

Restorative Solutions for Anterior Teeth in Early Childhood Caries

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ABSTRACT

Early childhood caries can often result in total destruction of primary anterior teeth. There is a plethora of options for restoring such teeth. However, there is insufficient clinical evidence to suggest that one type of restoration is superior to another. The article aims to review the past and recent restorative options for restoring primary anterior teeth affected by early childhood caries, based on their in-vivo clinical performance over a period of time. The electronic databases and hand-performed journal searches identified 46 relevant documents. The variables to decide the long term outcome of the restorative material chosen were operator preferences, esthetic demands by parents, the child's behavior, amount of remaining tooth structure and moisture and hemorrhage control. A lack of long term, controlled clinical data prevents the validation or endorsement of any of the restorative options for repairing carious or traumatized anterior primary teeth.

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INTRODUCTION

Infants and toddlers with caries experience have a high risk for subsequent caries in primary and permanent dentition as well. The consequence of Early childhood caries results are destruction of primary maxillary incisors, which further effect the chewing efficiency, loss of height, development of tongue-thrusting and/or mouth-breathing, speech disturbances, and psychological behavioural complications. Therefore, integrity of the primary dentition should be preserved until they exfoliate normally. ¹ Primary maxillary anteriors and first molars are involved while the mandibular primary incisors remain unaffected. ^{2,3}

Restoration of primary teeth carious lesions is challenging due to the dimensional assortment compared with permanent dentition, lesser surface area for bonding as well as issues related to child behaviour and cost of treatment. In a literature review by Lee in 2002, data was scarce on the longevity of these restorations in a clinical setting. ⁴ Waggoner (2015) further elucidated that behaviour management, age of child, parental consent and difference in caries risk are the probable obstacles for the longevity of restoration of primary anterior teeth in clinical set up. ⁵

Given the mentioned snags, management of ECC requires high impact and resource requirement to make astute decisions to choose the restorative material for the children

The aim of this article is to review the past and recent restorative options for restoring primary

anterior teeth affected by early childhood caries, based on their In-vivo clinical performance over a period of time.

MATERIALS AND METHODS

1)SELECTION CRITERIA FOR ARTICLES CITED

All in-vivo randomised clinical trials with a follow-up of not less than 9 months were included in the review. Any meta-analyses and case reports with results based on a follow-up of less than 9 months were excluded. Only studies citing ECC as a reason for restorative procedure were included.

2)SEARCH STRATEGY AND DATA EXTRACTION

The following databases were searched for English language literature from 1997-2017: MEDLINE (via PubMed), Cochrane Library, EMBASE (Elsevier Science), Google Scholar, EBSCOhost and Wiley Online Library. To identify relevant studies, we used the following key words: 'Early Childhood Caries' 'Primary Incisors' 'Restorative Dentistry' 'Esthetic'. We also did a hand search of relevant journal published articles in gray literature with no subsequent reports.

3) DATA COLLECTION AND ANALYSIS

A total of 238 references were identified and, after adjusting for duplicates or supplementary reports, 159 remained. 113 of the citations clearly did not meet the selection criteria for this review and were discarded. The full text of the remaining 46 records

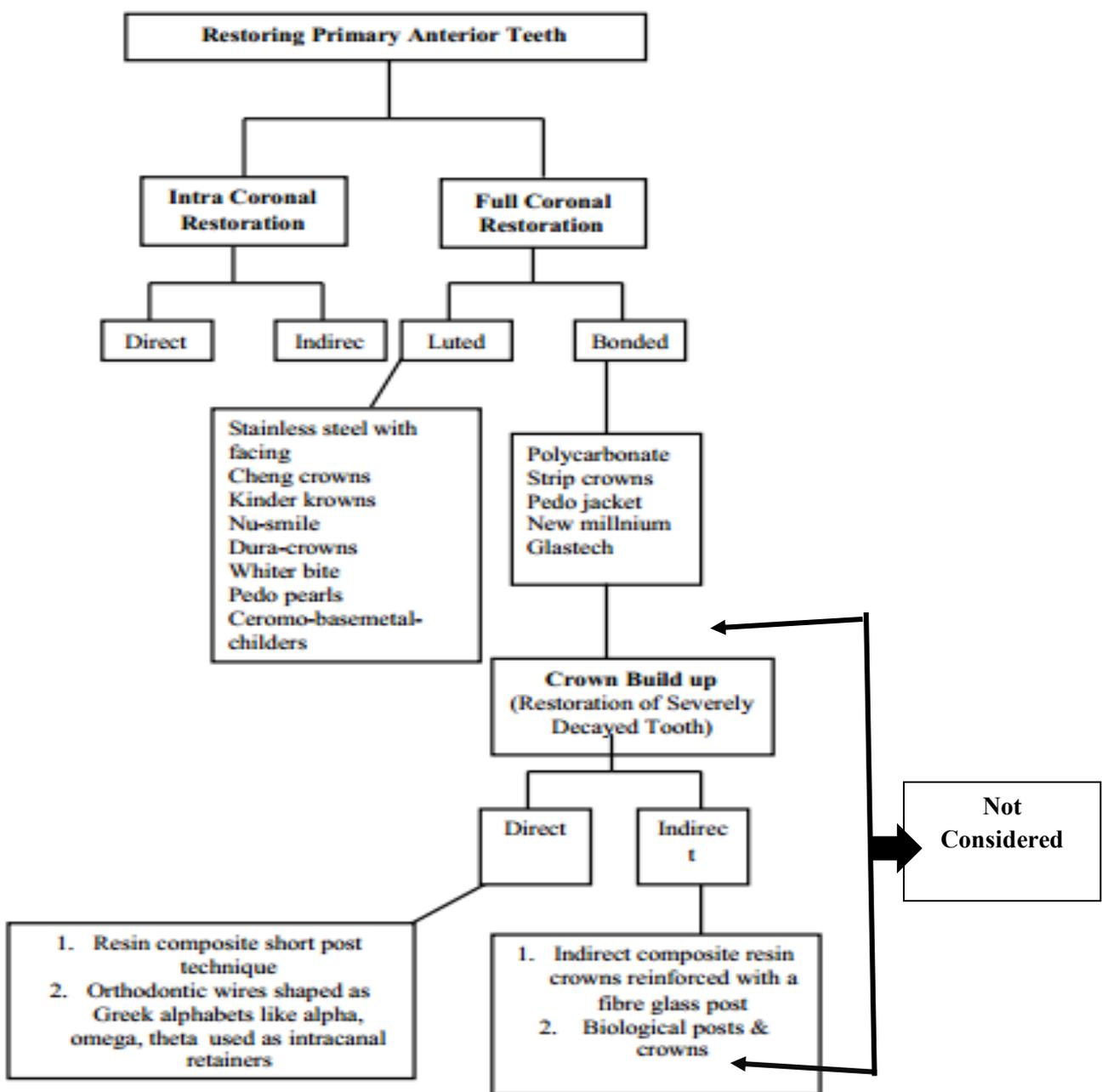
was retrieved, screened in greater detail, and assessed for eligibility. The selected articles reported results based on Likert scales and evaluation of sensitivity and specificity.

Independent reviewers performed extraction of data and the quality assessment. Cochrane's Collaboration's Risk of Bias Tool and AMSTAR-2 were used to judge the strength of evidence based on the validity of the results.

Restorations for primary anterior teeth were considered under two main categories- Intracoronal and Full coronal restorations. [6] (Table 1)

Intra-Coronal Restorations

A total of 18 relevant articles were shortlisted in which the following restorative materials were included: (1) Conventional Glass ionomer cements composite resin (2) compomers, (3) resin-modified glass ionomers, and (4) Composite resin for primary anterior teeth (Class III and Class V)



Most of the authors reported that the dimensional variations of primary dentition like lesser thickness of enamel, proximity of pulp horns to the interproximal surfaces, smaller size of crown prove challenging for performing the restorative techniques. Preparations which are conservative in depth with close attention to detail for material placement is required to restore the interproximal caries.⁴ Some authors suggested that conservative preparations like slot preparation were not effective. In many instances, the retention of very small Class III restorations was questionable due to small surface area available for etching and bonding. Eight articles recommended that small Class III restorations with a labial or lingual dovetail incorporate a large surface area for bonding to enhance retention. This could entail veneering the entire labial or lingual surface as part of the restoration. Piyapinyo and White conducted an in vitro study which reported that incorporation of 0.3 mm deep labial reduction to simulate a veneer-like preparation in Class III cavity preparation exhibited greater bond strength.⁷

On the other hand, two clinical studies of 24 and 12 months duration, respectively, demonstrated that there were no clinically significant difference between primary incisors that had been restored with Class III slot cavity preparations versus Class III preparations with dovetails.^{8,9}

Placement of Class III restorations is also technique sensitive due to moisture and haemorrhage control from the gingiva, and retention of the rubber dam.⁵

Various restorative materials have been utilised for Class V cavitated lesions. Croll et al reported resin modified glass ionomer cement had a 98% success in Class V and for 100% success rate in Class III placed in anterior teeth with an average duration of 4.5 years.¹⁰ A clinical trial done in 3-5 year old children including 94 deciduous anterior teeth showed retention rate of compoglass, composite resin and glass-ionomer as 95%, 21%, and 12.5%, respectively over a period of 9 months.¹¹ It was suggested that the low success rate of composite could be due to the thinner enamel and less mineral content in primary teeth than the permanent teeth

Another clinical trial reported that comparable clinical outcomes were seen when efficacy of composite resin and resin-modified glass ionomer cement (RMGIC) were evaluated for class III restorations in 80 primary anterior teeth for 12 months using Ryge criteria.¹² Another study reported that the survival rate after 18 months follow up was found to be 90.3% for RMGIC, 100% for compomer restorations and 80.6% for composite resin restorations in primary teeth

according to the FDI criteria in 31 patients.¹³ In RMGIC group there was statistically significant increase in surface roughness, colour mismatch, anatomic form loss and marginal deterioration. Failure of restoration composite resin group was due to restoration fracture.

The morphology of primary teeth has been under scrutiny for aiding in the retention of restorative materials. A study reported that the difference in time allotted for mineralization—1 year in the primary incisor and 7 to 8 years in the permanent incisor resulted in lower degree of microcrystal arrangement in primary teeth.¹⁴ Moreover, the prismless layer of primary teeth may not respond well to acid etching. Corniff and Hamby recommended that enamel's should be removed by a diamond bur before acid etching to increase surface area, mechanical locks or slots which will prevent dislodgement of restorations.¹⁵

Despite the presence of a gradient of mineralization, dentin of the primary teeth is less mineralized. This results in thicker hybrid layer that is not completely penetrated by the bonding agent and lower bond strengths in primary teeth. Nör et al recommended shorter etching time for primary dentin to reproduce the hybrid layer as it more reactive to acid etching than permanent teeth.¹⁶ Another study observed through SEM that a resin-reinforced hybrid layer was formed in primary teeth with total-etch technique of 15 seconds etching time.¹⁷

For many clinicians composites were the first choice for restoring anterior teeth due to their strength, wear resistance, esthetics and color-matching capabilities when compared to all the materials. But these materials were most technique sensitive as mentioned above.

Compomers have an advantage of fluoride release and more moisture tolerance than composite resins. Resin-modified glass ionomers release fluoride, do not require etching, and are less moisture sensitive. But aesthetics are not as good as compomers or composite resins.

On the other hand, GIC was not a popular choice due to poor esthetics and strength, except for Atraumatic Restorative Technique (ART).

Full Coronal Restorations

Over the last decade parents expect a higher esthetic standard for their children's primary teeth. We found a total of 28 relevant articles pertaining to such restorations in primary anterior teeth, and their in-vivo performance with a selection criteria as given by Waggoner.

According to Waggoner, full coronal restoration are required when a) caries is present on multiple surfaces b) incisal edge is involved c) extensive cervical decalcification d) pulpal therapy is indicated e) High-risk patients f)

incisors having large single surface restorations g) hypoplastic teeth h) poor moisture or hemorrhage control.⁵

The various options available for full coronal restorations are documented as under-

1) STAINLESS STEEL CROWNS

Stainless steel crowns although considered to be the most durable, economical and reliable method of restoring severely carious and fractured primary incisors as documented in literature of past 5 decades, may be completely unacceptable and rejected by a majority of parents for their child's anterior teeth, in present times.

MODIFICATIONS OF STAINLESS STEEL CROWNS

Preveneered Stainless steel crowns (PVSSC)

Various Preveneered SSC (Cheng crowns, Kinder crowns, Pedo Pearls Nu-smile and Whiter biter, Pedo Compu crowns and Dura crowns) crowns were developed to serve as an alternative solution for esthetics. However, no long-term clinical studies were found to match their performance over other restorative options.^{19,20}

Similarly, Dura crowns and Kinder crowns have been documented as case studies in literature wherein Kinder crowns were preferred due to pleasing shades available.^{21,22,23}

Disadvantages of Preveneered crowns are costly and entire replacement of crown if facing chips or breaks. But the retention rate was 90% after six to 17 months.⁵

In a clinical trial Dhillon, Hughes and Mobley reported 96.8% PVSSC restorations were successful as compared to 80.8% success rate for Resin Bonded Strip Crowns restorations when compared the clinical and radiographic success in 57 primary maxillary incisors.²⁴

However, studies have shown 12% to 39% of wear or partial facing loss, and 24% total loss of the esthetic facing of PVSSC.^{23,25,26}

2) BONDED CROWNS

a) Strip Crowns

Webber et al in 1979 introduced bonded strip crown which was preferred esthetic restorative option for carious primary incisors.²⁷ The prevalence of use of strip crowns by pediatric dentists ranges from 45-73%.²⁸ However, it is also technique-sensitive and adequate tooth structure must remain for sufficient surface area for bonding and retention. Therefore, longevity of the crown is questionable, if a lot of tooth structure is absent.²⁹ Retention can be achieved by using mini pins as suggested by Carranza, and Garcia-Godoy suggested use of mini pins for

retention.³⁰ Judd et al reported no failure of retention in one year when composite resin short posts were used in 92 pulpectomised anterior teeth.³¹ Alternatively, a technique using an omega-shaped stainless steel wire hooked into the root canal opening was also suggested.³²

Despite the popularity of composite resin strip crowns, the literature on long term clinical efficacy is limited. The vast majority of clinical studies that evaluated strip crowns were retrospective.³³⁻³⁸ Retrospective data can provide useful information especially when the number of existing prospective clinical trials is limited.³⁹⁻⁴¹ All the above studies reported an overall retention rate above 80% after 18 to 24 months.

OTHER RESIN-BONDED CROWNS

Other alternatives are also developed other than the celluloid crown form that has been used for strip crowns.^{20,42}

Composite Shell Crowns:

Updyke and Sneed described an indirect technique custom made composite shell crowns for aesthetic restoration of the maxillary anterior teeth⁴³, which will allow the restoration of multiple teeth at the same time by carrying out the restorative process on cast. The advantage of this technique was, no need for post cementation adjustment as the occlusion on lingual aspect can be checked on the cast.¹⁹

Polycarbonate Crowns:

Most of the authors found these crowns are least resistant to fracture or dislodgement due to strong abrasive forces. There are no long-term studies of polycarbonate crowns available and their use is very limited today.^{5,45,46}

Pedo Jacket:

The performance of Pedo Jacket crowns in 129 children over a 12-month follow-up in a prospective clinical trial showed an overall clinical success of 89.5%. Discoloration, wear, or complete loss of the crown were found in 13.1%, 5.4%, and 7.6% of children, respectively. Although not statistically significant, failures were found to be associated with poor patient cooperation, oral hygiene, or operator error. The authors concluded that the crowns were easy to use, and are a viable treatment alternative for carious primary anterior teeth.⁴⁷

New Millennium

Only three studies were found which suggested that these crowns can be finished and shaped with a highspeed bur and they concluded that when the crown is placed onto an inadequately reduced preparation they easily crack.¹⁹⁻²¹

Artglass Crowns

Updyke reported that out of 95 Artglass crowns that were evaluated using FDI criteria for clinical

performance, 79 received Alfa (representing clinically ideal), 11 received Bravo (representing clinically acceptable), and 5 received Charlie (representing clinically unacceptable) ratings over a 2 year follow up. The majority of failures were due to bond failure.⁴⁷

C) ZIRCONIA CROWNS

Zirconia crowns are relatively new in the practice of pediatric dentistry and are recommended for anterior and posterior teeth due to their strength, durability and esthetics.

There is a learning curve in the placement of pediatric zirconia restorations. These require a feathered margin as in other crown preparations; but also need more tooth reduction when compared to strip crowns and SSCs. Unfortunately, these preformed crowns cannot be crimped, and their retention is reliant on the internal surface designs and cementation dependant on operator skill.⁴⁸

Table 2 lists the Zirconia crowns currently available for the primary dentition.⁴⁹

Only few studies evaluated the clinical performance of zirconia crowns. Walia et al conducted a randomised clinical trial, including 129 teeth in 39 children of age 3 to 5 years reported that the retention rate was highest for zirconia crowns (100%) followed by veneered SST crowns (95%) and strip crowns were found to be the least retentive (78%) in carious and traumatised primary maxillary incisors.⁵⁰ The low retention rate of strip crowns was attributed to in healthy tooth structure remaining and technique sensitive procedure.

Salami et al (2015) reported that the parental satisfaction with zirconia crowns was highest when compared with strip crowns and veneered SSCs.⁵⁰ A retrospective study reported that 96 % of crowns were intact and 36% had gingival inflammation and color mismatch in 20.8 months follow up.⁵¹ Inflammation was attributed to poor oral hygiene as 86% of crowns had closed margins. No recurrent caries or opposing tooth wear was noted.

Company	Form	Availability	Shades	Internal surface
NuSmile ZR (NuSmile Pediatric Crowns, Houston, Texas)	Right/left in upper centrals, laterals, canines and lower canines Universal contour in lower incisors	Upper central, lateral, canine, lower canine and lower incisors	Two shades	Intaglio surface
Cheng Crowns (Peter Cheng Orthodontic Laboratories, Inc., Exton, Pennsylvania)	Right/left	Upper central, lateral, canine and lower canine	Two shades	Crimp-lock retentive design
Kinder Crowns (Mayclin Dental Studios, St. Louis Park, Minnesota)	Available in universal contour and right/left	Upper central, lateral, canine and lower canine Two models available: Original and LP (less prep) Offered in short and regular lengths	Two shades	Internal retention bands
EZ Pedo (EZ-Pedo, Inc., El Dorado Hills, California)	Right/left in upper incisors Universal contour in lower incisors	Upper central, lateral, canine and lower universal Narrow length available for canine	One shade	Zir-Lock Ultra grooves

TABLE 2: Zirconia Crowns for Primary Teeth ^[49]

A recent in-vitro study by Shobber and Alkhadra reported, when four commercially available primary anterior esthetic crowns were subjected to force with crosshead speed of 1 mm/min until they fractured, NuSmile Zirconia crowns showed the highest load to fracture (937.36 + 131.68 N), while Preveneered Cheng Crowns showed the lowest (415.57 + 12.28 N)⁵².

OTHER CERAMIC-BASED CROWNS:

CEREC crowns

All ceramic crowns use CAD/CAM technology for their fabrication. The whole procedure can be completed in a single visit. No clinical evidence of their performance was available that fitted in a long term study.

CONCLUSION:

A wide array of esthetic options exist for the pedodontist to restore carious primary incisors, but due to limited controlled, clinical data it is difficult to suggest any one superior restorative material. However many dentists have been using many of these options for years with much success. The variables to decide the long term outcome of the restorative material chosen are operator preferences, esthetic demands by parents, the child's behavior, amount of remaining tooth structure and moisture and hemorrhage control.

Meanwhile, clinical long term in-vivo studies of all newer restorative materials are definitely warranted, to establish that these tend to stay as the best available options for restoring anterior teeth in ECC.

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