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

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DOI: https://doi.org/10.22271/oral.2021.v7.i1f.1160

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 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 caries towards 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 \[1, 2\].

According to a US based Survey, not even 50% chose pulpotomy as the treatment of choice for carious vital primary maxillary incisors \[4\]. Rather an almost split view existed between pulpotomy, pulpectomy and indirect pulp therapy among the dentists \[5\]. 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](image)

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:

1. What will be your choice of diagnosis? (Options- clinically healthy pulp/ reversible pulpitis/ irreversible pulpitis)
2. What will be your treatment of choice? (Options- restoration/ indirect pulp capping/ pulpotomy/pulpectomy)
3. What is the reason behind your choice of treatment?
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 practitioners 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 practitioners), 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).

| Diagnosis                        | 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).

| Diagnosis                        | Other Count | %     | PEDO Count | %     | p value |
|----------------------------------|-------------|-------|------------|-------|---------|
| 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 Indirect pulp capping 33.64%, followed by Pulpotomy 28.50%, Pulpectomy 21.50% and Restoration 16.36% (Table 3).

| Treatment                        | 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).

| Treatment                        | Other Count | %     | PEDO Count | %     | p value |
|----------------------------------|-------------|-------|------------|-------|---------|
| Indirect pulp capping            | 32          | 36.78 | 40         | 31.50 | 0.42    |
| Pulpotomy                        | 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 |
|---------------------------------------------|
| According to the radiograph and clinical findings what will be your diagnosis with respect to the 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 invasion | 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 |
| Pulpotomy | 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 + iodoform was selected as medicament of choice by majority for pulpectomy. A majority selected for omocresol as 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 |
| | Easy | 6.67 |
| | Esthetic | 66.67 |
| | Good seal | 26.67 |
**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 periapical tissues [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 irreversible pulpitis could be incorrect 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 out restorations 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 pulpitomy 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

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| Material | Antibacterial | Good seal | Resorption rate that of tooth | Preserves pulp |
|----------|--------------|-----------|-----------------------------|---------------|
| Ferric sulphate | 37.50 | 25.00 | 37.50 | 100.00 |
| Formacresol | Availability | 7.69 | Fixes pulp | 53.85 |
| GIC | Evidence based practice | 7.69 | Good results | 7.69 |
| MTA/Biodentin | Preserves pulp | 7.69 | Suitable material for primary tooth | 7.69 |
| LSTR | Availability | 6.67 | Best for children | 6.67 |
| SDF | Biocompatible | 6.67 | Biocompatible | 40.43 |
| ZOE | Easy | 21.33 | Evidence based practice | 2.13 |
| SDF | Esthetic | 20.00 | Good results | 6.38 |
| ZOE | Fluoride releasing | 33.33 | Good seal | 42.55 |
| SDF | Reparative dentine formation | 6.67 | Reparative dentine formation | 8.51 |
| ZOE | Strength | 6.67 | Strength | 6.67 |

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**Endoflas**

- **Antibacterial**: 37.50
- **Good seal**: 25.00
- **Resorption rate that of tooth**: 37.50
- **Preserves pulp**: 100.00
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. Although the success was high, but using stainless steel crowns in aesthetic zone could be displeasing for the child as well as unacceptable for the parent. Whereas Nguyen et al. (2017) performed pulpotomy using FS+MTA [21]. The high 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 between 96-100%. [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 anterior 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, 10, 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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