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Treatment of carious vital primary incisors: The dilemma and its edification!

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Abstract
A dilemma exists for the diagnosis and treatment planning of carious vital primary incisors with deep carious lesion, which on excavation can cause pulpal exposure. The aim of this survey was to account the approach of pediatric and general dentists from the Indian population for the same. A proforma containing a clinical and radiographic scenario along with a set of 5 questions was circulated to 700 pediatric and general dental practitioners, to know about their choice of diagnosis, treatment plan, medicament of choice and reason behind their treatment and medicament of choice. A wide range of results were achieved pointing towards the necessity of a better understanding which is required in the spheres of diagnosis and treatment of carious vital primary maxillary incisors.

Keywords: Carious vital primary incisors, deep carious primary incisors

Introduction
The treatment of carious vital primary incisors ranges from a restoration to complete removal of the pulp and this depends upon the extent of cariestowards the pulp. The American Academy of Pediatric Dentistry guidelines (AAPD 2017 and 2020) on pulp therapy state that pulpotomy is indicated when caries removal results in pulp exposure [1, 2] Similar indication was cited by Fuksin 2008 [3]. But these indications are not specific for incisors. In spite of high success rates of molar Pulpotomy which ranges from 83% to 100%, limited literature is available which presents the outcomes of carious vital primary incisors treated with pulpotomy [3, 5].

According to a US based Survey, not even 50% chose pulpotomy as the treatment of choice for carious vital primary maxillary incisors [6] Rather an almost split view existed between pulpotomy, pulpectomy and indirect pulp therapy among the dentists [6] This might be due to the studies that show higher success rates of indirect pulp capping and pulpectomy over pulpotomy in primary anterior teeth. The poor prognosis of Pulpotomy could be attributed to the poor sealability of the medicaments used for it historically. With the advent of bioactive materials such as MTA/Biodentine the success rates of pulpotomies have shot upto 100% [7, 14] Therefore, the change in trend of medicaments used for pulpotomy, could possibly lead to a change in the treatment selection of a dentist.

So, in an attempt to quantify the opinions of pediatric and general dentists for the treatment of carious vital primary incisors a questionnaire based survey was conducted. The aim of this simple survey was to determine the most common choice for treatment and the medicament used for the chosen treatment along with the reason for each choice.

Materials and method
In order to figure out the choice of majority of the dental surgeons with respect to treatment of vital asymptomatic primary incisors with deep caries, a questionnaire-based survey was conducted. The proforma for the same was distributed via online and offline portals for both pediatric and general practitioners. The proforma consisted of a case scenario with clinical and radiographic findings, on the basis of which five questions were asked. The designation of each participant was noted as being a General Practitioner or a Pediatric Dentist.

The case scenario presented had the following as clinical findings "A patient aged 3 years 2 months with chief complaint of unsightly upper tooth decay, the teeth were asymptomatic with no history of pain or any tenderness on percussion (vitality was positive)."
For radiographic findings an IOPAR was presented in which the tooth under consideration was marked by an arrow.

Fig 1: IOPAR for radiographic findings

On the basis of these clinical and radiographic findings a set of 5 questions were asked. The questions with their respective options are as follows:
What will be your choice of diagnosis? (Options- clinically healthy pulp/ reversible pulpitis/ irreversible pulpitis)

1. What will be your treatment of choice? (Options-restoration/ indirect pulp capping/ pulpotomy/pulpectomy)
2. What is the reason behind your choice of treatment?
3. Depending on your choice of treatment which medicament will you use?
4. What is your reason behind choosing this medicament?
5. The proforma was distributed to around 700 dentists.

The responses received were then tabulated in Microsoft excel sheet. The percentages of given answers for each question were calculated as a separate result for pediatric and general dentist practiotioners and a combined result of the sample as whole. Z test was applied for each parameter to establish a significance if any. P value less than 0.05 was considered as significant.

Results

The proforma was distributed to around 700 dentists (pediatric and general dentist practiotioners), out of which 214 responded. Amongst these 214, 59.35% (n=127) were Pediatric Dentists and 40.65% (n=87) were General Dentists.
Detailed results for each question

1. What will be your choice of diagnosis? (Options - clinically healthy pulp/ reversible pulpitis/ irreversible pulpitis) Majority (44.8%) chose clinically healthy pulp followed by reversible pulpitis (36.92%) and irreversible pulpitis (18.22%) as the choice of diagnosis (Table 1).

Table 1: Results for question 1

	Frequency	%
Clinically healthy pulp	96	44.86
Irreversible pulpitis	39	18.22
Reversible pulpitis	79	36.92

This trend was similar for both general dental practitioners and pediatric dentists with majority selecting clinically healthy pulp followed by reversible pulpitis. Irreversible pulpitis was chosen by the least in both the groups (Table 2).

Table 2: Difference between general and pediatric dentist responses for question 1

According to the radiograph and clinical findings what will be your diagnosis with respect to the marked tooth?	**Other**		**PEDO**		**p value**
	Count	**%**	**Count**	**%**	
clinically healthy pulp	38	43.68	58	45.67	0.77
irreversible pulpitis	12	13.79	27	21.26	0.17
reversible pulpitis	37	42.53	42	33.07	0.16

2. What will be your treatment of choice?
(Options-restoration/ indirect pulp capping/ pulpotomy/ pulpectomy) The choice of treatment of majority was In-direct pulp capping 33.64%, followed by Pulpotomy 28.50%, Pulpectomy 21.50% and Restoration 16.36% (Table 3).

Table 3: Results for question 2

	Frequency	**%**
Indirect pulp capping	72	33.64
Pulpectomy	46	21.50
Pulpotomy	61	28.50
Restoration	35	16.36

When the results were corroborated individually for each group it was noticed that while the sequence was same for pediatric dentists group but it was different for general dental practitioners. The percentage of participants that selected pulpectomy was significantly higher for pediatric dentists than for the general dentists (Z test; p value 0.00) (Table 4).

Table 4: results for question 2 for each group and the p value

What will be your treatment of choice with respect to the same marked tooth?	**Other**		**PEDO**		**p value**
	Count	**%**	**Count**	**%**	
Indirect pulp capping	32	36.78	40	31.50	0.42
Pulpectomy	9	10.34	37	29.13	0.00
Pulpotomy	30	34.48	31	24.41	0.11
Restoration	16	18.39	19	14.96	0.51

An analysis of the relation of the choice of diagnosis and choice of treatment was done (Table 5). According to this it was seen that the maximum dentists preferred doing indirect pulp capping when the diagnosis was clinically healthy pulp or reversible pulpitis. Although pulpectomy was chosen as a treatment option majorly when the diagnosis was irreversible pulpitis but it was seen that a small percentage (29.13%) of pediatric dentists chose pulpectomy even when the diagnosis they gave was either clinically healthy pulp or reversible pulpitis.

Table 5: relation between diagnosis and treatment choice

According to the radiograph and clinical findings what will be your diagnosis with respect to the marked tooth?	What will be your treatment of choice with respect to the same marked tooth?	Count	%
Clinically healthy pulp	Indirect pulp capping	40	41.67
	Pulpectomy	4	4.17
	Pulpotomy	26	27.08
	Restoration	26	27.08
Irreversible pulpitis	Indirect pulp capping	1	2.56
	Pulpectomy	33	84.62
	Pulpotomy	5	12.82
Reversible pulpitis	Indirect pulp capping	31	39.24
	Pulpectomy	9	11.39
	Pulpotomy	30	37.97
	Restoration	9	11.39

3. What is the reason behind your choice of treatment?

Various reasons were provided for each treatment option, which are given in Table 6 along with their percentages.

The reason of majority for choosing both indirect pulp capping and pulpotomy was caries removal that may cause pulpal exposure.

For pulpectomy while majority gave the reason of selection as pulpal involvement but a minor percentage selected better prognosis as the reason, yet another set of minority opted for pulpectomy because of the anatomical restraints of the primary incisors and some opted it because they were taught to do so in their curriculum.

The reason that the tooth in question was asymptomatic was given by majority of participants who chose restoration as their treatment option.

Table 6: Reasons behind treatment of choice

What will be your treatment of choice with respect to the same marked tooth?	What is the reason behind your choice of treatment as per question number 2?	%
Indirect pulp capping	Asymptomatic	16.67
	Caries removal may cause pulp exposure	56.94
	Dentine thickness less	1.39
	Minimal invasion	5.56
	Minimal invasivion	1.39
	Prevent progression	1.39
	Prognosis	2.78
	Pulp not involved	8.33
	Pulpal involvement	2.78
	Reparative dentin formation	2.78
Pulpectomy	Caries removal may cause exposure	19.57
	Easy	10.87
	Periapical involvement	4.35
	Poor pulpal demarcation	2.17
	Prognosis	15.22
	Pulpal involvement	43.48
	Small size can cause exposure	2.17
	Taught	2.17
Pulpotmy	Asymptomatic	6.56
	Caries removal may cause pulp exposure	67.21
	Easy	1.64
	Pulpal involvement	19.67
	Small size can cause exposure	3.28
	Taught	1.64
Restoration	Asymptomatic	48.57
	Caries removal may cause exposure	11.43
	Easy	2.86
	Minimal invasion	2.86
	Primary teeth	2.86
	Pulp not involved	28.57
	Vital	2.86

4. Depending on the choice of treatment which medicament will you use?
   According to the treatment of choice various materials were chosen by the dentists (Table 7). Calcium hydroxide was the most common medicament of choice for indirect pulp capping. Calcium- hydroxide + iodoformwas selected as medicament of choice by majority for pulpectomy. A majority selected for omocresolas the medicament of choice for pulpotomy while only minority opted for newer biocompatible materials like MTA or Biodentine. Composites were material of choice of majority of participants who chose restoration as their treatment option.

Table 7: Medicaments as per the treatment of choice

What will be your treatment of choice with respect to the same marked tooth?	Depending upon your choice of treatment (as per question number 2), which medicament will you use?	%
Indirect pulp capping	Calcium hydroxide	68.06
	Calcium hydroxide + iodoform	1.39
	Endoflas	1.39
	GIC	2.78
	MTA/Biodentine	13.89
	SDF	5.56
	ZOE	6.95
Pulpectomy	Calcium hydroxide	8.70
	Calcium hydroxide + iodoform	50.00
	Endoflas	13.04
	Formacresol	15.21
	ZOE	13.04
Pulpotomy	Calcium hydroxide	9.84
	Endoflas	1.64
	Ferric sulphate	3.28
	Formacresol	57.38
	LSTR	1.64
	MTA/Biodentine	19.67
	ZOE	6.56
Restoration	Calcium hydroxide	8.57
	Composite	42.86
	GIC	37.14
	MTA/Biodentine	5.71
	SDF	5.71

5. Reason for choice of medicament?

The results of reason of choice of medicament are presented in Table 8.

Table 8: Reason for choice of medicament

Depending upon your choice of treatment (as per question number 2), which medicament will you use?	What is your reason behind choosing this medicament?	%
Calcium hydroxide	Antibacterial	3.33
	Availability	5.00
	Biocompatible	8.33
	Easy	3.33
	Fluoride releasing	1.67
	Good results	5.00
	Good seal	5.00
	High success rate	1.67
	Obturating material for primary tooth	1.67
	Preserves pup	3.33
	Reparative dentine formation	60.00
	Resorption rate that of tooth	1.67
Calcium hydroxide + iodoform	Antibacterial	8.33
	Availability	4.17
	Biocompatible	4.17
	Easy	20.83
	Evidence based practice	4.17
	Good results	4.17
	Good seal	4.17
	Ideal	4.17
	Obturating material for primary tooth	8.33
	Reparative dentine formation	4.17
	Resorption rate that of tooth	29.17
	Safest	4.17
Composit	Easy	6.67
	Esthetic	66.67
	Good seal	26.67

Endoflas	Antibacterial	37.50
	Good seal	25.00
	Resorption rate that of tooth	37.50
Ferric sulphate	Preserves pulp	100.00
Formacresol	Availability	7.69
	Devitalizing agent	7.69
	Evidence based practice	7.69
	Fixes pulp	53.85
	Good results	7.69
	Preserves pulp	7.69
	Suitable material for primary tooth	7.69
GIC	Availability	6.67
	Best for children	6.67
	Biocompatible	6.67
	Easy	13.33
	Esthetic	20.00
	Fluoride releasing	33.33
	Reparative dentine formation	6.67
	Strength	6.67
LSTR	It can be used in pulpotomy to repair the tissue soon	100.00
MTA/Biodentin	Biocompatible	40.43
	Evidence based practice	2.13
	Good results	6.38
	Good seal	42.55
	Reparative dentine formation	8.51
SDF	Biocompatible	25.00
	Caries arrest	75.00
ZOE	Availability	10.00
	Easy	10.00
	Fast resorption of CaOH	10.00
	Good results	10.00
	Good seal	10.00
	Obtundant	10.00
	Obturating material for primary tooth	10.00
	Reparative dentine formation	10.00
	Resorption rate that of tooth	20.00

Discussion

The term “clinically normal pulp” is used to classify a pulp that has no signs or symptoms, where percussion and palpation tests do not elicit any tenderness and radiographic examination demonstrate normal appearance of the pulp chamber, root canals and periapicaltissues [15]. Although clinical picture that was presented pointed towards absence of any symptoms but the radiograph clearly showed that this was a case of reversible pulpitis. It was evident from the radiograph that on removal of caries pulpal exposure was bound to occur. As per Eidelman’s (1992) histopathological study on primary incisors with deep carious lesions, it was seen that two-thirds of cases with pulp exposures on removal of caries had reversibly inflamed pulps [16]. Many selected clinically health pulp despite evidence that deep caries can definitely cause some amount of inflammation.

Selecting irrerversible pulpitiscould beincorrect because clinically the tooth did not show symptoms of pain or any radiographic signs which may present irreversible pulpitis.

The most common choice for clinically healthy pulp and reversible pulpitis was indirect pulp therapy. Literature reports that it is and will be difficult to carry outrestorations of primary anterior teeth [17]. Therefore to do a restoration is on lower priority because of their poor longevity in primary [17]. The AAPD guidelines of restoring primary teeth (2020) states that restoration of primary anterior teeth can be especially challenging due to: the small size of the teeth; close proximity of the pulp to the tooth surface; relatively thin enamel; lack of surface area for bonding; and issues related to child behavior [18].

The most common reason for choosing indirect pulp therapy as well as pulpotomy was that the carious removal may cause exposure of the pulp. Although in an asymptomatic tooth it appears a logical choice to opt for indirect pulp therapy but, AAPD guidelines (2017&2020) for vital pulp therapy state that pulpotomy is performed in a primary tooth with extensive caries but without evidence of radicular pathology when caries removal results in a carious or mechanical pulp exposure [1, 2]. Also, according to a histopathological study on primary incisors with deep carious lesions it was seen that two-thirds of cases with pulp exposures on removal of caries had inflammation limited to the coronal pulp thus making pulpotomy a more appropriate treatment option [16].

In spite of the above mentioned facts many pediatric dentists opted for pulpectomy as the more appropriate treatment in such cases keeping in mind the clinically healthy asymptomatic nature of the pulp, as according to them the success rates of pulpectomy were higher than that of pulpotomy. There are studies which show that the success rates of Pulpectomy are more than pulpotomy in such teeth (casas aminabadi). The poor prognosis of pulpotomy in these studies was due to the pulpotomy medicaments used i.e. Formocresol and Ferric Sulphate which have a questionable biological seal [19, 20].

Another reason mentioned was that the anatomical constraints of poor coronal and radical pulpal demarcation due to tiny dimension of the primary incisors makes performing pulpotomyon them difficult than pulpectomy. This reason was more commonly presented by general dental practitioners because of their lack of training and perception that it is mechanically challenging to severe a non-demarcated pulp in anterior teeth.

Some claimed that “pulpotomies don’t work in primary anterior teeth”, which is not supported by evidence. Studies

like Howley (2012) and Nguyen (2017) that were conducted on carious vital primary maxillary incisors presented the success rate of pulpotomy equivalent to that of pulpectomy [6, 21]. The high success rates in both the studies can be justified by the maintenance of the seal in these teeth. Howley *et al*. (2012) performed formocresol pulpotomy with stainless steel crowns.[6]Although the success was high, but using stainless steel crowns in aesthetic zone could be unpleasing for the child as well as unacceptable for the parent. Whereas Nguyen *et al*. (2017) performed pulpotomy using FS+MTA [21]. Thehigh success rates of this study were in accordance with the results of various studies on primary molars pulpotomies using MTA/Biodentine with a range of success between96-100% [7, 14]. Therefore, it has been demonstrated in literature that the high success of pulpotomy resides in the ability of a material to seal the pulp. MTA and Biodentine are the materials which provide impeccable seal due to their properties of formation of dentinal bridge.

In our survey only a small percentage (19.67%) of dentists selected MTA/Biodentine as the choice for medicament for pulpotomy, although the ones who selected it knew their importance and adequate features i.e. their biocompatible nature and ability to form excellent seal. Rest of the participants gave more conventional options like formocresol or ferric sulphate. Although these are also valid choices but they may not result in high success rates for pulpotomy of primary anteriors as was seen in studies by Casas *et al*. (2004) and Aminabadi *et al*. (2008), unless the teeth are restored with a material like stainless steel crowns that provide adequate seal as was evident in the study by Howley *et al*. (2012) [6, 19, 20].

Conclusion

The present survey showed that inspite of the fact that the literature is replete with studies which showed success of pulpotomy in deep carious vital primary incisors, the dentists were still divided in their opinion with 33.64% choosing IPC, 21.50% dentists choosing pulpectomy, 28.50% pulpotomy and remaining 16.36% choosing restoration as a treatment choice for such teeth. Therefore, the need of the hour is to get the dental surgeons equipped with adequate knowledge about the indications and success rates of a less invasive treatment i.e. pulpotomy as well as with the use of newer biomaterials for carious vital primary maxillary incisors.

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