

Anterior Crowns for Primary Anterior Teeth: An evidence Based Assessment of the Literature

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Abstract

Aim: To review the literature concerning the restoration of primary anterior teeth with pre-formed crowns or with the use of crown forms. **Methods:** A search of the dental literature was made electronically using the key words: crowns, primary teeth, anterior teeth, strip crowns, stainless steel crowns, veneered crowns, (a)esthetic, restorative. All papers were read and assessed for their relevance to paediatric dentistry and then graded according to a predetermined set of criteria. These criteria were used to identify those reports that met nearly 100% of the criteria were graded A; 75% grade B1; more than 50% graded B2 and all other were graded C. **Results:** There were 90 papers in all using all the search key words. Of these none were rated grade A; B1 or B2 and all remaining valid papers (not single restoration case reports), 50 were graded C. Failure rates varied between 0% and 50% for strip crowns; 32-39% for veneered metal crowns. The review indicated there is some evidence as to the efficacy and value of using anterior primary teeth crowns because of the improved aesthetics that they achieve. There was an obvious lack of prospective well controlled studies and more studies are needed. **Conclusion:** No clinical studies concerning anterior crowns on primary teeth were identified that met all or even a majority of the criteria, indicating that there was little, good scientific support for any of the clinical techniques which clinicians have utilized for many years to restore primary anterior teeth. While a lack of strong clinical data does not preclude the use of these techniques it points out the strong need for well designed, prospective clinical studies to validate the use of these techniques.

Introduction

One criticism of many of the clinical techniques that dentists use to restore primary teeth is that there is insufficient evidence that what we do has a scientifically proven outcome. This paper discusses the published literature relating to the full coronal coverage of primary anterior teeth. The restorations available include the traditional use of resin based composite strip crowns as shown in Figure 1, using a celluloid matrix. More recently open faced stainless steel crowns, and pre-veneered crowns have become available such as the NuSmile Crowns as shown in Figure 2. Other similar products are available from other companies (Orthodontic Technologies; 'Kinder Krowns', Mayclin Dental Studios; Dura Crowns, Space Maintainers Laboratory; Chen



Figure 1 Composite resin strip crowns for the restoration of the maxillary primary incisors.



Figure 2 Nusmile® faced crowns for the restoration of primary incisors.

Crowns). Literature regarding polycarbonate crowns was not included in this review as these crowns, while somewhat popular 25-30 years ago, these days they are no longer utilized. Additionally, plain, non-veneered stainless steel crowns used on anterior teeth were not included either. While there are several studies that have looked at clinical performance of pre-formed metal or stainless steel crowns (SSC) on posterior teeth, there appears to be no published data on the use of SSC on primary anterior teeth, although this has been, and continues to be a practice of some dentists. Additionally, there are some commercially available preformed crown forms made of a copolyester (Pedo Jackets, Space Maintainers Laboratory, USA) but no literature reports could be found on these.

Key words: crowns, anterior, primary teeth, children

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The grading criteria used for the literature review is described in the introductory paper to this series by Curzon and Toumba [2006]. There were 25 selection criteria used for this systematic review. A few of the criteria were: the paper was a clinical, prospective study utilizing children, operators and examiners were trained and calibrated, a control group was utilized, the study lasted at least 2 years, post-operative assessment was blinded, and the paper was published in a peer-reviewed journal. Papers were deemed to be either **Grade A**: Fulfilling all selection criteria; **Grade B1**: Relevant and fulfilling all but one or two of the selection criteria; **Grade B2**: Relevant and fulfilling the majority of selection criteria; **Grade C**: Rejected, fulfilling few of the criteria. For the purposes of this literature review case reports, technique articles, and retrospective studies carried out by reviewing past clinical treatments were not considered because of insufficient design lacking proper inclusion and exclusion criteria, calibration, and reproducibility criteria. Therefore, they were all automatically given a **Grade C**.

A PubMed search was done using various key words such as

- crowns, primary,
- anterior teeth,
- stainless steel,
- (a)esthetic,
- restorative.

The results of various searches yielded a list of over 90 articles which in some way addressed the problem of full coronal coverage of primary anterior teeth. Upon review of this list several articles were discarded because they did not specifically address the topic, resulting in over 50 articles which were selected for evaluation by the systematic review.

Unfortunately, none of the reviewed articles were found to meet sufficient criteria to be graded **A**, **B1** or **B2**. Every article on the list lacked appropriate design, follow-up time, calibration, or blindedness, which were required for inclusion. A vast majority of the articles were descriptive of techniques utilized to restore badly decayed primary anterior teeth, often including a case report. There were a number of retrospective clinical studies which looked at success of various crown techniques, but all of these lacked ideal design, control and blindedness. A number of in vitro articles were available that examined various physical properties of the crowns in a laboratory setting. Finally, there were also a few review articles. Most notable among these articles were two by Lee [2002] and Waggoner [2002] which represented a comprehensive review and a position paper concerning the restoration of primary anterior teeth published as part of the proceedings of a pediatric dentistry restorative consensus conference sponsored by the American Academy of Pediatric Dentistry in 2002.

While none of the articles reviewed could be graded in the **A**, **B1** or **B2** categories, at least of a mention of some of the results of the retrospective studies (**Grade C**) will be made here. Most of these retrospective articles dealt with resin based composite strip crowns. Kupietzky, et al. [2003] in an 18 month retrospective study found an 88% full retention rate for strip crowns and found that the strip crowns performed well aesthetically, except when placed over teeth that had undergone pulpectomy treatment and obturation with iodoform past. Similarly, in a later 3 year retrospective study, Kupietzky, et al. [2005], found that 80% of strip crowns were totally retained after 3 years, and 20% were partially retained, with none being completely lost. Similar retention numbers were reported by Mortada and King [2004] in one of the only prospective studies found. In their study they reported a retention rate of 80% after 18 months of strip crowns which were reinforced with an omega shaped stainless steel wires embedded in the root canal.

Ram and Fuks [2006] reported 80% retention of strip crowns in a retrospective study with 24-74 months follow-up. Several articles reported retention rates of strip crowns when placed under general anesthesia and reviewed retrospectively. These studies which had follow-up times averaging from 6 months to 2 years and reported retention rates of 50% [Tate, et al., 2002]; 70% [El-Eheideb and Herman, 2003], 78% [Su and Chen, 1992], 93% [Eidelman, et al., 2000] and 100% [O'Sullivan and Curzon, 1991]. Eidelman, et al. [2000] also reported a 63% retention rate of strip crowns when placed under sedation.

In a retrospective study, with an 18 month follow-up by Kupietzky and Waggoner [2003], they reported that parental satisfaction with resin based composite strip crowns was excellent. However, parents who were not satisfied with durability (i.e. chipping and loss of crown) demonstrated significantly lower satisfaction with the crowns overall.

Two papers reported clinical success rates and parental satisfaction of pre-veneered stainless steel crowns. Roberts, et al. [2001] found parental satisfaction with a pre-veneered crown (Whiter Biter II, Whiter Biter Inc., this crown is no longer available) to be excellent, in spite of 32% of the crowns losing some or all of the esthetic white facing from the stainless steel crown. In another article, Shah, et al. [2004] found parental satisfaction to also be high for another type of pre-veneered crown, Kinder Crown, (Mayclin Dental Studios, Minneapolis, Minn.) This again, in spite of 39% of the crowns demonstrated some loss of the esthetic facing, either from fracture (24%) or wear (15%).

These retrospective studies would seem to indicate that both strip crowns and pre-veneered crowns can be expected to perform well in some circumstances, but both definitely have their limitations, particularly with respect to durability. Parental satisfaction also appears to be high for both types of crowns.

Various laboratory studies have evaluated various properties of pre-veneered crowns, such as the colorimetric values of the veneers [Hosoya et al., 2002], retention of pre-veneered crowns on typodont teeth [Guelmann, et al., 2003] and repairing pre-veneered crowns [Yilmaz and Yilmaz, 2004]. Other studies in the laboratory have studied the tensile bond strength of intra-canal posts [Pithan, et al., 2002], polyethylene ribbon fibers for reinforcement of resin crowns [Island and White, 2005], and the effects of eugenol and non-eugenol fillers on short post retention [Alves and Vieira, 2004].

The technique and case reports include descriptions of the placement technique of strip crowns, [Webber, et al., 1979; Croll, 1990; Drummond, 1993; Ram and Peretz, 2000; Kupietzky, 2002; Margolis, 2002], open-face crowns [Helpin, 1983; Hartmann, 1983; Croll and Helpin, 1996], pre-veneered crowns [Croll, 1998 and 2003; Waggoner, 2003] ceramic crowns [Hsu and Shen, 2004], indirect composite resin crowns [Ellis, et al., 1992; Updyke and Sneed, 2001; Motisuki, et al., 2005], chair side veneering of stainless steel crowns [Wiedenfeld, et al., 1994; Wiedenfeld, et al., 1995], biological restoration [Ramires-Romito, et al., 2000; Mandroli, 2003] and intra-canal reinforcement [Wanderley, et al., 1999; Vieira and Ribeiro, 2001; Mendes, et al., 2004].

Discussion

As is evidenced by the literature review there are no prospective, long term clinical studies which validate or strongly endorse any of the restorative options for full coronal coverage of carious anterior primary teeth. Clinicians can argue that the method they utilize to restore carious primary incisors is best, but there is actually little scientific evidence to support any claims. Additionally, it might be asked what the phrase "best restore" means. Is it the most durable restoration? Is it the most conservative? Or is it the least technique sensitive? Or is it the most aesthetic? A different restorative option might be suggested for any of these questions.

Because there is a lack of supporting clinical data with regard to the restoration of primary incisors and canines, it would be judicious to consider why this is so. As observed by Waggoner [2002], there are several difficulties in designing clinical studies to evaluate restorative options of primary incisors. One need only consider the population of patients that require these restorations to develop a list of obstacles. First, children who get dental caries in the primary incisors are generally very young and hence, due to their young age and lack of cognitive abilities, are usually very uncooperative for dental treatment. Early childhood caries (ECC) or baby bottle tooth decay is usually seen in the 18-36 month old child, although it can be seen even younger [Tinanoff and O'Sullivan, 1997]. To have a valid or useful clinical study of restorative techniques the behaviour of the children should be similar when all the restorations are

placed. With these young children, unless they are completely unconscious, as with general anaesthesia (GA), their negative behaviour can influence the clinician's ability to place the restorations under ideal circumstances. Because these children are usually candidates for sedation, GA, or immobilization, few clinicians want to consider placing these children into an "experimental" situation where failure of a restoration can mean a significant problem for replacement. Even if the clinician were willing to do this, many parents likely would not be, especially if failure of the "experimental" restoration might require additional sedation or other management techniques to be utilized a second time. Yet another concern with this population of children is that high caries risk children often are found in lower socio-economic groups. It has been found that obtaining consistent follow-up and preventive care in this population can be challenging [Berkowitz, et al., 1997]. In clinical studies, follow-up evaluations are an integral part of the study design, and without these follow-up evaluations long term performance of the restorations cannot be done.

Additionally, because incisors will generally not become carious, except in children with a high caries risk, restorations placed in these children may perform differently than a similar restoration in a low caries risk child [Al-Shalan, et al., 1997; Almeida, et al., 2000]. A reluctance of a clinician to attempt a restoration that might not be as aesthetically pleasing as they are used to doing is yet another difficulty. For instance, if a clinician routinely places resin strip crowns and has good success with them, s/he would probably be very reluctant to place an open face crown or plain stainless steel crown as part of an experimental design, simply because they realize that the resulting aesthetics would not be as pleasing as the strip crowns which they routinely place. Finally, cost may be a factor which can impede these clinical studies. The time, expense, and effort to manage these young children and restore the incisors can be a costly exercise, particularly when compared with other restorative or surgical procedures.

Therefore, difficulties with behaviour management, the young age of the child, parental consent, cost of treatment, reluctance on the part of the clinician, and differences in caries risk may all be obstacles to obtaining well controlled, good, prospective clinical data on restorative options for primary incisors. Unfortunately, many of these problems cannot, and will not, go away or change, so while the studies are most definitely needed, they will not likely get much easier to design and complete [Waggoner, 2002].

Conclusions and Recommendations.

An extensive review of the dental literature concerning the full coronal coverage of primary anterior teeth was performed and articles systematically reviewed by objective criteria. As a result no clinical studies were identified that met all or even a majority of the criteria, indicating that there was little, good scientific support for any of the clinical techniques which clinicians have utilized for many years to restore primary anterior teeth. While lack of strong clinical data does not preclude the use of these techniques it points out the strong need for well designed, prospective clinical studies to validate the use of these techniques. Several difficulties and obstacles have been described which make these types of clinical studies difficult to carry out. In spite of the difficulties, it is recommended that efforts be made to scientifically evaluate clinical longevity and success of various restorative techniques for primary anterior teeth.

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Comment: Anterior Crowns for Primary Teeth.

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Despite the improvements in adhesive technology and restorative options for permanent teeth, it is technically difficult to restore anterior primary teeth where there has been severe loss of tooth tissue following dental caries or dental trauma or where teeth erupt with hypomineralised or hypoplastic defects. As Waggoner has so well summarised in his review paper, there is little evidence for good outcomes using any of the currently available procedures.

There is continual clinical support for and against restoring anterior primary teeth and it is important to remind ourselves why we do restore these teeth. Anterior primary teeth do not have the same priority as posterior teeth in maintaining space and they are often closer to exfoliation when children present with severe dental caries. However, from the perspective of controlling dental caries, it makes no sense at all to restore posterior teeth and leave open lesions with a high microbiological load when we are trying to prevent future lesions.

Other options such as discing and extraction can be considered, but these are certainly not acceptable today across all communities and dental practices, and do not address the aesthetic issues. Young children do have feelings about their appearance and this also needs to be taken into consideration when anterior teeth need to be treated.

As well as the call for prospective clinical studies, as noted in the review paper, further efforts need to be made to investigate the many unanswered technical issues. When strip crowns are placed, what is the minimal thickness of composite resin that should be aimed for? What happens with shrinkage at the gingival margin during curing? If there is shrinkage around the whole margin, should it be re-etched and sealed after the crown has been cured? Knowing that there will be prismless enamel in primary teeth, what can be done to the enamel to improve bonding? Are shell crowns in the various materials available a better option?

Given the difficulties acknowledged by previous studies, and highlighted so well by Dr Waggoner, further research into the technology of restoring anterior teeth should go before or at least alongside the prospective clinical studies.