

## **Zirconia Crown in Pediatric Dentistry - A Comprehensive Review of Literature**

<sup>1</sup>Dr. Niruket Yadav, Consultant Pedodontist, Kritanjali Dental Implant Centre, Bulandshahr.

<sup>2</sup>Dr. Prem Shankar Chauhan, Post Graduate Student, Department of Pediatric and Preventive Dentistry, Army College of Dental Sciences, Secunderabad.

<sup>3</sup>Dr. Khushboo Malhotra, MDS, Consultant Pediatric and Preventive Dentist, Ahmedabad, Gujarat.

<sup>4</sup>Dr. Gitika Singh, Post Graduate Student, Department of Pediatric and Preventive Dentistry, Army College of Dental Sciences, Secunderabad.

<sup>5</sup>Dr. Shivangi Chaudhary, M.D.S., Department of Pedodontics and Preventive Dentistry, Chandra Dental College & Hospital, Safedabad, Barabanki.

<sup>6</sup>Dr. Lubna, M.D.S., Department of Pedodontics and Preventive Dentistry, Chandra Dental College and Hospital, Safedabad, Barabanki.

**Corresponding Author:** Dr. Niruket Yadav, Consultant Pedodontist, Kritanjali Dental Implant Centre, Bulandshahr.

**How to citation this article:** Dr. Niruket Yadav, Dr. Prem Shankar Chauhan, Dr. Khushboo Malhotra, Dr. Gitika Singh, Dr. Shivangi Chaudhary, Dr. Lubna, “Zirconia Crown in Pediatric Dentistry - A Comprehensive Review of Literature”, IJMACR- July – August - 2022, Vol – 5, Issue - 4, P. No. 224 - 230.

**Copyright:** © 2022, Dr. Niruket Yadav, et al. This is an open access journal and article distributed under the terms of the creative commons attribution noncommercial License 4.0. Which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**Type of Publication:** Review Article

**Conflicts of Interest:** Nil

**Abstract:** Early childhood caries (ECC) is a protracted multifactorial disorder which continues to be dominant in children; Stainless steel crowns are one of the earliest crowns used in dentistry to restore teeth. The only disadvantage of SSC was its un-esthetic appearance. Due to an increasing in esthetic and concerns about toxic and allergic reactions to certain alloys, zirconia was proposed as a new ceramic material in the later part of 20th century. It has become a popular alternative to alumina as biomaterial and is being used in dental applications. The aim of present review of literature is to discuss various aspects of pediatric zirconia crown in detail.

**Keywords:** ECC, Zirconia crown, Pediatric patient

### **Introduction**

Infants and toddlers with caries experience have a high risk for subsequent caries in primary and permanent dentition as well. The consequence of early childhood caries results are destruction of primary maxillary incisors, which further effect the chewing efficiency, loss of height, development of tongue-thrusting and/or mouth-breathing, speech disturbances, and psychological behavioral complications. Therefore, integrity of the primary dentition should be preserved until they exfoliate normally.<sup>1</sup>

Deciduous teeth with two or more deteriorated surfaces should be replaced with complete coronal restoration.<sup>2</sup> The mutilated teeth can be restored with full coronal restoration in order to preserve the integrity of primary dentition until their natural exfoliation. Till date, various preformed crowns have been tried as full coronal restorations for both therapeutic and preventive treatment.<sup>2</sup>

Stainless steel crowns were the choice of full coronal restoration, as they were easily available as preformed, pre-trimmed and pre-contoured crowns with wide range of sizes and with proven clinical efficiency.<sup>3</sup> Stainless steel crowns, introduced by “Rocky Mountain” company were later improved by various manufacturers.<sup>4,5</sup>

Stainless steel crowns are pre-formed metal crowns that have shown significant clinical success and are considered a favorable restoration method for multiple surfaces and larger carious lesions on primary molars. Studies have evaluated the performance of stainless-steel crowns in comparison to other restoration methods and found that stainless steel crowns showed a higher lifespan and durability. The stainless-steel crowns have reasonable costs and are less technique sensitive during placement. Despite the favorable qualities mentioned above, stainless steel crowns have some drawbacks, including their poor esthetic appearance.<sup>6</sup>

In the present era, all children and their guardians are interested in the choice of restorations for caries damaged teeth, and the children’s esthetic desire and ratification of dental restorations by guardians has been increased. Dentists treating children with the primary anterior carious teeth often face parental supervision in the choice of full coronal dental restorations, and parents are becoming more engaged in professional decision than it’s ever been before.<sup>7,8</sup>

The technological advances in material science led to the evolution of preformed zirconia crowns for primary teeth, so as to fulfill the esthetic demands, at the same time promise good durability. Pediatric zirconia crowns were introduced by EZ-pedo and became commercially available in 2008. Later preformed zirconia crowns were popularized by companies like Nusmile, Kinder crowns, Cheng crowns, Signature crowns, and many more. These preformed crowns differed with respect to size, shape, shade, and pattern of retention component.<sup>9</sup> Thus, the aim of present review of literature is to discuss various aspects of pediatric zirconia crown in detail.

### **Zirconia Pediatric Crowns**

Prefabricated crowns have been widely used in pediatric dentistry for the last 50 years. 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.<sup>10</sup>

Zirconia crowns for primary teeth, so as to fulfill the esthetic demands, at the same time promise good durability. Zircon has been known as a gem since ancient times. The name zirconium comes from the Arabic “Zargun” (golden in color) which in turn comes from the two Persian words “Zar” (Gold) and “Gun” (Color).<sup>11</sup> Zirconia is a crystalline dioxide of zirconium. Zirconium oxide was first used for medical purposes in 1969 for orthopedic application. It was proposed as a new material for hip header placement instead of titanium or alumina prostheses. Zirconia crowns are known as “Ceramic Steel” as it provides strength close

to available metal crowns as well as colour similar to that of natural teeth.<sup>12</sup>

**Properties of Zirconia**

Table 1: Properties of Zirconia <sup>13,14</sup>	
Form	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. In dentistry, zirconia is used in the form of yttria-stabilized tetragonal polycrystal (Y-TZP), magnesia-partially stabilized zirconia, and zirconia-toughened alumina.
Density	Density 6.05 g/cm <sup>3</sup>
Hardness	Hardness 1200 HV
Bend strength	1200 MPa
Compressive strength	Compressive strength 2000 MPa
Fracture toughness	7- 10 MPam <sup>1/2</sup>
Young’s modulus	Young’s modulus 210 GPa
Thermal expansion coefficient	11x10 <sup>-6</sup> 1/K

**Zirconia pediatric crown brands available on the market**

Zirconia pediatric crown brands available on the market include Ez-Pedo, Nusmile ZR, and Kinder Crowns Zirconia (Table no. 2)

**EZ – Crown**

EZ-pedo company first developed monolithic zirconia pedo crowns as anterior and posterior crowns. Jeff Fisher and John Hansen did years of research with local dentists before founding all ceramic crown; EZ-Pedo Inc., in Loomis, California, in 2010. EZ-crowns got clearance from US Food and Drug Administration and clearance from FDA for use in 2009.

It comes with the patented retention technology “zir-lock” i.e., retentive grooves which extent all the way to the crown margins, preventing cement washout. It also prevents entry of harmful bacteria and moreover it provides two times more surface area for bonding. Additional retention is provided through blasting with Aluminum oxide.<sup>15</sup>



Figure 1: Zirlock inside the EZ crown

**Nu-Smile Zirconia**

It is made up of high-grade monolith Zr ceramic. It has increased durability with strength more than enamel. The translucency of Zr ceramic provides excellent esthetics and prevents the problem of dark tooth showing through pulp ally treated teeth. These are scientifically developed

using CT and digital scan of natural primary teeth. They have 0.2 mm margins and in two shades (light and extra light). There are 0-6 sizes for upper and lower canines whereas lower incisors have 1-4 universal sizes. In posteriors, there are 1-7 sizes. It is also provided with a Nu-smile try-in crown to check fitting prior to final cementation. This feature not only saves the clinician's chair side time but also eliminates extra steps and disinfection of the crown. Nusmile zirconia crowns have improved marginal adaption to the tooth and are smaller at the cervical crevice than the other brands.<sup>14,16</sup>

### Kids-e-Crown

These crowns are available in two kits i.e., anterior and posterior crown kit. The posterior crowns have inner flat occlusal table with uniform axial walls. There are micromechanical boxes for retention. The wall thickness is 0.3 mm and margins are 0.2 mm. The sizes for anterior crowns ranges from 0-5 and in posterior, there are five regular sizes 2-6 and three narrow sizes 3-5. The narrow sizes are mid-sizes with broader Bucco-lingual dimensions for proximal lesions and space loss cases. The labeling of the crowns is permanently embossed inside the crown.<sup>14</sup>

### Kinder crowns Zirconia

It is based on Nano technology, produces most consistent, high-quality zirconia. It has polished surface to reduce opposite enamel wear. It has internal retention system which locks the restoration after cementation. This retention bands also provide with additional surface area for bonding. Fine feathered margin of zirconia kinder crown makes the emergence profile for the crown as natural as possible. It is available in two sizes: Midsize and Regular size. Mid-sizes are designed for first and second primary molars to alleviate seating issues in situations when you are placing crowns back-

to-back or when your patients have experienced major space loss. The mid-sized crowns hold their Bucco-lingual width, and at the same time as the mesio-distal width has been reduced to allow for easier placement and positioning.<sup>14</sup>

Table 2: Zirconia pediatric crown brands available on the market	
Brand Name	Company
Nusmile Zirconia Crown	Nusmile Ltd.
Cheng Zirconia Pediatric crowns	Cheng Crowns
Kids E Crown	Kids E Dental
Signature Preformed Zirconia Crown	3M
Zirconia Kinder Crown	Kinder Crown

### Clinical Procedure

#### Anterior Crown Technique

**Crown selection:** Select appropriate size of crown by measuring mesiodistal width with vernier caliper or simple divider.

#### Tooth preparation

**Incisal reduction:** Reduce 1.5-2mm incisal Ly using donut shape bur following the incisal plane.

#### Supra-gingival reduction

Make a chamfer finish line of 0.5- 1 mm on all four sides of crown. Equi-gingival margins using chamfer bur. Supra-gingival reduction using a taper bur, remove the chamfer finish line going 1-2 mm sub-gingival making a feather edge or no finish line.

#### Check fit and bleeding control

Check for passive fit of selected crown. Control bleeding using pressure or hemostat. Clean the crown under tap water and with alcohol to remove blood and saliva.

## Posterior Crown technique

### Crown selection

It can be done by using mesio-distal dimension of the corresponding tooth with the help of divider. This is done by holding a crown up to their existing tooth or considered the mesio-distal dimension and selected the crown size to be used based on the original size of the tooth. Alternatively, a digital x-ray system that may pre-size the crown by taking measurements in software and match patient's interproximal width to the corresponding crown size.

### Occlusal preparation

Using the marginal ridge of the adjacent teeth as a reference point, 1.5–2 mm of occlusal reduction is performed. An adequate occlusal reduction is extremely important for the proper fit and placement of pediatric zirconia crowns. The final occlusal plane of the seated pediatric zirconia crown is determined by the amount of occlusal reduction. For occlusal reduction, it is recommended using a coarse grit wheel diamond bur (1.2 mm).

### Bucco-Lingual Reduction

Reduce Bucco-lingual wall approximately 1-1.5 mm using a flame-shaped diamond bur. During Bucco-lingual reduction, keep the bur parallel to the tooth. Keeping the bur parallel to the tooth ensures consistent reduction from the occlusal down to the gingival tissue.

### Interproximal Reduction

Inter-proximally 1mm is reduced using a flame shaped diamond bur, such as a 368 or 330 tapered carbide. During interproximal reduction, keep the bur parallel to the tooth and remain supra-gingival. This technique reduces the likelihood of contacting the pulp.

## Feather Margin

Using a flame-shaped diamond bur reduces sub-gingivally 1-2mm, ending with a feathered margin. Often there is a remaining band of tooth structure, just below the tissue - removing that tooth structure is the key to achieving a passive fit.

## Trial Fitting

The most important key to remember when placing Zirconia is that a passive fit is required. Zirconia are solid ceramic and do not flex. If the crown won't go into place without resistance, there is need to reduce more tooth structure. The appropriately sized crown will seat passively and sub-gingivally 1-2 mm and should not alter the gingival tissue.

## Cementation

The tooth and the crown are cleaned of all blood residues. Hemostasis of the gingiva is obtained via pressure applied with a finger. A resin cements or dual cure resin cements should be used for the cementation.

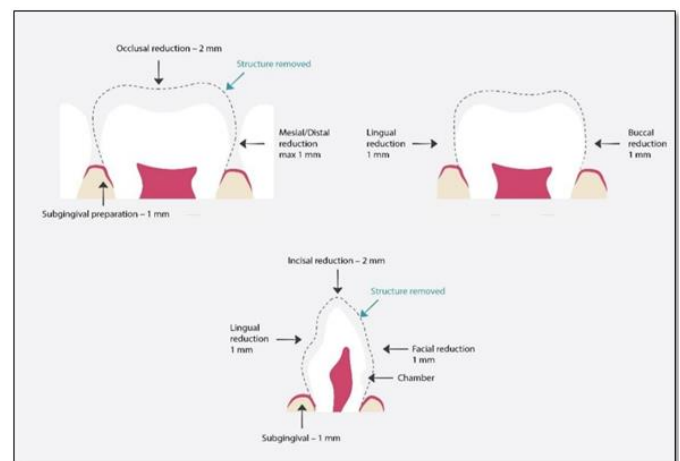


Figure 2: Tooth Preparation for Zirconia Pediatric Crown

## Indication of Pediatric Zirconia Crown<sup>17</sup>

1. Followed by pulp therapy procedures;
2. Restoration in non-carious lesions or development defects;
3. Restoration of fractured primary molars;

4. Fractured anterior teeth
5. Restoration in children who require general anesthesia treatment;
6. Discoloured primary teeth
7. Children with high-risk caries

#### **Advantage of Pediatric Zirconia Crown<sup>18</sup>**

1. Appealing esthetics
2. Fast application
3. Superior hardness compared with other crown materials.
4. Biocompatible
5. High abrasion resistance
6. Colour stable
7. Retain a high polish

#### **Disadvantage of Pediatric Zirconia Crown<sup>19,20</sup>**

1. These crowns cannot be crimped or contoured to fit a crown preparation. Similar to a pre-veneered crown, when placing a Zirconia crown, the preparation must be made to fit the crown rather than the crown fitting the prep.
2. Take a lot of trial and error in preparation.
3. These crowns must fit passively.
4. They cannot be forcefully pushed onto a tooth. This also means that the margins cannot be adjusted for a tighter cervical fit. Haemorrhage must be well controlled
5. Cost

#### **Conclusion**

Numerous alterations and newer aesthetic crowns have been accessible to overcome the drawbacks of stainless-steel crowns. Zirconia crowns in pediatric dentistry have gained maximum acceptance, out of any of the esthetic choices available, due to its excellent appearance and relatively high durability. Prefabricated zirconia crowns could be an easy, restorative option to traditional stainless steel and composite strip crowns due to their

unparalleled advantages. Zirconia crowns offer high end esthetics, superior durability, and easy placement compared to composite restorations and strip crowns.

#### **References**

1. Eshghi A, Kowsari-Isfahan R, Khoroushi M. Evaluation of three restorative techniques for primary anterior teeth with extensive carious lesions: a 1-year clinical study. *J Dent Child (Chic)*. 2013 ;80(2):80-7.
2. Bolaca A, Erdogan Y. In vitro evaluation of the wear of primary tooth enamel against different ceramic and composite resin materials. *Niger J Clin Pract* 2019; 22:313-9
3. Mendes FM, De Benedetto MS, Zardetto CG, et al. Resin composite restoration in primary anterior teeth using short-post technique and strip crowns: a case report. *Quintessence int*. 2004;35(9):689–692. 15470991
4. Messer LB, Levering NJ. The durability of primary molar restorations: II. Observations and predictions of success of stainless-steel crowns. *Pediatr Dent*. 1988 ;10 (02): 81–85.
5. Clinical AC. American Academy of Pediatric Dentistry. Guide line on pediatric restorative dentistry. *Pediatr Dent*. 2012; 34 (05): 173.
6. Alzanbaqi SD, Alogaiel RM, Alas Mari MA, Al Essa AM, Khogeer LN, Alanazi BS, Hawash ES, Shaikh AM, Ibrahim MS. Zirconia Crowns for Primary Teeth: A Systematic Review and Meta-Analyses. *Int J Environ Res Public Health*. 2022 Feb 28;19 (5):2838. doi: 10.3390/ijerph 19052838. PMID: 35270531; PMCID: PMC 8910015.
7. Khatri A. Esthetic zirconia crown in pedodontics. *Int J Pedod Rehabil* 2017;2(1):31–33.
8. Waggoner WF, Cohen H. Failure strength of four veneered primary stainless-steel crowns. *Pediatr Dent* 1995; 17:36–40.

9. Murali G, Mungara J, Vijayakumar P, T K, Kothimbakkam SSK, Akr SP. Clinical Evaluation of Pediatric Posterior Zirconia and Stainless-Steel Crowns: A Comparative Study. *Int J Clin Pediatr Dent*. 2022 Jan-Feb;15(1):9-14. doi: 10.5005/jp-journals-10005-2125. PMID: 35528490; PMCID: PMC9016913.
10. Innes, N.P.; Ricketts, D.; Chong, L.Y.; Keightley, A.J.; Lamont, T.; Santamaria, R.M. Prefomed crowns for decayed primary molar teeth. *Cochrane Database Syst. Rev.* 2015, 2015.
11. Piconi C, Maccauro G. Zirconia as a ceramic biomaterial: a review. *Biomaterials* 1999; 20: 1-25.
12. Helmer JD, Driskell TD. Research on bio ceramics. Symposium on use of ceramics as surgical implants. Clemson University, South Carolina: USA 1969.
13. Bica, C.; Pescaru, P.; Stefanescu, A.; Docan, M.O.; Martha, K.; Esian, D.; Cerghizan, D. Applicability of Zirconia-Prefabricated Crowns in Children with Primary Dentition. *Rev. Chim.* 2017, 68, 1940–1943.
14. Krishnamoorthy, S.H., Dr. Nikhil Das, K.R. and Dr. Vijaya Nath, S. “Zirconia in pediatric dentistry – a review”, 2021. *International Journal of Current Research*, 13, (04), 17136-17141
15. Babaji P. *Crowns in Pediatric Dentistry*. 1<sup>st</sup> ed. Jaypee Pub Ltd; 2015.
16. Cheng Appa MM D, Kannan A, Sharma D. Anterior and posterior crowns in primary dentition: A contemporary review. *Int J Oral Care Res* 2020; 8:83-7
17. Szytler K, Wiglusz RJ, Dobrzynski M. Review on Prefomed Crowns in Pediatric Dentistry-The Composition and Application. *Materials (Basel)*. 2022 Mar 11;15 (6): 2081. doi: 10. 3390/ ma15062081. PMID: 35329535; PMCID: PMC8950869.
18. Kiran S, Majeethia H, Jani M. A Precautionary Technique for the Accidental Ingestion of Prefomed Zirconia Crowns in Pediatric Dentistry. *J South Asian Assoc Pediatr Dent* 2021;4(1): 58–61
19. Arunima, Ahuja V. Gamut of tooth-coloured opportunities to reinstate the paediatric smile: A review. *J Dent Panacea* 2021;3(4):157-164.
20. Amrutha B. Tooth coloured crowns in pediatric dentistry: A Review. *Int J Curr Res*. 2019;11(5): 4098–104.