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REVIEW ARTICLE

CROWNS IN PEDIATRIC DENTISTRY: A REVIEW

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ABSTRACT:
Maintenance of the primary dentition in a nonpathologicand healthy condition is importantfor the overall well being of the child. Treatment of the severely destructed teeth poses a challenge for the pediatric dentist as three important considerations have to be kept in mind, patient's behavioral management, preservation of the tooth structure and parental satisfaction.The technological advances in dental materials for use on children that have occurred in the past few decades make constant re-evaluation of our treatment philosophies and techniques a necessitybecause what was an acceptable treatment approach in the past may not necessarily be the best treatment option for our young patients today.Effort has been made to bring together the various approaches for full coverage restorations in pediatric dental practice. Each technique and material carries its own advantages and disadvantages. Many options exist to repair carious teeth in pediatric patientsas is discussed, from stainless steel crowns to its various modifications to other esthetic crowns like strip crowns and zirconium crowns which are rising in their popularity.
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INTRODUCTION

Dental decay in children's teeth is a significant public health problem, affecting 60% to 90% of school children in industrialized countries (WHO Report 2003).[1] In Scotland, the National Dental Inspection Programme (NDIP 2003) showed that over half of 5-year old children had decayed primary teeth, with the average number of decayed teeth in these children being five. 15% of the 5-year olds in this sample had already at least one tooth extracted. This large burden of treatment need has implications both for individual patients, and on a public health agenda basis.[2]

Several options are available for providing full coverage restoration for the primary dentition, with each approach having advantages and disadvantages. Commonly used full coverage crowns include stainless steel crowns and its modifications, polycarbonate crowns and strip crowns. Stainless steel crowns (SSC) have been used to restore primary and permanent posterior teeth for almost 50 years. They are prefabricated crown forms that are adapted to individual teeth and cemented with a biocompatible luting agent. "The SSC is extremely durable, relatively inexpensive, subject to minimal technique sensitivity during placement, and offers the advantage of full coronal coverage.[3]A considerable amount of literature exists to support the success of SSCs to restore severely decayed and/or pulpotomized primary molars.[4-7]Despite the favorable qualities mentioned, SSCs have a major drawback—namely, their poor esthetic appearance.

Open-face SSCs are another cosmetic solution to stainless steel crowns, although they also have several disadvantages.[8]Theprocedure is time consuming and requires additional preparation and use of multiple materials. Excellent esthetic appearance with acceptable longevity has been obtained from resin-based crowns (strip crowns) for decayed and/or fractured anterior primary incisors.[8,

[9] but they are technique-sensitive restorations. Polycarbonate crowns are another treatment approach to address the restoration and esthetics of anterior primary decayed teeth. They are more esthetic than stainless steel crowns, easy to trim and adjust and requires less chair side time.

Each of these methods has short comings but each of them can be used at some time. The search for the ideal full coverage restorations in pediatric dentistry continues. The purpose of this library dissertation is to throw light and analyze the recent developments and trends regarding the full coverage restorations in pediatric dentistry.

PRE-FORMED METAL CROWN

Preformed metal crown (PMCs) for primary molar teeth were first described in 1950 by Engel[10] followed by Dr. William Humphrey(1950). They were made of stainless steel and were referred to by an acronym of **SSC**. However soon the metal used was changed to nickel-chromium and these days it is best referred to as a preformed metal crown (PMC).

INDICATIONS FOR USE IN PRIMARY TEETH[11]

Stainless steel crowns are the restoration of choice in the following situations:

1. Extensive decay of primary teeth
2. Following pulp therapy procedures
3. As a prevention restoration
4. Restoration of primary molars affected by localized or generalized developmental problems
5. As an abutment for a space maintainer or denture
6. Strong consideration should be given to the use of stainless steel crowns in children who require general anaesthesia for dental treatment.
7. Severe bruxism

INDICATIONS FOR USE FOR PERMANENT MOLAR TEETH[12]

1. As an interim restoration of a broken-down or traumatized tooth until construction of a permanent restoration can be carried outor the eventual orthodontic status is established.
2. When financial considerations are a concern, permanent PMCs are useful as a medium-term, economical restoration in clinically suitable cases.
3. PMCs can be used in teeth with developmental defects. The crowns are beneficial for restoring the occlusion and reducing any sensitivity caused by enamel and dentin dysplasias in young patients.
4. Restoration of a permanent molar which requires full coverage

ADVANTAGES

1. Their lifespan is the same as that of an intact primary tooth.
2. They provide protection to the residual tooth structure that may have been weakened after excessive caries removal.
3. The technique sensitivity or the risk of making errors during their application is low.
4. Their long-term cost effectiveness is good.
5. They have a low failure rate.

DISADVANTAGES

1. Unsightly metallic appearance.
2. Cannot be used when the tooth is only partially erupted.

OPEN FACED STAINLESS STEEL CROWN

The preformed stainless steel crown is the most durable and reliable restoration for a primary incisor in need of complete coverage but it is also true that it is the least attractive. To take advantage of the strengths of preformed stainless steel crowns and improve the appearance of treated teeth, the dentist can cut away the cosmetically prominent aspect of the crown, remove enough of the luting cement to leave retentive undercuts, and fill the void with bonded resin composite.[13]

THE SUCCESS OF OPEN-FACE STAINLESS STEEL CROWN IS CAUSED BY:

1. Firmly bonding resin to teeth tissue
2. Using dentin bonding
3. Phosphoric acid etching. A rough and porous structure may be formed on the remaining glass ionomer cement. Unfilled resin may infiltrate into this irregular and hard surface, form holding tags, and, thus, contribute to bonding.[13]

ADVANTAGES

There is dramatic improvement over the plain metallic appearance of stainless steel.[14]

DISADVANTAGES [14]

1. The procedure is time consuming.
2. Metal margins can still be seen.
3. Clinicians have to contend with hemorrhage control during application of composite facings.
4. May have a short lifespan

5. May have poor color stability under oral conditions

Yilmaz et al. in 2004 compared the clinical success of stainless steel crowns (SSCs) made esthetic by open facing or veneering on posterior primary teeth. Thirty-three crowns (18 open-face and 15 veneered) were placed and followed up for 18 months with semiannual evaluations. This study showed that open-face SSCs had a higher but not significantly different success rate than veneered SSCs. Upper-arch crowns exhibited a higher success rate than those in the lower arch.

PREVENEERED STAINLESS STEEL CROWNS

Preveneered stainless steel crowns (PVSCCs) offer a potential esthetic and durable restoration for grossly decayed primary teeth, as these crowns allegedly combine the durability of conventional SSC with the esthetic appeal of composite resin.These crowns are available with a variety of facing materials such as composite resin or thermoplastic resin bonded to the stainless steel crown. Esthetic veneers are retained on the stainless steel crowns using a variety of mechanical and chemical bonding approaches.[7]

Currently, at least 4 manufacturers fabricate this product. Preveneered crowns were initially developed for primary anterior teeth; later preveneered crowns for primary molars became available. The various types of PVSSCs available commercially differ in terms of the method of facing attachment to the SSC, shades available, crown length and clinician's ability to crimp the crown.[15]

ADVANTAGES

1. Aesthetically pleasing result is obtained with relatively short operative time.
2. Durability
3. They give good results in conditions where moisture control is difficult.

LIMITATIONS

1. The addition of resin creates a SSC with an increased thickness compared to a conventional SSC, and therefore more extensive tooth preparation is required to allow for proper fit and occlusion. [7]
2. The dentist has no choice on the resin shade, and the supplied crowns are sometimes so white that they look artificial in the mouth. [7]
3. Pre-veneered crowns are substantially more expensive than traditional stainless steel crowns.
4. The labial section of the margin cannot be crimped, because the bonded resin material will detach. The uncrimped region, therefore, does not fit as precisely as does a nonveneered steel crown.
5. Crown forms that are tried in, but do not fit, cannot be sterilized under pressure with high heat, because such treatment will destroy the attached resin layer.
6. Re-shaping of the resin veneers is often necessary to eliminate the overly convex appearance characteristic of these crowns, and this takes additional laboratory or clinical time.
7. Difficulty in placing multiple approximating crowns in patients with crowding or space loss due to bulk.
8. Resin facing material is relatively inflexible and brittle that tends to break when subjected to heavy force.

STRIP CROWN

Among the most esthetic and popular restorations for carious primary anterior incisors are composite resin strip crowns. Resin composite strip crowns (SCs) have been utilized for over 2 decades to restore carious primary teeth.[14]This is the first choice of many clinicians due to the superior esthetics and the ease of repair if the crown subsequently gets chip off or fracture. This is, however, the most technique-sensitive option.

Figure 1: Strip crowns [14]

Strip crowns serve in the anterior sector as a matrix for a composite reconstruction (figure 1) Besides the celluloid crown form that historically has been used for strip crowns, there have been at least 2 other bonded alternatives. (Table 1)

Table 1:

Crown	Manufacturing Company	Details
Strip crowns	Space Maintainers Laboratory; 3M	Seamless plastic crown forms without long cervical collars
Pedo Jacket crowns	Success Essentials; Space Maintainers Laboratory	Copolyester crown form One shade
New Millenium crowns	Success Essentials, Space Maintainers Laboratory	laboratory-enhanced composite resin material

PEDO JACKET CROWNS

The Pedo Jacket is handled similarly to a celluloid crown form, only the "jacket" is made of a tooth-colored copolyester material, which is filled with resin material and left on the tooth after polymerization instead of being removed as the celluloid crown form is. There are difficulties with this crown. One problem is that these crowns only come in one shade, which is very white, so matching; adjacent, nonrestored teeth can be difficult. Also, because the crowns are made of a copolyester, they cannot be trimmed or reshaped with a high-speed finishing bur due to the fact that the material will melt to the bur. [15]

NEW MILLENIUM CROWNS

This crown is similar in form to the Pedo Jacket and strip crown except that it is made of a laboratory-enhanced composite resin material. Like the other two, the crown form is filled with resin material and bonded to the tooth. These crowns can be very esthetic and can be finished and reshaped with a highspeed bur. The crown forms are very brittle, however, and can crack or fracture if forced down onto a preparation that has not been adequately reduced. These crown forms are also significantly more expensive than either of the other two.[12]

ADVANTAGES

1. Highly esthetic
2. Parental satisfaction is high[16]

DISADVANTAGES

1. Most technique sensitive
2. Proper isolation and hemostasis are crucial for successful treatment. Restoration of a severely decayed primary anterior tooth with a strip crown restoration is often complicated by hemorrhage around the operative site.
3. Ideal oral hygiene prior to commencement of treatment is preferred but is not always possible. Many children appear for treatment with inflamed gingiva, which may interfere with proper curing of the restorations, resulting in discolored crowns due to excessive bleeding during the curing process.[8]

INDICATIONS

1. Extensive or multisurface caries in primary incisors
2. Congenitally malformed primary incisors
3. Discolored primary incisors
4. Fractured primary incisors following trauma
5. Developmental defects like Amelogenesis imperfecta[17]

CONTRAINDICATIONS

1. If caries removal results in insufficient tooth surface area for bonding or extensive subgingival caries.
2. If moisture control is difficult.
3. Impinging deep overbite
4. And the presence of periodontal disease.

POLYCARBONATE CROWN

Conventional Class III carious lesions in primary teeth are usually treated with composite resins or amalgam. However, more severely decayed teeth require stainless steel crowns, composite crowns or polycarbonate crowns.

Polycarbonates are aromatic linear polyesters of carbonic acids. They exhibit high impact strength and rigidity and are termed thermoplastic resins since they are molded as solids by heat and pressure into the desired form.Their heat distortion point is 270° F.[10] They were popularin the 1970's, however, although they were more aesthetic than stainless steel crowns the polycarbonate material was brittle and did not resist strong abrasive forces, exhibiting frequent fracture and dislodgement.

With the advent of composite strip crowns they lost their popularity. In the 1990's new manufacturing techniques made them thinner and more flexible

resulting in stronger restoration and resurgence in their use.

Some of the commercially available polycarbonate crowns include:

3M ESPE Polycarbonate Crowns
Kudos polycarbonate crowns
PedoNatural Crowns

INDICATIONS [10]

1. Full coverage restorations of maxillary anterior teeth extensively involved with caries. Children exhibiting nursing bottle syndrome frequently require full coverage offered by polycarbonate crowns.
2. Malformed or fractured teeth
3. Discolored teeth
4. Restoration of teeth after pulpectomy or pulpotomy procedures.

CONTRAINDICATIONS [10]

1. Bruxism
2. Evidence of excessive abrasion to anterior teeth
3. Deep impinging overbite

The tensile modulus and flexural strength and compressive strength can be increased by addition of certain particulate additives to produce a composite. Such fillers could greatly increase the wear resistance and longevity of the polycarbonate crowns.

ADVANTAGES

1. Improved esthetics
2. Extreme dimensional stability
3. They are unaffected by dilute mineral and organic acids, ether and alcohol.
4. Less chair side Time [10]

DISADVANTAGES

1. Poor abrasion resistance.
2. Crown is frequently dislodged if the tooth is heavily destroyed and retention form is inadequate. [10]

ZIRCONIA PAEDIATRIC CROWN

These are crowns made of zirconia for the primary dentition that contain no metal. Zirconia restorations are not new to the dental world and are one of the dominant types of ceramics used for a variety of computer aided design /computer aided manufacturing restorations, including framework/hand veneer, framework/milled veneer, full-contour fixed prosthodontics, implant abutments, and large implant-supported substructures.

Zirconia is currently the strongest dental ceramic available and is also esthetically pleasing. Even though zirconia is widely accepted as a restorative material for the permanent dentition, it is a relatively new restorative material for the primary dentition. Current research on passive fit prefabricated zirconia crowns for primary anterior teeth is limited.

Some of the commercially available pediatric zirconia crowns are discussed:

1. E Z Pedo crowns
2. NuSmile Zirconia crowns
3. Cheng Zirconia pediatric crowns
4. Kinder Zirconia pediatric crowns

IMPORTANT CONSIDERATIONS FOR PROPER SEATING OF THE CERAMIC CROWN

(a) Adequate subgingival facial reduction
(b) Complete removal of the cingulum area
(c) Labial and lingual surface should meet at the thin incisal edge corresponding to the planned incisal edge of the final restoration. The thin incisal edge helps to reduce the internal interferences between the tooth and the internal surfaces of the crown.

CONCLUSION

Through this manuscript, effort has been made to bring together the various approaches for full coverage restorations in pediatric dental practice. Each technique and material carries its own advantages and disadvantages. Many options exist to repair carious teeth in pediatric patients as is discussed, from stainless steel crowns to its various modifications to other esthetic crowns like strip crowns and zirconium crowns which are rising in their popularity.

There is insufficient controlled, clinical data to suggest that one type of restoration is superior to another. This does not discount the fact that dentists have been using many of these crowns for years with much success. Operator preferences, esthetic demands by parents, the child's behavior, and moisture and hemorrhage control are all variables which affect the decision and ultimate outcome of whatever restorative outcome is chosen.

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