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Pediatric Crowns: From Stainless Steel to Zirconia

A Peer-Reviewed Publication
Written by Ian Shuman DDS, MAGD, AFAAID

Abstract

Although advances in preventative dentistry techniques; and community-fluoridated water as well as increased dental education have reduced the incidence of caries in children, early childhood caries is still highly prevalent in the U.S. and worldwide. When the carious lesion is too large to restore with a direct restoration, a preformed pediatric crown is indicated.

Educational Objectives

At the conclusion of this educational activity, participants will be able to:

1. Identify the clinical issues that require pediatric crowns;
2. Know the types of crowns available for primary teeth;
3. Describe the strategies for preparing full-coverage crowns for primary teeth;
4. Understand the methods used for cementation of primary crowns.

Author Profile

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Abstract

Although advances in preventative dentistry techniques; and community-fluoridated water as well as increased dental education have reduced the incidence of caries in children, early childhood caries is still highly prevalent in the U.S. and worldwide. When the carious lesion is too large to restore with a direct restoration, a preformed pediatric crown is indicated. Following the success of zirconia for adult teeth, primary teeth can now be restored with this material.

Introduction

In the past, extraction was the primary course of treatment for extensively decayed primary teeth. However, with the ability to save primary teeth with large carious lesions, the pulpotomy; and restorations were modalities used. In addition, crowns were considered a viable alternative to extraction, and more importantly, were recognized as the best mediator in prevention of restorative failure when compared to direct restorations.[1]

Primary teeth have been effectively treated with crowns for developmental defects;[2] after pulpal therapy;[3] for fractured teeth;[4] for restoring "multisurface caries, and for patients at high caries risk,"[5] in teeth where a direct restoration (i.e., amalgam, glass ionomer, composite) is likely to fail;[6] for teeth with extensive wear;[7] and as abutments for space maintainers[8] among others.

Over the past eighty years, crowns for primary teeth have undergone generational advancements, including design, materials, and cement formulations. Improvements in materials science along with innovations in manufacturing processes and dental materials have provided a variety of dental crowns available, fabricated from different materials that allow for a more esthetic restoration.[9]

Dentists today use five main types of pediatric crowns: stainless steel, composite strip, polycarbonate, resin-veneered, and zirconia ceramic. Each of these crown types has advantages and disadvantages that dictate its suitability for different applications. **(Table 1)** Some of the most important factors considered by dentists when choosing a crown type are durability, esthetics, retentiveness, adaptability, placement time, allergenicity, and cost.

Stainless Steel Crowns

Initial success with pediatric full-coverage restorations occurred in the 1950s with the use of stainless steel crowns. **(Figure 1)** Engel first described the use of these preformed metal crowns for primary molar teeth followed by Humphrey.[10,11] These early crowns, composed of nickel-chromium, could cause a variety of "oral clinical signs and symptoms that can include a burning sensation, gingival hyperplasia, labial desquamation, angular cheilitis, erythema multiforme, periodontitis, stomatitis with mild to severe erythema, papular perioral rash, loss of taste or metallic taste, numbness, and soreness at the side of the tongue."[12]

Due to its allergenic potential, nickel affects 10% of the general population.[13,14] Feasby et al. reported an increased nickel-positive patch test result in children 8 to 12 years of age who had received old formulation nickel-chromium crowns.[15] This is no longer an issue since the current metal composition of stainless steel crowns contains a blend of metals that includes iron, carbon, chromium and 9%-12% nickel, "similar to that of many orthodontic bands and wires."[16]

A study by Kulkarni et al. evaluated the release of nickel and chromium from dental fixed appliances such as space maintainers and stainless steel crowns. Their findings revealed that the release of nickel and chromium was well below the average dietary intake (200-300 ppm/day) and were

Table 1: Advantages and Disadvantages of Various Pediatric Crowns

Stainless steel	Composite strip	Polycarbonate	Resin-veneered	Zirconia
Durable Retentive Low cost Easy to trim and contour Adaptable to occlusion Fast placement time Insensitive to hemorrhage or moisture	Excellent esthetics Moderate cost	Improved esthetics Low cost	Good esthetics Insensitive to hemorrhage or moisture	Exceptional durability Excellent esthetics
Poor esthetics Potential allergenicity and other oral/extraoral signs and symptoms	Technique-sensitive Low durability Requires adequate hemorrhage and moisture control	Technique-sensitive Requires adequate hemorrhage and moisture control	Higher cost Limited trimming or crimping of crown Potential allergenicity	High cost Inability to contour Increased operatory time for placement

thus incapable of causing any toxic effects.[17] Therefore, it is important to advise parents that the stainless steel crowns used today have an extremely low potential for causing any untoward reactions.

These crowns are also known to be durable. A study by Prabhakar et al. assessed the ability of stainless steel crowns to withstand compressive, shearing, and torsional stresses in-vitro.[18] They concluded, "Even at maximal physiologic masticatory force levels, a grossly destructed tooth restored with SSC is able to resist deformation." However, like all crowns, specific protocols must be followed, specifically with respect to margins. If at all possible, the margins should end on healthy tooth structure and not restorative materials as this can contribute to microleakage and failure. An in vitro study by Memarpour et al. evaluated the marginal adaptation and integrity of stainless steel crowns "specifically fitted so that the crown margins overlaid the restorative materials..."[19] When compared to other restorative materials, amalgam and glass ionomer demonstrated the least microleakage. These findings have been substantiated by other studies as well.[20,21]

Figure 1: Stainless steel crowns

Perhaps the greatest problem with stainless steel crowns is their poor esthetics. This limits their use to primary first and second molars (as well as canines in some cases). However, even if restoring posterior primary teeth, many parents still refuse this restoration due to its poor esthetic value. Children who have stainless steel crowns may be teased, and parents may request restorations that are esthetic in order to prevent negative self-esteem issues from arising. According to Damon and others, "One of the most important goals of providing oral health care for these children is to maximize their psychological development. Oral disfigurement can negatively alter normal development, leading to emotional and behavioral difficulties that typically result in diminished self-esteem."[22, 23,24] Venkataraghavan et al. went on to describe in stronger terms the encompassing nature of primary teeth that, besides being attractive, are also "indicative of nutritional health, self-esteem, hygienic pride, and economic status."[25]

Composite Strip Crowns

Also known as celluloid crown forms, composite strip crowns are transparent, hollow, plastic crowns that are filled with composite resin and placed over the prepared tooth. **(Figure 2)** Excess resin is removed, and the composite resin bulk is cured through the clear crown matrix. Once fully cured, the form is stripped away from the composite resin leaving a directly bonded composite crown. One of the earlier mentions of this technique was by Webber et al. who, in 1979, described the restoration of primary anterior teeth using a celluloid crown form and composite resin.[26] This technique is often used to restore highly carious and/or fractured anterior primary teeth. A key advantage is decreased chair time when compared to other techniques.

Figure 2: Composite strip crowns

Another option to restoring carious and fractured anterior primary teeth is achieved by virtue of layering the composite resin as described by Eden and Taviloğlu.[27] A composite resin core is built up in successively cured layers. The final layer is created using composite resin and the strip crown form. This prevents uncured composite that may occur using a bulk-fill technique as described earlier. It also avoids excessive shrinkage and the stresses that might otherwise occur with the bulk-fill technique. Although these materials provide an esthetic restoration, they are also susceptible to fracture. Because the hardening composite inside composite strip crown forms must adhere to dentin and enamel, their placement is sensitive to hemorrhage and moisture.

Polycarbonate Crowns

Polycarbonate crowns are prefabricated shells formed from acrylic or polycarbonate resin. **(Figure 3)** Described by Miller in 1973,[28] they are available in a variety of sizes and are lined with acrylic or composite resin. Once cured and trimmed, the polycarbonate crown is cemented to the prepared tooth. These chairside-fabricated crowns provide an esthetic, tooth-colored restoration at a low cost. Polycarbonate crowns come in one universal shade, which can be modified with cements and liners. Their durability varies between different applications, but they are most often used as temporary restorations. Hickel and Krämer emphasized the importance of restoring damaged primary anterior teeth with (among others) polycarbonate crowns for phonetic reasons.[29]

Figure 3: Polycarbonate crowns

Perhaps the most common problem with this technique is not the crown itself but the cementation process used to lute the crown to the prepared primary tooth. Various methods have been suggested for improving adhesion. A study by Wiggins et al. evaluated the tensile strength relative to preparation design using retentive grooves.[30] Results showed that it was not grooves that improved retention but the type of cement used, specifically zinc phosphate cements. Tsamtsouris et al. verified this in 1977.[31] However, with modern luting cements, resin adhesion can certainly improve the longevity of polycarbonate crown adhesion.

Pre-Veneered Stainless Steel Crowns

Resin-veneered stainless steel crowns combine the durability of a stainless steel crown with the esthetics of a resin facing. **(Figure 4).** These crowns are available for both posterior and anterior primary teeth and have been described in the literature for the restoration of deciduous teeth.[1] These crowns are available from various manufacturers (e.g., Cheng Crowns, NuSmile, and Kinder Krowns). The primary issues with these crowns are the need to reduce additional coronal tooth structure, limitations in the ability to crimp the margins prior to cementation, and loss of the esthetic acrylic facing, among others.

A study by Lopez-Loverich et al. sought to evaluate the retention of stainless steel crowns vs. preveneered crowns on primary anterior teeth.[32] They concluded that there was "good crown retention rates for both crown types with no statistically significant difference between them." O'Connell et al. evaluated the clinical performance of two brands of stainless steel veneered molar crowns after three years (NuSmile crowns and Kinder Krowns). The study found that the primary problem with resin-veneered crowns used in posterior primary molars was facing fracture.[33] In addition, when the adjacent tooth was missing, fracture was more likely to occur, possibly due to the increased force of occlusion on the veneered crown. In this study, facing fracture or partial/complete loss of the facing happened in 47% of crowns; however, it had "minimal impact on parental satisfaction in the majority of cases." With this in mind, part of the informed consent should include awareness to the potential for loss of the veneer over time.

Figure 4: Resin-veneered crowns

As with all veneered stainless steel crowns, they are less sensitive to hemorrhage and moisture during placement. However, their limited crimpability requires greater removal of tooth structure. Resin-veneered crowns are typically more expensive than stainless steel, composite strip, and polycarbonate crowns. Nevertheless, when considering the reduction in chair time coupled with the ease of cementing a stainless steel substructure all while achieving instant esthetics, this crown is often a convenient choice for many clinicians.

Zirconia Crowns

Zirconium oxide has been used for medical purposes since the late 1960s.[34] Its earliest use was for orthopedic application as a new material for femoral head replacement in hip surgery. Prior to the advent of zirconia, traditional materials included titanium or alumina. In 2001, Suttor et al. proposed the use of presintered, all-ceramic zirconia-oxide for crown and bridge frameworks.[35] The machined zirconia was overlaid with veneer ceramic, thus creating one of the earliest zirconia-ceramic restorations. After many generations and incarnations of zirconia restorations, all-zirconia has been available as a reliable and esthetic alternative to traditional porcelain-to-metal and porcelain-to-zirconia crowns and bridges. One of the most exciting areas of this restorative revolution is the use of zirconia in pediatric crowns. **(Figure 5)**

Figure 5: Zirconia ceramic crowns

The form of zirconia used in dental crowns is yttria stabilized zirconia (YSZ). **(Table 2)**[36] The crystal structure of YSZ is a ceramic of zirconium dioxide made stable at room temperature by the addition of yttrium oxide.[37] By replacing some of the zirconia ions in the zirconia lattice with yttria ions, hardness and chemical inertness are improved. This technique gives YSZ a feature known as transformation toughening. This trait offers the highest flexural strength of all zirconia-based materials, allowing it to resist crack propagation. Additional benefits of YSZ are the ability to replace metals due to extremely high strength and toughness, higher resistance to chemicals, and superior erosion resistance. YSZ is biocompatible, autoclavable, and equal to, or more durable, than natural enamel. These properties among others have been studied, and numerous findings conclude that zirconia is an excellent material of choice for full-coverage restorations in pediatric patients.

Clinically, prefabricated zirconia crowns for primary teeth are handled differently than stainless steel crowns. Because they cannot be crimped, zirconia crowns must be prefabri-

cated with specific attributes. Evaluating one type of pediatric zirconia crown (Cheng Crowns) offers insight into these unique features. These crowns are precision milled from monolithic YSZ in the laboratory by computer-aided design and manufacture. Using YSZ with the proper sintering process offers high flexural strength and natural translucency. In addition, when manufactured in this way, the core can eliminate dentin show-through, thus avoiding the "dark stump" phenomenon. These crowns have slim facial contours, thin walls, and low mesio-distal arches. These qualities not only give the crowns exceptional beauty, but are also designed to minimize tooth preparation and ensure a perfect fit. This exclusive crown design, together with proprietary finishing processes, makes these pediatric zirconia crowns highly esthetic and functional.

Table 2

Prime Features of Yttria-Stabilized Zirconia (YSZ)	
Very high mechanical strength	Very low thermal conductivity
High impact resistance	High chemical resistance (acids/bases)
Very high wear resistance	High corrosion resistance
Very high erosion resistance	

Zirconia Crowns and Fracture Resistance

A study by Townsend et al. evaluated the fracture resistance of commercially available zirconia crowns vs. the fracture resistance of preveneered stainless steel crowns for primary molars.[38] They found that the increase in force required to fracture a zirconia crown directly correlated with crown thickness.

Zirconia Crowns and Opposing Tooth Wear

Zirconia is known for its low wear on opposing dentition. Unlike traditional ceramic, the wear rate of zirconia against opposing teeth is minimal. In an in vitro study by Choi et al., the wear against antagonistic primary teeth was evaluated. A variety of full-coverage restorative materials were compared including all-ceramic zirconia, lithium disilicate glass-ceramic, leucite glass-ceramic, and stainless steel crowns.[39] Results showed that the groups with the highest wear rates were leucite followed by lithium. Zirconia and steel groups demonstrated the lowest wear rates.

Zirconia Crowns and Clinical Uses

Zirconia restorations have been used in many common and unique clinical cases. When restoring highly carious anterior deciduous teeth, zirconia crowns can offer an excellent alternative to other pediatric restorative options. Over a 30-month period, Ashima et al. reported on the success of prefabricated zirconia crowns for "grossly decayed maxillary primary incisors."[40] They found that the crowns exhibited "good retention and esthetic results…and represented a promising alternative for rehabilitation of decayed primary teeth."

Beside the routine treatment of carious primary teeth, zirconia crowns have been used to treat conditions such as amelogenesis imperfecta. A clinical report by Duprez et al. evaluated the prosthetic rehabilitation of a patient diagnosed with hypocalcified amelogenesis imperfecta with an anterior open bite.[41] Following oral surgery to correct an open bite, 28 zirconia-based ceramic single crowns were used to restore both esthetics and function. The total treatment spanned a period of eight years and a two-year follow-up revealed "satisfactory results and no deterioration in the restorations."

Zirconia Crowns and Parental Satisfaction

An important factor when selecting pediatric crowns is the "triangle of agreement."[42] This concept implies that the clinician, parent, and child (when able) should decide together the best course of treatment when placing full-coverage crowns on primary teeth. More often than not, both parents and children do care about the esthetics of their teeth and in today's cosmetically conscious society, this plays an important role. Thus there is a need for crowns that correct the primary tooth back to a healthy state in both function and appearance.

Following the restoration of 57 anterior primary zirconia crowns in 18 children, Holsinger et al. led a retrospective analysis of clinical success and parental satisfaction.[43] Criteria evaluated included "retention, gingival health, color match, contour, marginal integrity, and opposing tooth wear." Parents were highly satisfied by the size, color, and form of the crowns with 89% reporting, "They would highly recommend these crowns." This finding offers a unique insight in that it may actually increase referrals.

Another area of interest is the opinion of the pediatric patient and their ability to consider the esthetic options available for restoring primary teeth. Testing 20 children aged 5-8 years (who were seeking dental treatment) and their parents, Pani et al. used a questionnaire and pictures of carious lesions and their treatment.[44] They found that the children were able "to make informed decisions regarding esthetic restorations and that there was no difference between the responses of the children and their parents on most points. Zirconia crowns appeared to be the most acceptable full-coverage restoration for primary anterior teeth among both children and their parents."

Pediatric Zirconia Crowns: Clinical Technique

The patient, an eight-year-old male presented for emergency examination with swelling of the upper right posterior gingiva. His mother noticed the lesion, and was surprised that the patient had not reported having pain. Examination revealed a carious lesion in tooth B, and buccal swelling of the attached gingiva. **(Figure 6)**

Figure 6

Figure 7

The tooth was not mobile and there were no other signs and symptoms. A radiograph revealed radiolucency in the coronal portion of the tooth into the pulpal area. **(Figure** 7**)** An adult premolar was present apical to the roots of this first primary molar. The tooth appeared to be restorable and a treatment plan was made for pulpectomy and zirconia crown. The patient was placed on clindamycin and reappointed three days later.

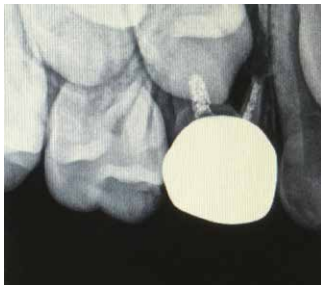
The tooth was anesthetized using lidocaine 1:100,000 x 1.8cc and a rubber dam placed over the tooth. Following caries removal, the coronal structure was prepared for a full-coverage restoration, and a pulpectomy was performed. The canals were obturated **(Figure 8)**, and the chamber filled with a glass ionomer restoration.

Figure 8

A zirconia crown (Cheng Crowns) was selected for fit and tried on the tooth. Once satisfied, the intaglio was cleaned by microetching with 50 um aluminum oxide. This was then rinsed, dried, and a silane-coupling agent placed on the bondable surface. The crown preparation was then rinsed, dried, and a dual-cure, self-etch primer/bond was applied to the tooth structure, dried, and light cured. A dual-cure resin cement was injected into the bondable crown surface and the zirconia crown cemented to the coronal prep. **(Figure 9)** Following excess resin cement removal, the occlusion was rechecked and the patient dismissed. The patient was seen for a two-week post-treatment follow-up and a radiograph taken.

Figure 9

Figure 10



Summary

Esthetic, full-coverage pediatric restorations are now available for both posterior and anterior primary teeth. In addition to their appearance, there are additional properties that are appealing on a variety of levels.

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Author Profile

Ian Shuman DDS, MAGD, AFAAID maintains a full-time general, reconstructive, and aesthetic dental practice in Pasadena, Maryland. Since 1995 Dr. Shuman has lectured and published on advanced, minimally invasive techniques. He has taught these procedures to thousands of dentists and developed many of the methods. Dr. Shuman has published numerous articles on topics including adhesive resin dentistry, minimally invasive restorative, cosmetic and implant dentistry. He is a Master of the Academy of General Dentistry, an Associate Fellow of the American Academy of Implant Dentistry, a Fellow of the Pierre Fauchard Academy. Dr. Shuman was named one of the Top Clinicians in Continuing Education since 2005, by Dentistry Today.

Author Disclosure

Ian Shuman DDS, MAGD, AFAAID has no commercial ties with the sponsors or the providers of the unrestricted educational grant for this course

Questions

1. Which of the following is indicated when the carious lesion is too large to restore with a direct restoration?
   a. Amalgam with pins
   b. Indirect onlay
   c. A preformed pediatric crown
   d. Cast-gold crown

2. Primary teeth have been effectively treated with crowns for which of the following?
   a. Developmental defects
   b. Fractured teeth
   c. Restoring multisurface caries and for patients at high caries risk
   d. All of the above

3. Primary teeth have been effectively treated with crowns for all but which of the following?
   a. After pulpal therapy
   b. In teeth where a direct restoration (i.e., amalgam, glass ionomer, composite) is likely to fail
   c. In teeth with minimal wear
   d. As abutments for space maintainers

4. Dentists today use which five main types of pediatric crowns?
   a. Stainless steel, mastique forms, polycarbonate, resin-veneered, and zirconia ceramic
   b. Stainless steel, composite strip, polycarbonate, resin-veneered, and feldspathic porcelain
   c. Stainless steel, composite strip, V-Ring matrices, resin-veneered, and zirconia ceramic
   d. Stainless steel, composite strip, polycarbonate, resin-veneered, and zirconia ceramic

5. Some of the most important factors considered by dentists when choosing a crown type are ___.
   a. durability
   b. ductility
   c. adaptability
   d. a and c

6. Initial success with pediatric full-coverage restorations occurred in the 1950s with the use of ___.
   a. zirconia
   b. stainless steel crowns
   c. type II gold
   d. none of the above

7. Who first described the use of these preformed metal crowns for primary molar teeth?
   a. Engel
   b. Engelhardt
   c. Englebert
   d. Vogel

8. Early preformed metal crowns were composed of ___.
   a. nickel-titanium
   b. chromium-cobalt
   c. nickel-chromium
   d. titanium dioxide

9. Due to its immunologic allergenicity, nickel affects what percentage of the general population?
   a. 20%
   b. 80%
   c. 10%
   d. 5%

10. The current metal composition of stainless steel crowns contains a blend of ___.
    a. iron, carbon, chromium
    b. chromium, cobalt, nickel
    c. radium, iron, titanium
    d. lead, cesium, neon

11. Similar to orthodontic bands and wires, modern stainless steel crowns contain ___.
    a. 10%-15% chromium
    b. 5% nickel
    c. 9%-12% nickel
    d. a and b

12. Perhaps the greatest problem with stainless steel crowns is their ___.
    a. poor esthetics
    b. inability to be crimped
    c. sensitivity to cementation
    d. all of the above

13. According to Damon and others, oral disfigurement can negatively alter normal development, leading to emotional and behavioral difficulties that typically result in diminished ___.
    a. mental capacity
    b. self-esteem
    c. social skills
    d. all of the above

14. According to Venkataraghavan, besides being attractive, primary teeth are also indicative of ___.
    a. nutritional health
    b. self-esteem
    c. economic status
    d. all of the above

15. Which of the following describes transparent, hollow plastic crowns that are filled with composite resin and placed over the prepared tooth?
    a. Celluloid crown forms
    b. Composite strip crowns
    c. Zirconia crowns
    d. a and b

16. What are the clinical steps described when using a strip crown?
    a. Composite is placed inside the strip crown; excess resin is left around the margins; the composite resin bulk is cured, and the form is stripped away.
    b. Composite is placed inside the strip crown; excess resin is removed; the composite resin bulk is cured, and the form is left in place.
    c. Composite is placed inside the strip crown; excess resin is removed; the composite resin bulk is partially cured, and the form is stripped away.
    d. Composite is placed inside the strip crown; excess resin is removed; the composite resin bulk is cured, and the form is stripped away.

17. Which of the following described the restoration of primary anterior teeth using a celluloid crown form and composite resin?
    a. Webber
    b. Foreman
    c. Kenmore
    d. Brinkman

18. What technique is often used to restore highly carious and/or fractured anterior primary teeth?
    a. Strip crown
    b. Teflon tape
    c. Lumineers
    d. Stainless steel crowns

19. Although the strip crown technique provides an esthetic restoration, they are also susceptible to ___.
    a. ductile deformation
    b. partial catastrophic failure
    c. fracture
    d. a and c

20. Because the hardening composite inside composite strip crown forms must adhere to dentin and enamel, their placement is sensitive to ___.
    a. dryness and high white cell count
    b. xerostomia and nicotinic stomatitis
    c. hemorrhage and moisture
    d. none of the above

21. Polycarbonate crowns are prefabricated shells formed from polycarbonate resin or ___.
    a. acrylic
    b. Teflon
    c. titanium
    d. a and b

Questions

22. Which of the following described polycarbonate crowns as available in a variety of sizes and lined with acrylic or composite resin?
    a. Murphy
    b. Carvey
    c. Miller
    d. Canter

23. Polycarbonate crowns are available in ___.
    a. transparent forms
    b. shades A1 and C4
    c. all Vita shades
    d. one universal shade

24. Who emphasized the importance of restoring damaged primary anterior teeth with (among others) polycarbonate crowns for phonetic reasons?
    a. Hickel and Krämer
    b. Seinfeld and Kramer
    c. Smith and Jones
    d. Cramer and Kramer

25. Which of the following are limitations with resin-veneered stainless steel crowns?
    a. The ability to crimp the margins prior to cementation
    b. Loss of the esthetic acrylic facing
    c. The need to reduce additional coronal tooth structure
    d. All of the above

26. A study by Lopez-Loverich et al. sought to evaluate the retention of stainless steel crowns vs. preveneered crowns on ___.
    a. primary posterior teeth
    b. mixed dentition
    c. primary anterior teeth
    d. third molars

27. The form of zirconia used in dental crowns is ___.
    a. yttria-stabilized zirconia
    b. yttrium aluminium garnet
    c. yttrium ziconia garnet
    d. yttrium aluminium zirconia

28. The crystal structure of YSZ is a ceramic of zirconium dioxide made stable at room temperature by an addition of ___.
    a. yttrium tetra-oxide
    b. yttrium aluminium garnet
    c. yttrium oxide
    d. neodymium-doped yttrium aluminium garnet

29. YSZ is able to replace metals due to its extremely ___.
    a. low strength and toughness
    b. high deformation
    c. high strength and toughness
    d. low ability to withstand occlusal forces

30. Which type of pediatric zirconia crown offers unique features including slim facial contours, thin walls, and low mesio-distal arches:
    a. Cheng Crowns
    b. Kinder Krowns
    c. Just Smiles Crowns
    d. Bruxinator Crowns

Notes

INSTANT EXAM CODE 15145

ANSWER SHEET

Pediatric Crowns: From Stainless Steel to Zirconia

Name: Title: Specialty:

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Educational Objectives

1. Identify the clinical issues that require pediatric crowns;
2. Know the types of crowns available for primary teeth;
3. Describe the strategies for preparing full-coverage crowns for primary teeth;
4. Understand the methods used for cementation of primary crowns.

Course Evaluation

1. Were the individual course objectives met?

Objective #1: Yes No Objective #2: Yes No

Objective #3: Yes No Objective #4: Yes No

Please evaluate this course by responding to the following statements, using a scale of Excellent = 5 to Poor = 0.

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5. How do you rate the author's grasp of the topic?	5	4	3	2	1	0
6. Please rate the instructor's effectiveness.	5	4	3	2	1	0
7. Was the overall administration of the course effective?	5	4	3	2	1	0
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9. Please rate the usefulness of the supplemental webliography.	5	4	3	2	1	0
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_____

13. Was there any subject matter you found confusing? Please describe.

_____

14. How long did it take you to complete this course?

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3.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	18.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
4.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	19.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
5.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	20.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
6.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	21.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
7.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	22.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
8.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	23.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
9.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	24.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
10.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	25.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
11.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	26.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
12.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	27.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
13.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	28.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
14.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	29.	Ⓐ	Ⓑ	Ⓒ	Ⓓ
15.	Ⓐ	Ⓑ	Ⓒ	Ⓓ	30.	Ⓐ	Ⓑ	Ⓒ	Ⓓ

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