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Review Article **Dentistry**

Various Types of Preformed Crowns Used in Pediatric Dentistry: A New Appraisal

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Abstract

The aim of this analysis is to compare and contrast the numerous categories of preformed crowns that can be used to restore the primary teeth in children. Historically, preformed crowns have been widely available for the past 50 years. The clinical performance of preformed crowns has evolved to meet higher functional, mechanical, and aesthetic demands. Preformed crowns are available in a range of prefabricated sizes and shapes. Preformed crowns can vary depending on their properties, compounds, methods of preparation and biocompatibility.

Keywords: Pediatric crowns, primary teeth, material composition, teeth restoration, repair procedure.

INTRODUCTION

Dental caries is one of the most widespread medical conditions both in adults and children. According to WHO Oral Health facts, more than 530 million children suffer from dental caries of primary teeth. A survey from 2019 conducted by Public Health England shows that one in four five-year-olds have had dental caries. The National Dental Inspection Program in Scotland found that 15% of Scottish children had at least one tooth extracted due to caries before the age of five. This number increases to 42% for eight year-olds. The consequences of primary tooth decay include local and systemic problems. Local potential problems include pain due to pulp or periapical tissue inflammation and infection of permanent tooth buds, which can interfere with odonto-genesis and cause a defect called Turner's tooth.

Premature loss of primary teeth can potentially cause malocclusion, tongue movement disorders, chewing disorders, change of facial features, and behavioral difficulties. The presence of caries in primary teeth increases the risk of caries in permanent teeth. Systemic implications include symptoms of infection such as high temperature and apathy. Long-term pain can lead to eating difficulties, which can cause weight loss and growth and development disorders. This illustrates how crucial it is to keep primary teeth healthy and prevent the development of caries. If caries develops, it is highly recommended to implement treatment as soon as possible.

The treatment options for irreversible caries contain nonrestorative cavity control including the Hall technique and techniques associated with the removal of caries. Removal can be performed selectively, either through selective caries removal or stepwise caries removal, or non-selectively by removing all demineralized dentin. The use of the latter- mentioned procedure has not been recommended. After preparation, the dental tissue must be restored. Choosing the best method of restoration is another important step to provide the best treatment results. The most chosen restoration material is glass ionomers, composite resin, compomer, and amalgam, or prefabricated crowns. Many studies compare these materials to each other in terms of durability, secondary caries, endodontic complications, or restoration loss. According to many studies, the best outcome is achieved by using prefabricated.

INDICATIONS FOR USE—PRIMARY MOLAR TEETH

The indications given in the literature for use of PMCs for primary molar teeth have been endorsed by a number of authors:

- After pulp therapy for restorations of multisurface caries and for patients at high caries risk.

- Primary teeth with developmental defects where an amalgam is likely to fail (eg, proximal box extended beyond the anatomic line angles).
- Fractured teeth.
- Teeth with extensive wear.
- Abutment for space maintainer.

Nash made the point that carrying out a crown preparation of a tooth solely for use as an abutment is destructive to tooth tissue and that bands are preferable to support appliances to preserve arch space.

When both a crown and space maintainer are required, the space maintainer should be attached to a band cemented over the crown; with this arrangement, subsequent removal of the space maintainer leaves an intact and smooth crown surface.

In a recent editorial, Pinkerton suggested that indications for placement of a PMC should include child patients who are unlikely to attend regular recall appointments or who are unlikely to be reliable preventive patients. Duggal listed one exclusion criterion for fitting a primary molar crown—namely, an inability to fit one. This encompassed the amount of tooth tissue remaining and the ability of the patient to cooperate with the treatment. It has also been recommended that teeth approaching exfoliation within 6 to 12 months should not be fitted with a PMC.

INDICATIONS FOR USE—PERMANENT MOLAR TEETH

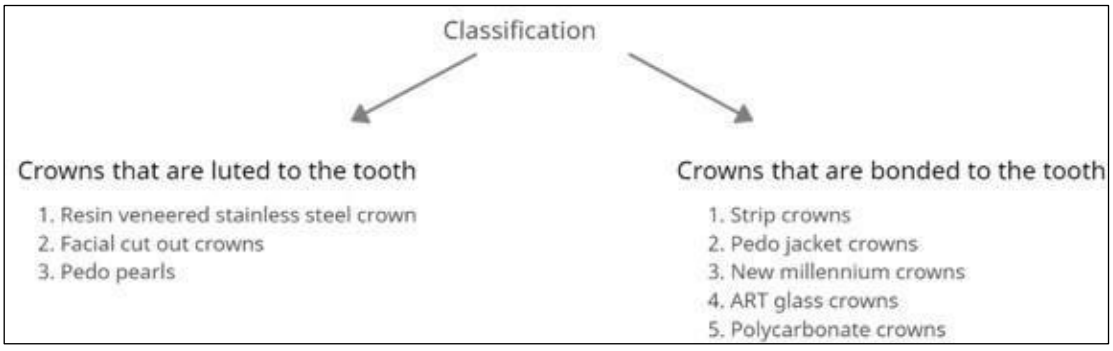
Less literature was available that discussed indications for use for permanent molar PMCs:

1. Interim restoration of a broken-down or traumatized tooth until construction of a permanent restoration can be carried out or 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. 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, restoration of a permanent molar which requires full coverage but is only partially erupted.

CROWNS

Prefabricated crowns have been widely used in pediatric dentistry for the last 50 years. The three recently most used ones are preformed metal crowns, resin veneered stainless steel crowns, and strip crowns. More aesthetic solutions include pre-veneered crowns and zirconia crowns. The use of pediatric crowns involves the proper preparation of the tooth crown for it to fit well, or it may involve no preparation and the use of the Hall technique. In the Hall technique, the reconstruction of the tooth is performed without local anesthesia by placing the crown on the remaining tooth tissue and pressing it to the correct position using finger pressure or the patient's occlusion force [2].

The use of crowns is especially recommended for teeth after pulp treatment or with advanced decay damage. They are also a good solution in the case of developmental disorders of dental hard tissue. They can also be used as a method of reconstruction of deciduous teeth during procedures under general anesthesia. Their primary purpose is to allow tight restoration, with a long-term positive outcome and without major failures. The overall procedure should cause as little pain and as little trauma for the young patient as possible. Innes *et al.*, in their systematic review conclude that the use of crowns is associated with a reduced risk of major failure, pain, and formation of abscess in the long term compared to conventional restorations. The use of crowns may be associated with a higher risk of gingival bleeding. There are a small number of studies comparing different types of crowns. Therefore, we cannot, in the current state of knowledge, say which crowns are best. This refers to the use of zirconia crowns as a replacement for stainless steel crowns.



Preformed Metal Crowns

Preformed metal crowns (PMCs) can be divided into two groups depending on the composition. The first group is represented by stainless steel crowns (SSCs), while the second group includes nickel-chromium crowns. SSCs were introduced to dentistry in 1950. Their first prototypes were usually too large, with straight and very long sides. Proper adaptation to teeth

required many steps such as trimming, contouring, crimping, and finishing. The next generation of SCCs was focused on improving the imitation of natural tooth anatomy, which would help simplify the adaptation process. Introducing nickel-chromium crowns helped eliminate many disadvantages found in the first SSCs. Firstly, Cr- Ni crowns are fully shaped and resistant to defects. Secondly, thanks to improved anatomical accuracy, they rarely require trimming. It is worth noting that they also need to be modified to improve adaptation, but they usually need fewer steps to achieve it.

Preformed metal crowns (PMCs) are represented on the market by three main types of crowns. The first is untrimmed crowns. They require long adaptation due to a lack of trimming and contouring in the production process. An example of these crowns is Rocky Mountain Crowns. The second type is pre- trimmed crowns. The sides of these crowns are straight and festooned to follow the gingival crest line. They still require contouring and sometimes need to be trimmed. The third type is pre-contoured crowns. The sides of these crowns are pre-contoured and festooned. They show the best imitation of anatomical geometry, yet occasionally minimal trimming and recontouring are required in the adaptation process. An example of these crowns is Unitek Stainless Steel Primary Crowns by 3M. PMC usually contains 67% iron, 10–13% nickel, 17–19% chromium, and 4% of minor elements, although each brand available on the market has a slightly different composition [1, 3, 7, 9].

Open-Faced Stainless Steel Crowns

This is a form of the use of SSCs in the anterior section of the dental arch. The procedure includes adapting proper SSC. If needed, the crown is trimmed, crimped, and polished. After the crown is cemented and the cement sets, the labial wall of the crown is cut out and the luting cement is partially removed to create undercuts. In the following step, the space is filled with a more aesthetic material such as composite. Indications to use open-faced SSC:

1. Crown fracture;
2. Pulp protection.

Contraindications to use open-faced SSC:

1. Allergy or vulnerability to nickel;
2. Uncooperative patient;
3. A primary tooth near its exfoliation time;
4. A radiograph showing resorption of more than half of the tooth root;
5. Tooth fracture level below gingival margin.
6. Their main advantage is better aesthetics compared to traditional SSCs, however, the procedure is time-consuming and requires a dry restoration area. The restoration may have poor color stability and the metal margins of the crown might still be visible.

PRE-VENEERED STAINLESS STEEL CROWNS

PVSSCs combine the mechanical properties of SSCs with the additional aesthetic factor of composite resin or thermoplastic resin. The aesthetic part is either chemically or mechanically bonded to the crown. At first, the restoration of anterior primary teeth was introduced to their indications; later on, they were also developed to restore primary molars. The examples of PVSSCs available on the market are Nusmile Primary Crowns, Kinder Krowns, Cheng Crowns, Flex Crowns, Dura Crowns, and Whiter Biter. The exemplary composition of these crowns presented in Nu Smile Pediatric Crowns safety data sheet contains composite paste, iron, copper, silver, 2-hydroxyethyl methacrylate, chromium, nickel, zinc, manganese, silicon, molybdenum, cobalt, and carbon.

A study by Sean Beattie *et al.*, compared three pre-veneered stainless steel crown manufacturers for their fracture resistance. Their study involved EC crowns, Kinder Krowns, and NuSmile Primary Crowns. The crowns were subjected to uniaxial force. The results showed no significant differences in fracture resistance between the crowns tested, and furthermore, the forces required for fracture in each case exceeded the control child's occlusal force in the 6- to 10-year age range.

Their advantages are long durability and a good aesthetic. PVSSCs allow restoration when the treatment area cannot be perfectly dry. On the other hand, they require more aggressive tooth preparation compared to SSCs. They come with some limitations such as prefabricated resin shade, which can look

artificial. They are also wide mesio-distally, which can cause problems with placing them in patients with crowding. The labial section cannot be crimped, because it might weaken the aesthetic facing and cause premature failure. It is also worth noting that clinically try-in crowns that do not meet the proper parameters and require sterilization procedure, which can exert stress on the resin. To reduce the impact of stress, it is recommended to use steam sterilization [3, 7].

PEDO PEARL

These crowns can be included in the group of pre-veneered crowns. The base of these crowns is made of aluminum covered with epoxy paint which gives them an aesthetic tooth color. They are easy to adapt by cutting and crimping. If necessary, they can be covered with composite. Their disadvantages are their soft structure and possible shorter durability.

POLYCARBONATE CROWNS

Anterior primary teeth are usually damaged due to early childhood caries (ECC) caused by bottle feeding without proper hygiene. ECC usually starts on the labial surface of the upper incisors and progresses rapidly. The treatment depends mostly on the cooperation with the patient and includes non-restorative cavity control, preparation, and restoration with conventional materials. Crowns can also be used for restoration and are especially useful when the caries damage is extensive and conventional restoration might be problematic.

Polycarbonate crowns are made of aromatic polyesters of carbonic acids. They can be described as thermoplastic resins. The use of high temperature (around 130 ˚C) and pressure makes the material easy to mold and shape into the desired form. The material properties are thin structure and flexibility greater than that of acrylic resin crowns. On the other hand, these crowns do not resist high abrasive forces which can cause fracture or premature crown loss Polycarbonate crowns are at risk of fracture, dislodgement, and discoloration, all of which contribute to a possible unsuccessful treatment outcome. For this reason, many clinicians choose to use a different type of polymer crown type, strip crowns [1, 8].

STRIP CROWNS

Strip crowns are transparent plastic forms used to simplify work within upper incisors restoration. They can be filled with both chemical and light curing composite material. Once the material has set, they can be easily removed, leaving a smooth surface. According to Kupietzky *et al.*, their advantages ease of fitting, trimming, and removal. They are also thin and transparent, which makes them easier to match to natural dentition and control composite color [3].

For the best treatment results, patients require proper hygiene instructions and further proper hygienization. Parents must be aware that the lack of

proper oral hygiene decreases the chances of successful treatment, which means that they are partially responsible for the procedure's overall outcome. The surrounding soft tissue must be free of inflammation. Strip crowns provide high aesthetics and functionality. They are also cheap and easy to repair. However, their disadvantages include the need to maintain a dry restoration area. Any moisture or blood can interfere with the bonding, and blood can also cause discoloration of the composite material. Their use is also restricted to primary teeth having enough enamel to allow proper bonding after preparation. Minimal reduction is required for proper preparation.

PEDO JACKET CROWN

Similar to strip crowns, Pedo Jacket Crowns primarily differ in the material used. They are made from tooth- colored copolyester and filled with resin material. Pedo Jacket Crowns are only available on the market in a single- color shade. Another difference compared to strip crowns is that Pedo Jacket crowns are left on the tooth after polymerization. They cannot be adapted by trimming and reshaping with high-speed finishing bur, as doing so would melt the co- polyester [4].

NEW MILLENNIUM CROWNS

The New Millennium Crowns are made of laboratory-improved composite resin material and are also similar to strip crowns. Their advantages include high aesthetics and parental satisfaction. They can be adapted by reshaping them with a high-speed but, however their disadvantages include a fragile structure, the need for a dry restoration area, as well as the possible discoloration of the crown by the hemorrhage. They also cannot be crimped. Preparation for New Millennium crowns is similar to strip crown preparation [7].

ARTGLASS CROWNS

Artglass Crowns, also known as Glastech, are made up of polymer glass which forms a three-dimensional molecular network with a cross-linked structure. They contain such fillers as micro-glass and silica, which improve their durability and aesthetics compared to strip crowns. Their longevity is comparable to that of porcelains.

ZIRCONIA PEDIATRIC CROWNS

Zirconia has three forms including a monoclinic, tetragonal, and cubic one. These structures are stable in various temperature ranges. The Monoclinic form is stable at room temperature; above 1170 ◦C, zirconia changes into a tetragonal form, while at 2370 ◦C, the main form is the cubic one. When zirconia is cooled, the tetragonal phase changes into the monoclinic phase, causing a volumetric expansion of 3–4%. In dentistry, zirconia is used in the form of yttria-stabilized tetragonal polycrystal (Y-TZP), magnesia-partially stabilized zirconia, and zirconia- toughened alumina. Zirconia has many beneficial properties [9].

Firstly, it is very strong, and secondly, it offers good aesthetic properties and good biocompatibility. Zirconia shows high wear and corrosion resistance. It can also resist crack propagation due to a change in the crystalline phase. Zirconia pediatric crowns require minimal preparation; moreover, the whole preparation and restoration process can be completed during a single visit. They are also an alternative for patients with Ni-Cr allergy or sensitivity. Their disadvantage is their high cost. While they cannot be modified, they also show greater thickness than PMCs. According to Sumer *et al.*, zirconia crowns exhibit less plaque accumulation, as evidenced by follow-up visits. They also show nearly zero risk of developing secondary caries and significantly lower restoration loss rate in comparison to strip crowns. A study by Pinar *et al.*, shows that plaque index and gingival index exhibit lower values around zirconia crowns compared to SSCs. This results in better gingival health. Zirconia pediatric crown brands available on the market include Ez-Pedo, NuSmile ZR, and Kinder Crowns Zirconia.

CONCLUSIONS

In pediatric dentistry, a great deal of effort is required to obtain proper restoration. The first difficulty is to ensure the child's cooperation due to their age; a fear of dentistry is a frequent obstacle in the treatment process. Therefore, it is vital for treatment procedures performed in pediatric dentistry to utilize the simplest and least traumatic procedures that have the best prognosis regarding long-term durability. This review presents one of the approaches for full coverage restoration in pediatric dentistry practice using different types of preformed pediatric crowns. The use of pediatric crowns makes it possible to achieve long-term and positive therapeutic effects. Their use is often easier and faster than manual reconstruction, especially in the case of multi-surface cavities.

They are also a good option for restoring teeth after pulp treatment and those with abnormal hard tissue development. PMCs are the most used crowns. Currently, these crowns contain very low levels of nickel and are associated with a low risk of nickel allergy and hypersensitivity. It should be mentioned that there are many types of PMCs available on the market. They differ in terms of composition and prefabrication methods. Therefore, it is important to select solutions corresponding to the dental operator's needs and demands. Over the years, new types of pediatric crowns were introduced to the market to overcome the disadvantages of stainless steel crowns and respond to the demand for higher aesthetics, such as zirconia crowns. An important factor that requires further investigation is a comparative analysis of the use of crowns from different materials, such as a comparison of the long-term durability of zirconia crowns in comparison with PMCs.

REFERENCES

1. Engel, R. J. (1950). Chrome steel as used in children's dentistry. *Chron Omaha Dist Dent Soc*, 13, 255-258.
2. Humphrey, W. P. (1950). Use of chrome steel in children's dentistry. *Dental Survey*, 26, 945-949.
3. Wheeler, R. C. (1974). *Dental Anatomy, Physiology and Occlusion*. 5th ed. Philadelphia: Saunders; 43-79.
4. Hobson, P. (1970). Pulp treatment of deciduous teeth II. Clinical investigation. *Br Dent J*, 128, 232-238.
5. Full, C. A., Walker, J. D., & Pinkham, J. R. (1974). Stainless steelcrowns for deciduous molars. *JADA*, 89, 360-364.
6. Duggal, M. S., Curzon, M. E. J., Fayle, S. A., Pollard, M. A., & Robertson, A. J. (1995). *Restorative Techniques in Paediatric Dentistry*. 1st ed. London: Martin Dunitz.
7. Law, D. B., Sim, J. M., & Simon, J. F. (1966). A new look at Class IIrestorations in primary molars. *Dent Clin N Amer*, 10, 341-355.
8. Citron, C. J. (1995). Esthetics in pediatric dentistry. *New York State Dent J*, 61, 30-33.
9. Myers, D R. (1977). Factors producing failure of Class II silveramalgam restorations in primary molars. *ASDC J Dent Child*, 44, 226-229.
10. Allen, W. E. (1966). Stainless steel: Its use in pedodontics. *Dent Clin N Amer*, 1, 357-363.