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RESEARCH ARTICLE

ANTERIOR CROWNS IN PEDIATRIC DENTISTRY: A LITERATURE REVIEW

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ABSTRACT

Esthetic treatment requirement of severely mutilated primary anterior teeth in the case of early childhood caries (ECC) is one of the greatest challenges to pediatric dentists. The choice of restoration depends on various factors such as amount of tooth structure remaining, ability to obtain adequate moisture control, child's cooperating ability, esthetic demands, and cost factor. A practitioner should choose convenient, durable, and reliable solution which is fulfilled with complete knowledge of different crown forms.Satisfactory restoration of these teeth, improving esthetics, along with management of space and function has always been a challenge for pediatric dentists. Although restorations placed in pediatric patients are technically temporary, they are often required to last for years, meaning that the need for strength and durability—as well as esthetics—should not be underestimated. An ever-increasing demand for esthetics has lead to innovations and development of newer treatment modalities for these problems. The purpose of this article is to review latest materials and techniques in managing primary anterior teeth to decide the choice of the full coronal restorative material.

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INTRODUCTION

Early childhood caries (ECC) is a serious public health problem that is common in both underdeveloped and industrialized population. [1]Maintaining the integrity of primary teeth till exfoliation is important not only to maintain arch integrity but also to prevent psychological effects associated with loss of teeth.[2] In the modern civilized cosmetically conscious world, well contoured and well aligned white teeth set the standard for beauty. Such teeth are not only considered attractive, but are also indicative of nutritional health, self esteem, hygienic pride and economic status.[3] With the growing awareness of the esthetic options available, there is a greater demand for solutions to unsightly problems such as nursing bottle caries, malformed and discolored teeth, hypoplastic defects, tooth fractures and bruxism in children. Esthetic restoration of primary anterior teeth can be especially challenging due to the small size of the teeth, close proximity of pulp to tooth surface, relatively thin enamel and surface area for bonding, issues related to child behavior and finally cost of the treatment.[4] Apart from a compromise in esthetics, dental destruction may also lead to development of parafunctional habits like tongue thrusting and speech problems, psychological problems, reduced masticatory efficiency and loss of vertical dimension of occlusion.

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[5]Hence it is important to restore crowns destroyed by caries to preserve the integrity of primary dentition until its exfoliation and eruption of permanent teeth. The purpose of this article is to review the various esthetic options after pulpectomyavailable for restoring the primary incisors and enhance the clinician's ability to make the best choice of selection for each individual situation.

PEDIATRIC TREATMENT CHALLENGES

Age is the first and foremost of the special challenges when working with pediatric patients. Very often children with anterior caries present at the young age of 2 or 3 years, once a problem has become evident to the parent or sometimes to the primary healthcare practitioner. Demineralization of primary teeth is significantly faster than that of permanent teeth, leading to the urgency for timely treatment.[6] Although primary incisors are among the first to exfoliate, they do have a very significant "lifespan." On average, central incisors begin to exfoliate naturally between the ages of 7 and 8 years, and lateral incisors exfoliate between the ages of 8 and 9 years.[7] Patient cooperation is another significant factor that must be taken into account. On occasion, young children have the potential to be pre-cooperative or uncooperative. Many times it is the practitioner who is the apprehensive one, however. The mastery of the clinical procedure along with some simple behavior management techniques can mean the difference between treatment success and failure. Patient behavior after restoration is another area to consider when planning treatment.

Children will not and cannot be expected to be gentle with their teeth. Anterior teeth take a lot of wear and tear, and restorations must be durable and reliable enough to be "kid tough." In addition, up to 38% of children are bruxers.[8] Bruxing leads to flexure of the tooth and the ultimate failure of an intracoronal restoration. Intracoronal restorations of primary anterior teeth rely upon retention from bond to enamel or dentin as the case may be. Any mechanical retention incorporated into the preparation will also help with retention; however, flexure is a problem. Due to the morphology and size of primary teeth as well as the thickness of enamel, retention and adhesive strength are difficult to predict.

Signifcance of Primary Anterior Caries: Caries is a biofilm (plaque)-induced acid demineralization of enamel or dentin, mediated by saliva. The disease of early childhood caries (ECC) is the presence of 1 or more decayed (noncavitated or cavitated lesions), missing (due to caries), or filled tooth surfaces in any primary tooth in a child 71 months of age or younger. In children younger than 3 years of age, any sign of smooth-surface caries is indicative of severe early childhood caries (S-ECC). From ages 3 through 5, 1 or more cavitated, missing (due to caries), or filled smooth surfaces in primary maxillary anterior teeth or a decayed, missing, or filled score of ≥4 (age 3), ≥5 (age 4), or ≥6 (age 5) surfaces constitutes S-ECC. The clinical appearance of severe ECC follows a particular pattern: Maxillary incisors followed by the maxillary and mandibular first primary molars and the mandibular cuspids.[9]In addition to management problems, there are a number of procedural problems that need to be addressed while restoring primary incisors.)Their crowns are short and narrow, while the pulp chamber is large with respect to the size of the crown. In pulpectomised primary anterior teeth where the entire crown is destroyed by the carious process, only a small amount of the tooth structure is available for bonding. Enamel, if and when present, is also less amenable to acid etching than the permanent teeth because of more aprismatic enamel. In many cases, the entire coronal structure is destroyed, sparing only the root and hence only dentine to bond to the restorative materials. Not surprisingly, in the past, and often even now, many of these teeth are extracted.[10]This paper addresses various options for restoring those kind of teeth.

Full coronal restorations .[1]

Indications for full coverage restoration

- Multisurface caries
- Extensive cervical decalcification
- Following pulp therapy
- Fractured anterior
- Loss most of the tooth structure
- Multiple hypoplastic de disturbances on anterior teeth
- Discolored teeth that are aesthetically unpleasing

Classification

Based on method of cementation to tooth

- Bonded crowns – polycarbonate crowns, strip crowns, pedo jacket crowns, Artglass crowns
- Luted crowns – stainless steel crowns with facing , Kinder Krowns , Cheng crowns, NuSmile crowns, Dura crowns, Whiter Biter crowns, PedoCompu crowns, High density polyethylene veneered crowns

Based on the material of the crowns

- Polymer – polycarbonate crowns, strip crowns
- Pre veneered stainless steel- Nu- smile Signature
- Zirconia – EZ pedo, Nu-Smile ZR
- Aluminium veneered with tooth colored material – Pedo pearls

DESCRIPTION

Open faced stainless steel crowns: Stainless steel crowns are most long-lasting, costeffective and reliable for restoration rigorously carious and primary incisors that are fractured. They can be easily placed, resistant to fracture, resistant to wear and continue to attach firmly to tooth until exfoliation. However there is a compromise in esthetics due to the unpleasant silver metallic appearance. Thus various modifications have been adopted to enhance its use in primary anterior teeth.[12]It was introduced by Hartmann in 1983.[13] Stainless steel crowns can be modified for its use in the anterior teeth by an open faced stainless steel crown. For this a fenestrationis prepared on the labial surface of the stainless steel crown to leave a crown perimeter which is then restored with a resin veneering/ tooth colored plastic material. The esthetics is fair and provides the advantage of the strength of preformed stainless steel crowns. However the placement of crown is time taking as it involves two-step process.

Advantages :[1]

- Economical
- Robust
- Easy to use
- Well adapted to tooth
- Esthetically pleasing

Disadvantages: [1]

- Gingival hemorrhage or moisture is present or cannot be controlled,
- Difficult to manage saliva and blood contamination while composite facing is done
- Increased chairside time
- Metal may show at the gingival margin of the crown

Weidenfeld et al[14] stated that chairside veneering technique is successful in restoring severely damaged anterior teeth and the veneering maintains adaptability, strength and gingival contour with better cosmetic effect.

Pre veneered stainless steel crowns: Crowns manufactured with composite resins and thermoplastics bonded to the metal are pre veneered stainless steel crowns. They served to be a suitable, strong, unfailing, and esthetic solution to the complicated challenge of restoring severely carious primary incisors. The various available pre veneered crowns are Cheng crowns, Kinder Krowns, Nu-Smile crowns, Dura crowns.[12]

Cheng crowns: Cheng crowns were introduced in 1987 by Peter Cheng Orthodontic Laboratories. They are stainless steel pediatric anterior crowns faced with a superior quality composite, meshbased with a light cured composite.[13]They are natural-looking, stain-resistant crowns and are available for both the right and left centrals, laterals as well as cuspids.[5]

Advantages:[13]

- One visit procedure
- Less technique sensitive
- Most accepted crowns
- Can be autoclaved
- Economic
- Stain resistant
- Does not cause any wearing of the opposing tooth

Disadvantages: [13] Veneer may fracture while crimping Baker et al[15] conducted a study to evaluate the amount of sheer force necessary to fracture, dislodge or deform the esthetic veneer facing of commercially available veneered primary crowns. They concluded that Cheng crowns showed statistically significant results compared to all the other available crowns.

Kinder Krowns: Kinder crowns have the most natural shades and contour existing for the pediatric patient. The great intensity and vitality from the lifelike composite divulge a natural smile without the bulky "Chicklet" look of other restorations. They are available in 2 shades i.ePedo 1 and Pedo 2. Pedo 2 shade is the most natural shade1.[1] While Pedo 1 shade is for those cases where bleached white tooth color is required. Kinder Krowns can be used in fixed bridge fabrication for replacing lost primary central incisors. These crowns also have an additional mechanical retention called as IncisaLock. It provides better retention and more space for composite, which makes it strong without the need for sacrificing much of tooth structure.[1]

Nu Smile crowns: Nu Smile crowns have the most natural looking veneer facing. They can undergo heat sterilization without any significant effect on the bond strength and color. Available in 2 sizes i.e regular and large for centrals, laterals and canines. They have facing only on the labial side, allowing crimping possible only on the lingual side.[5]

Advantages:[13]

- Natural looking crowns
- Autoclavable
- Good esthetics
- Increased longevity
- Patient- parent's satisfaction
- Less chairside time
- Will not discolor

Disadvantages:[13]

- Poor gingival health
- Costly
- Bulky
- Crimping may lead to fracture

MacLean et al[16] concluded that Nu Smile crowns are the most clinically successful full coverage restorations for the anterior primary teeth with severe decay.

Dura crowns: Dura crowns are high density polyethylene veneered crowns. They can be crimped both on the gingival facial margin as well as the lingual margin. They can be easily festooned and easily trimmed with crown scissors. It has got a full-knife edge. These crowns are available in a single shade. Though these crowns provide better esthetics, but they have a few disadvantages to mention. Crimping of the metal portion will weaken the aesthetic facing and may lead to premature failure. Instead care must be taken to have as much as close fit possible in order to reduce the need for crimping and to minimize the dependence on the strength of the cement. Also it requires a lot of tooth reduction prior to the placement of the crown. Hassan et al stated that sizes and shades of pre veneered stainless steel crowns are also a major problem8 .Guelmann et al[12] reported that Dura Crown, Kinder Krown, and NuSmile crowns were significantly more retentive when crimping and cement were combined than the non veneered crowns. Gupta et al[18] concluded that veneer resistance to fracture for NuSmile crimped crowns was comparable to non crimped crowns. The crimped crowns, however, were associated with greater veneer surface loss.

Whiter Biter crowns: Whiter Biter crowns are preveneered stainless steel crowns which have a polymeric coating with a polyester/epoxy hybrid composition.[13]The coating is very thin but it does not peel or chip under normal use and mastication. Roberts et al10 found that 32% of the crowns lose some of the esthetic white facing.

PedoCompu crowns: PedoCompu crowns are stainless steel anterior crowns with high quality composite facing and mesh based with a light cured composite crown. They are colorstable and plaque resistant.[1,13]

Advantages:

- Does not wear the opposing tooth
- Color stable
- Natural appearance

High density Polyethylene veneered crowns: Esthetic preformed crowns which are veneered with high density polyethylene that is thermoformed over a preformed stainless steel crown.

Advantages: [13]

- High elasticity
- Great flexural strength
- Can withstand shear force
- Natural appearance
- High density polyethylene adapts to tooth by mechanical retention and does not disengage easily
- Chipping, crazing and splitting does not occur
- High density polyethylene has greater density over the composite facing that is commonly used

Pedo Pearls Pedo: Pearls are metal crowns coated with epoxy resin, which serve as permanent crowns for primary teeth. The difference was that the metal used was aluminum in place of stainless steel. The epoxy resin coating adheres better with aluminum surface rather than stainless steel. Available in universal size and can be used on any side. This was first introduced in 1980.

However, the aluminum crowns are quite soft and which may create a problem with long-term permanence. Likewise in the areas of heavy occlusion, there is usually wearing off of the white coating.[13] In spite of these problems they offer, these crowns can be easily placed of all the crowns with reasonable esthetics.[1] While using these crowns it is advisable to fill them with either self cure or dual cure composite rather than using regular luting cement. When the epoxy resin coating wears off at the contact point with the opposing tooth, it can be patched up with more composite. Pedo pearls crowns should be avoided in the patients with a history of bruxism.[13]

Strip crowns: It is the most frequently used and esthetic of all the available restorations for the treatment of decayed primary incisors. These crowns are filled with composite resin and bonded on the tooth to be restored.

The benefits of these crowns include[13]

- Parent/patient are usually satisfied
- Ideal for the build-up of ankylosed tooth
- Simple to fit & trim
- Removal is fast & easy
- Easily matches natural dentition
- Leaves smooth shiny surface
- Easy shade control with composite
- Superior esthetic quality
- Ideal for photo cure
- Crystal clear and thin
- Large selection of size
- Easy to repair

The crowns help to seal the underlying tooth from acid attacks and reduce the chance of further decay on the tooth. The success rate depends on how much amount of sound tooth is available for the placement of the crown.[1]

Indications: [13]

- Interproximal caries, multisurface caries on primary anterior teeth
- After pulp therapy
- Restoration of fractured tooth
- Hypoplastic anterior teeth
- Amelogenesis imperfecta
- Discolored anterior teeth
- Congenitally malformed primary incisors

Contraindications:[13]

- Insufficient tooth structure for retention
- Deep overbite
- Bruxism
- Periodontal diseases

Margolis FS[20] describes the use of strip crowns as relatively easy technique which produces beautiful outcome in relatively short time. Ram &Fuks et al[21] observed a success rate of resin composite strip crown with a 2 yr follow up and concluded that strip crown is an esthetic modality with a satisfactory means of restoring carious primary incisors. Kupietzky& Waggoner[22] assessed parental satisfaction for composite strip crowns and concluded that parents were satisfied with the crowns regardless of the color, size or overall appearance. However they were not satisfied when asked about the durability of strip crowns. Though these crowns are widely accepted by patients, the chances of its failure are more. The reasons for this maybe due to technique sensitive procedure, adequate tooth structure is required and any lapse in patient selection, moisture and blood loss control, tooth preparation and placement of resin.

Polycarbonate crowns: Polycarbonate crowns are acrylic resin crowns for restoration of primary anterior teeth. It is esthetic than stainless steel crowns, easily trimmed and can be adjusted with pliers. The crowns can be crimped because of its flexibility. It is available in a universal colori.e translucent cement shade.[1]These crowns cannot resist the strong abrasive forces thus leading to occasional fractures; thus it is contraindicated in cases of severe bruxism and deep bite.[13]

Artglass crowns: Artglass is a polymer glass which provides a natural feel, bond ability associated with composite but esthetics and longevity of porcelain. It is a bifunctional and multifunctional methacrylates which forms a three dimensional molecular network with highly cross-linked structure. Due to such structural nature of the crown they are also known as "organic crowns". It consists of 55% microglass and 20% silica filler.[13]

Advantages

- Esthetics same as natural dentition
- Durable
- Wear is similar to enamel
- Inorganic filler particles provide color stability and make them plaque resistant
- Flexural strength is over 50% higher than porcelain
- Can be easily adjusted or repaired intraorally
- Ease and bondablitiy of a composite.
- Requires minimum chairside work

Pedo jacket crowns

Pedo jacket crowns are made up of a tooth-coloredcopolyester material, which is filled with resin material and left on the tooth after the polymerization instead of being removed as it is done in strip crowns. These crowns are available in only one shade, which is very white, so matching the up adjacent, non restored teeth can be hard. Also, because the crowns are made of copolyester, so they cannot be trimmed or reshaped with a highspeed finishing bur which may lead the material to melt to the heat produced by the bur.[1]

Advantages: [13]

- Crown placement can be completed in a single sitting
- Cost effective
- Multiple adjacent restorations with minimal tooth reduction
- Crown will not split, stain or crack
- Can be trimmed with scissors
- Disadvantages: [13]
- Available in a single color so shade selection is difficult
- Cannot be reduced by using high speed finishing bur

Zirconia crowns: It was introduced by John P Hansen & Jeffery P Fisher in 2010.[13]Zirconia is a form of crystalline dioxide of zirconium. In particular, the yttriumoxide-partially-stabilized zirconia (3Y-TZP) has mechanical properties very similar to those of metals and yet it has a color same as that of teeth. The mechanical strength of these crowns is similar to that of stainless steel crowns.[23] EZ crowns are the first manufactured zirconia crowns. EZ Pedo Company developed monolith zirconia pedo crowns as anterior and posterior crowns. They are solid tooth coloredmaterial that looks extremely esthetic from front view as well as inside the mouth.[13]Ashimaet al15 reported a case of a 4 yr old boy with discolored upper anterior teeth. They used zirconia crowns as it provides tooth like esthetics and strength close to available

metal crowns. They concluded that zirconia crowns are simple and efficient and represents a hopeful alternative for rehabilitation of severely decayed or fractured primary anterior teeth. More recently, a new type of ceramic material, based on zirconium dioxide, has been developed. Yttria-stabilized tetragonal zirconia polycrystal, Y-TZP, has a unique ability to resist crack propagation. This material is best suited for use in the restoration of posterior tooth.[25]

Cerec crowns – All ceramic crowns: Cerec crowns use CAD/CAM technology for the fabrication of the crowns. The whole procedure can be completed in a single visit. A digital image of the prepared tooth is taken and then converted into 3D computerized model of tooth, which is used as a model for fabrication of the crown. The ceramic blocks come in a wide variety of shades and colors and it is matched and selected as per the adjacent teeth.[13]

Advantages

- Single visit
- Time saving
- No temporization required
- Improved esthetics
- Very durable

Disadvantages

- Very expensive
- Requires extra training on the dentist's part to know the technology

Biologic crowns: It is a technique in which fragment reattachment using natural teeth is done and it is known as biologic restorations. It meets the esthetic as well as standards of natural teeth. This procedure was published as a case report first in 1964 by Chosak and Eildeman. They can be made from fragments selected from natural extracted teeth or from a bank of tooth tissues and can be bonded to the tooth with dual cure composite.

Benefits

- Natural esthetics
- Superficial smoothness and cervical adaptation compatible to surrounding teeth
- Avoids long clinical appointments
- Avoids laborious techniques
- Inexpensive

Limitations

- Lack of patient acceptance
- Lack of availability of teeth with similar structure, texture and color
- Longevity is poor.[13]

Sancheset al[26] evaluated the biological restorations as a treatment option for primary molars and found that it provided a good alternative to other esthetic restorative options.

Figaro crowns [27]

Figaro Crowns are recently introduced crowns for primary teeth. These are said to be all white, metal- free, and BPA (Bisphenol-A)-free, and are made from the highest – quality, safest, and time-tested products used in dentistry and medicine today. Figaro Crowns are made in the U.S.A. and possess all ISO Certifications required by Canada Health and the FDA. The technique of crown preparation, selection, and delivery is similar to what is taught in dental school when placing a Stainless Steel crown (Figaro Crowns).

Figaro Crowns' materials are said to be:

- Biocompatible – comprised of the same material currently used in pacemakers
- Strong - created for superior strength to withstand grinding and chewing bite force
- Safe - thoughtfully designed with materials that do not allow for sharp edges due to tooth grinding or shattering of the crown while clenching or chewing
- Cost Effective – we have virtually eliminated the risk of failure at delivery (i.e. cracking, breaking & chipping)
- BPA and Metal Free – provide peace of mind and reassurance for patient's parents
- Autoclavable - Studies yet to be done to prove the factors or advantages of Figaro crowns over other crowns.

Conclusion

Esthetic dentistry focuses on function and beauty with the values and the individual needs of the patient involving an attitude, artstic ability, intuition and technical competence. Esthetic dentistry can provide the beautiful smile that both parents and children desire. Dentists who care for children have the wonderful task and ability to create beautiful smile for these young patients. Many restorative options exist for treating primary anterior teeth. Finally the choice of restorative technique depends upon the operator preferences, esthetic demands by the parents and child's behaviour that affect the ultimate outcome of which ever restorative material chosen.

Limitations

The pedodontist has a wide array of esthetic crowns available for restoring primary anterior teeth. But majority of these crowns are manufactured only for maxillary primary anterior teeth. If full coronal restoration of mandibular incisors is desired, it requires the use of a maxillary lateral crown form, which regrettably, results in a very massive looking restored incisor. Other drawbacks of these crowns are that a few crowns are expensive and cannot be provided to the patients belonging to lower socioeconomic strata of the society. The beauty of the esthetic crown will depend on the clinician's knowledge, child's behavior, and retention of the crown and proper maintenance of the oral hygiene.

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