responses within each treatment option may not equal 1,493 due to the individual's decision not to respond.*

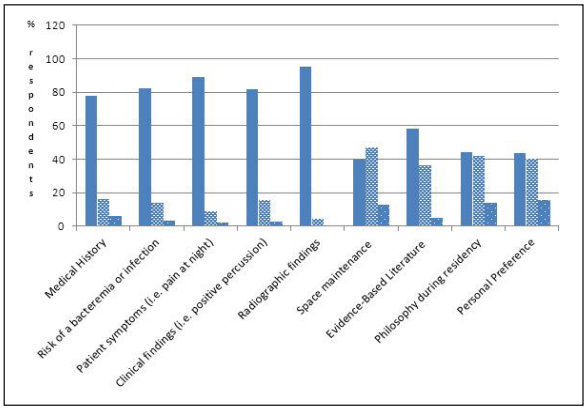

Figure 3. Importance of treatment decision factors regarding primary mandibular left second molar.

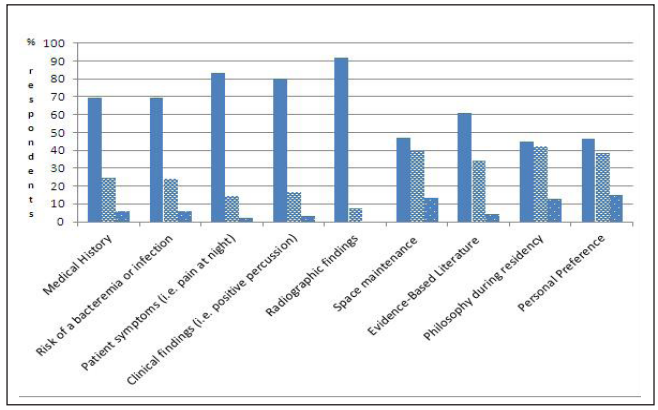

Figure 4. Importance of treatment decision factors regarding primary mandibular right second molar.

sulting with the cardiologist, and not treating these types of patients on a frequent basis.

DISCUSSION

The AAPD offers no recommendations for therapy in pulpally involved primary teeth in CHD patients.[1] There was some agreement among respondents, however, concerning treatment decisions.

As their treatment of choice, many respondents preferred extraction without placement of a space maintainer in patients with an irreversible pulpitis and CHD. Neither the severity nor type of cardiac condition affected the treatment decision. This was in contrast to 47% of respondents who chose extraction with distal shoe space maintenance as the treatment for the tooth with irreversible pulpitis and a negative medical history. The treatment to defer placement of a space maintainer in a patient with a heart condition may be based upon the potential chronic inflammatory response associated with the distal shoe appliance and the perceived risk.[18] This perceived risk may also explain why respondents indicated they are now employing more noninvasive methods of space maintenance (ie, reverse band and loop).

The preferred treatment selected for the reversible pulpitis was pulpotomy, regardless of the medical history provided. The lack of evidence-based research on the treatment of primary teeth with vital pulpotomies in children with CHD suggests that many practitioners are comfortable providing this treatment. The guidelines of the Australasian Academy of Pediatric Dentistry state that a vital pulpotomy is contraindicated in these patients. Their recommendations, however, are empirical. They have determined that extraction of a tooth with reversible pulpitis is preferable than pulp therapy in a patient with CHD to avoid any potential negative sequelae from an unsuccessful pulp treatment.[3]

Indirect and direct pulp therapy treatment options were chosen least in both scenarios (irreversible and reversible pulpitis), regardless of medical history. This finding may be explained by the diagnosis of irreversible pulpitis, which would have an unfavorable prognosis if treated in this manner. In addition to that, direct pulp therapy is not universally accepted as a treatment modality in carious exposures in primary teeth.[1]

The most important treatment decision factors regarding both irreversible and reversible pulpitis were radiographic findings and patient symptoms. The ranking of these factors for both teeth is consistent with current clinical concepts regarding pulp therapy.[1] The least important treatment decision factors for both teeth were personal preference, philosophy during residency, and space maintenance. It is noteworthy, however, that, although space maintenance was deemed as not important in the decision process, it appears to be a significant factor for the practitioner when treating a tooth with irreversible pulpitis. A comprehensive review of both the medical and dental literature does not provide sufficient evidence to support a change in treatment philosophy. The most recent AHA guidelines for patients at risk for endocarditis tend to support this position. These results demonstrate the challenge with treatment decisions when a prospective clinical research study cannot be completed due to the ethical nature of such a project. Instead, one must make treatment decisions based on anecdotal or empirical knowledge.

While there were some variations between the demographic variables and the treatment decisions and rationales regarding both teeth, none of the differences were deemed large enough to have clinical relevance. Therefore, demographic variables do not seem to have much influence regarding decisions about pulp therapy and CHD.

This study had a response rate of 23% among AAPD members. Therefore, it may not represent the treatment philosophy of most current members. Future studies should examine the rationale for treatment of potential infection from our medical colleagues in cardiology.

While many practitioners agree on treatment decisions concerning pediatric patients with CHD that have pulpally involved primary teeth, this survey's results suggest a need to develop a formal AAPD guideline for

dental management and treatment in pediatric patients with heart disease. This study illustrates the difficulty associated with developing guidelines when there is insufficient evidence upon which to base them.

CONCLUSIONS

Based on the results of this study, the following conclusions can be made:

1. The presence of CHD has an influence on treatment decisions in teeth exhibiting acute irreversible pulpitis with symptomatic apical periodontitis but not in teeth displaying reversible pulpitis with a normal periodontal status.
2. Regardless of tooth diagnosis and medical history, the 2 most important treatment decision factors were radiographic findings and patient symptoms.
3. Practitioner demographic factors do not appear to significantly impact treatment decisions involving pulp therapy in pediatric CHD patients.
4. More than half of the respondents indicated their treatment philosophy had not changed since residency. If treatment philosophy did change, most individuals indicated they are now employing more noninvasive methods of space maintenance.

ACKNOWLEDGMENTS

The authors wish to acknowledge Dr. William Kronenberger, Associate Professor of Clinical Psychology in Psychiatry at Indiana University School of Medicine, Dr. Judith Chin, Associate Professor in the Department of Pediatric Dentistry at Indiana University School of Dentistry, Dr. James Weddell, Associate Professor in the Department of Pediatric Dentistry at James Whitcomb Riley Hospital for Children, Dr. Michael Kowolik, Professor, Director of Graduate Research and Associate Dean for Graduate Education at Indiana University School of Dentistry, Dr. Angela Tomlin, Director at Riley Child Development Center at Indiana University School of Medicine, and Mr. George Eckert, Biostatistician at Indiana University School of Medicine, all in Indianapolis, Ind., for their contributions to this study and manuscript.

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