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BEYOND STAINLESS STEEL: THE NEW ERA OF ESTHETIC CROWNS IN CHILDREN

Dentistry

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ABSTRACT

Aim: To provide a comprehensive clinical and material-based overview of esthetic pediatric crowns, with a focus on recent innovations such as Kids-e-Crown®, BioFlx®, PedoCrown, and Propedo.**Materials and Methods:** An extensive literature review and material analysis were conducted, including studies published between 2015 and 2025. Clinical trials, in vitro studies, and systematic reviews were evaluated to assess the indications, preparation requirements, material properties, clinical performance, and limitations of these crown systems.**Results:** Zirconia crowns demonstrated superior esthetics, excellent biocompatibility, and high parental satisfaction, making them ideal for anterior and posterior esthetic rehabilitation. Newer alternatives like BioFlx® offer greater flexibility and ease of placement, particularly in uncooperative children. PedoCrown introduced a lightweight, repairable design suitable for high-wear scenarios like bruxism. Propedo crowns emerged as a high-strength, autoclavable zirconia option but require more extensive preparation.**Conclusion:** The evolution of pediatric crowns marks a transition toward materials and designs that prioritize not only durability and function but also esthetics and ease of use. With ongoing advancements, Clinicians now have more options to choose the right treatment for each patient. on clinical needs, child cooperation, and parental expectations.

KEYWORDS

Pediatric Crowns, Zirconia Crown, Esthetic Dentistry, Full-coverage Restoration.

INTRODUCTION

Dental caries remains a major global health burden, affecting nearly 70% of children and adults worldwide. Its multifactorial nature-rooted in the interaction between the host, oral environment, saliva, diet, and microbial activity-often results in early demineralization and eventual cavitation[1].

Early childhood caries (ECC) significantly impacts nutrition, sleep, school attendance, and the overall quality of life of both children and caregivers. Management strategies have shifted from traditional restorative approaches to minimally invasive, disease-modifying therapies, such as the use of silver diamine fluoride (SDF) to arrest caries progression[2]. However, when cavitation becomes extensive or structural integrity is compromised-particularly in children with added risk factors such as trauma, HIV infection, or chronic oral disease-full coronal coverage becomes essential.[3]

The increasing demand from both parents and young patients for aesthetically pleasing dental restorations has driven significant progress in the development and availability of prefabricated crowns for primary teeth [3].

Among pediatric dentists, the restoration of severely decayed or damaged deciduous teeth-while maintaining natural aesthetics-remains a complex clinical challenge. Over time, a variety of restorative techniques have been introduced, including strip crowns, stainless steel crowns (SSCs), polycarbonate crowns, acid-etched resin crowns, open-faced SSCs with chairside veneers, and commercially pre-veneered SSCs. Despite their utility, many of these options are associated with technical limitations, practical difficulties, or aesthetic shortcomings, limiting their widespread effectiveness in clinical practice [4].

Prefabricated zirconia crowns have emerged as a promising solution. These full-coverage restorations are fabricated from solid ceramic, offering superior aesthetics, excellent biocompatibility, and enhanced durability. As a result, zirconia crowns are becoming an increasingly preferred option for the aesthetic and functional rehabilitation of primary teeth [5,6].

DISCUSSION

The shift from stainless steel crowns to esthetic pediatric crowns is supported by multiple clinical, biological, and behavioral considerations relevant to modern pediatric dentistry. Human teeth, capable of withstanding forces up to 1000 N, require restorative materials that provide comparable durability while addressing parental expectations for natural esthetics-qualities achieved with zirconia and other tooth-colored crowns.[7] With nearly 60% of Indian children affected by dental caries, the demand for full-coverage restorations has increased, further emphasizing the need for restorations that balance strength and appearance.[8] Importantly, crown preparation in pediatric patients invariably requires the administration of local anesthesia, and therefore effective topical anesthesia becomes essential for obtaining cooperation. Since many children experience significant dental anxiety and fear of injections, studies comparing ice cones, clove oil, and lignocaine gel highlight their value in reducing pain perception and improving compliance during procedures such as tooth preparation for esthetic crowns. Because esthetic crowns often require more conservative tooth reduction and less chairside modification compared to stainless steel crowns, their use combined with effective topical anesthesia results in a smoother, less stressful experience for anxious children. [9] Biologically, the limited capacity of the pulp–dentin complex to tolerate inflammation further favors restorations that require minimal internal adjustment and preserve

pulpal health-advantages associated with the passive fit of zirconia crowns. Additionally, anesthetic challenges in inflamed teeth, such as the high failure rates seen in "hot teeth," underscore the importance of reducing procedure time and patient discomfort, both of which are facilitated by esthetic crowns.[10]

The preservation of primary dentition until natural exfoliation remains a fundamental principle in pediatric dentistry, supporting optimal function, comfort, and esthetics. Technological advancements, including the use of Electronic Apex Locators (EALs), have improved the precision of working length determination during pulpectomy, reducing radiation exposure and enhancing child cooperation[11] Zinc Oxide Eugenol (ZOE) continues to serve as the preferred obturating material due to its antibacterial efficacy, ease of use, and resorption pattern compatible with physiologic root resorption[12]. When additional coronal support is indicated, post systems provide enhanced retention while minimizing clinical time.[13]

The increasing demand for esthetic and durable restorations has driven the use of prefabricated esthetic crowns, particularly zirconia and resin-veneered stainless-steel crowns. These crowns exhibit superior esthetics, strength, and biocompatibility compared to conventional options. However, considerations such as antagonist wear, gingival response, and long-term biological behaviour remain essential for achieving predictable outcomes [14] Beyond the mechanical and biological aspects, esthetic rehabilitation significantly influences a child's psychological well-being, promoting positive self-image and social confidence.[15]

Collectively, the integration of esthetic crowns in pediatric dentistry represents an advancement toward holistic treatment-balancing biological integrity, functional performance, and psychological development in the growing child.

Table 1: Historical developments in pediatric crowns[16]

Year	Developments in pediatric crowns
1947	Preformed crowns (PMC) were introduced by Rocky Mountain company
1950	Stainless steel crown (SSC) was described by Engel and popularized by Willium Humphrey to Pediatric dentistry
1970	Polycarbonate crowns were introduced
1980	Pedo pearl crowns were introduced.
1983	Hartman recommended the veneered SSC technique for esthetic restoration of anterior crowns.
1987	Peter Cheng introduced Cheng crowns
1989	Kinder crowns were introduced
1997	PedoNatural crowns introduced
2010	EZ zirconia crowns were introduced by Hansen JP and Fisher JP as pediatric esthetic crowns.
2017	Kids-e-dental®, BioFlx crowns
2024	Pedo Crown, Propedo

INDICATIONS [16-18]

1. Children at high risk with anterior and/or posterior decay.
2. Children with extensive decay.
3. Large lesions or multiple surface lesions.
4. Pulpally treated teeth.
5. Involved incisal edge.
6. Extensive cervical caries.
7. Minimal caries but poor oral hygiene.
8. Difficult to control moisture due to child behaviour management problems.
9. Hypoplastic defects.
10. Significant tooth loss/fracture due to trauma.
11. Psychologic benefit.
12. Unesthetic incisors due to discoloration/intrinsic stain.

CONTRAINDICATIONS[16-18]

1. Non restorable teeth.
2. Teeth which can be restored by conventional means.
3. When there is inadequate spacing between teeth.
4. Crowding of anterior.
5. Deep impinging bite is present.
6. Severe bruxism.
7. When there is evidence of abrasion in the anterior teeth.

Table 2: Review of literature (2015–2025) on esthetic crowns in pediatric dentistry [18-24]

Author (Year)	Study Design	Sample Size/Age Group	Crown Type / Material	Outcomes Evaluated	Key Findings
Holsinger et al. (2015)	Retrospective cohort	n=53, 2–6 yrs	EZ-Pedo crown	Retention, gingival health, color match, marginal integrity	Zirconia crowns are clinically acceptable with high parental satisfaction
Al Shobber et al. (2017)	In vitro study	64 crowns (n=16 each group)	NuSmile ZR, Cheng zirconia	Fracture resistance	NuSmile zirconia had highest fracture resistance
Lin Jing et al. (2018)	In vitro study	75 extracted teeth (n=15/group)	EZ-Pedo	Crown height, cement failure	Increased prep height improves retention; most failures adhesive
Gayathri Murali et al. (2020)	Comparative study	29 children, 70 teeth, 3–9 yrs	Kinderkrown, KIDZ Crown	Retention, marginal integrity, wear, plaque, gingival health	Zirconia crowns performed well clinically; esthetic alternative to SSCs
Hamrah et al. (2021)	Systematic review	9 studies	Zirconia	Clinical, child and parental satisfaction	High satisfaction, but larger trials needed
Sumer Alaki et al. (2022)	RCT	32 children (120 teeth)	Zirconia, Strip crown	Gingival health, material loss	Zirconia showed better gingival health, less plaque
Ishani Rahate (2023)	Comparative study	72 teeth (n=24)	SSC, BioFlx, zirconia	Caries, plaque, restoration failure, gingival status	BioFlx is a viable esthetic, cost-effective option

Table 3: Currently available pediatric zirconia crowns[25-27]

Crown Name	Manufacturer	Material Composition	Preparation Requirements	Key Features	Limitations
NuSmile ZR®	NuSmile Ltd., USA	Zirconium oxide 88–96%, Yttrium oxide 4–6%	Incisal: 1.5–2.0 mm, Occlusal: 1.0–1.5 mm, Axial: 0.5–1.25 mm	Biochem cement, try-in crowns, available adjustment burs	Requires significant tooth reduction; relatively expensive
Cheng Crowns®	Peter Cheng Orthodontics, USA	Zirconium oxide 88–96%, Yttrium oxide 4–6%	Standard prep guidelines	Smart polish, crimp-lock margins	Limited shade options; rigid margins may challenge fit
Kinder Krowns®	Mayclin Dental Studio, USA	Zirconium oxide 88–96%, Yttrium oxide 4–6%	Incisal: 1 mm, Axial: 1 mm, Subgingival: 1–2 mm	Internal retention bands, prep kits available	May require adjustment for precise fit; higher cost
EZ Pedo®	EZ-Pedo Inc, USA	Zirconium oxide 88–96%, Yttrium oxide 4–6%	Occlusal: 1.5–2.0 mm, Axial: 0.5–1.0 mm	Zir-lock retention grooves, antifrictive coating	Requires use of specific bur kits; cannot be crimped or trimmed

Kids-e-Crown®	Kids-e-Dental LLP, India	Zirconia	Occlusal: 1.5–2 mm; Axial: 0.5–1 mm; Subgingival: 1–2 mm	Smart crown tech, minimal prep, micro-mechanical retention, laser-marked	Requires zirconia prep; less trim flexibility
BioFlx®	Kids-e-Dental LLP, India	Hybrid polymer resin	Occlusal: 1–1.5 mm; Proximal: 0.5 mm; Trimming optional with scissors; no crimping required	Flexible, no crimping, radiopaque, BPA-free	Less durable than zirconia
PedoCrown®	Pedo Crown Dental Pvt Ltd, India	Nano-ceramic composite resin	Occlusal: 1.5–2 mm; Buccal/Lingual: 1 mm; Proximal: 1 mm; Trimmable in all directions	Lightweight, customizable, repairable, orthodontic bonding	Chipping possible, not zirconia strength
ProPedo®	Not specified	Zirconia	Occlusal: 1.5–2 mm; Labial/Lingual: 0.5–1 mm; Chamfer margin: 0.5–1 mm; Subgingival: 2 mm	High flexural strength, biocompatible, autoclavable	Thicker crown, requires extensive prep, non-trimmable

Kids-e-Crown

Kids-e-Crown is a groundbreaking innovation and the world's first pre-formed smart pediatric zirconia crown developed specifically for children. Designed by a pediatric dentist with global professional input, it is a patented, research-backed product produced using high-precision technology to ensure superior quality and function. These crowns are anatomically correct and thinner than conventional options, allowing for more conservative tooth preparation. Their natural appearance, biocompatibility, and durability offer an optimal solution for restoring severely decayed primary teeth, thus improving both esthetic outcomes and parental satisfaction. A unique feature of Kids-e-Crown is the presence of **micro-mechanical locks** on the cementing surface, which enhances retention. The posterior crowns have a flat occlusal surface, simplifying crown preparation and adaptation, while the anterior crowns are designed universally to reduce inventory and confusion during placement. Laser markings and embossed identifiers further aid clinical handling. These zirconia crowns are suitable for cases requiring full coverage esthetic restoration, especially post-pulp therapy, and are compatible with glass ionomer cementation protocols.[28]

Kids-E-Crown™, an Indian-manufactured prefabricated zirconia crown, has emerged as an aesthetic and biocompatible alternative to stainless-steel crowns in pediatric dentistry. Clinical evaluations show that Kids-E-Crown™ provides excellent retention, good marginal integrity, and healthy gingival response, with minimal inflammation and no significant restoration failures during follow-up. Parents rated the crowns very highly for size, shape, and color, indicating strong aesthetic acceptance for anterior restorations [29].

In vitro investigations further support its reliability, demonstrating that Kids-E-Crown™ maintains stable color even after multiple autoclave sterilization cycles. Although slight L*, a*, and b* changes were observed, the overall ΔE values remained within clinically acceptable limits, confirming that repeated sterilization does not cause perceptible discoloration [30].

Collectively, the literature indicates that Kids-E-Crown™ is a durable, aesthetic, and clinically dependable zirconia crown system suitable for pediatric anterior teeth, offering a cost-effective and visually superior alternative to traditional restorative options.

BioFlx Crowns

BioFlx crowns, also developed by Kids-e-Dental LLP in India, represent a significant advancement in pediatric esthetic restorations due to their flexibility and adaptability, features not typically seen in traditional zirconia or stainless-steel crowns. These crowns are made from a high-impact, radio-opaque hybrid polymer resin, like materials used in robust medical equipment. This material selection ensures a balance of strength, esthetics, and resilience while being completely free of metals and bisphenol A derivatives. BioFlx crowns are monochromatic and designed to mask discoloration from arrested caries, thus enhancing their cosmetic value. The snug fit and self-adaptive nature reduce the need for extensive adjustments, making them especially beneficial in uncooperative children. Their sandblasted intaglio surface enhances bonding with self-setting resin-modified glass ionomer cement (RMGIC), and their radio-opacity aids in postoperative evaluation. These crowns do not require crimping and can be trimmed and contoured using dental scissors and Howe pliers, respectively. BioFlx crowns combine flexibility, esthetics, and ease of placement, positioning them as a viable alternative to SSCs in both anterior and posterior pediatric restorations.

Goswami et al. (2024) supported these findings through a three-case clinical series demonstrating successful restoration of primary molars using BioFlx crowns, with good retention, excellent esthetics, masking of SDF discoloration, and high parent–child satisfaction over a 6-month follow-up. The crowns also showed favorable occlusal self-adjustment and radiographic clarity of margins, reinforcing clinical practicality[31].

The most extensive evidence synthesis is provided by Al-Haj Ali (2025), who reviewed 18 studies including RCTs, in vitro analyses, and case reports. This review concluded that BioFlx crowns show intermediate fracture resistance, lower stress concentration on tooth structure, lower antagonist wear than zirconia, and high clinical success (92–98% retention), though SSCs still outperform them in retention. While color stability and surface roughness remain concerns, patient satisfaction consistently favors BioFlx due to superior esthetics and conservative preparation requirements[32].

Nagaveni et al. (2025) presented the first comprehensive narrative review describing the composition, design, indications, clinical steps, advantages, and limitations of BioFlx crowns, positioning them as a hybrid esthetic option combining the flexibility of stainless-steel crowns with the superior esthetics of zirconia. Their review emphasized minimal tooth preparation, high biocompatibility, ease of contouring, and self-adaptation, while identifying technique sensitivity and limited long-term studies as major gaps[33].

Pedo Crown

PedoCrown introduces a new generation of composite-based esthetic crowns for pediatric dentistry. Composed of high-strength composite resin enriched with nano-ceramic fillers (comprising over 50% of the structure), these crowns are designed to mimic natural tooth morphology and enamel translucency. Unlike conventional zirconia crowns, PedoCrown are significantly lighter (weighing less than 0.2 grams), offering superior comfort for pediatric patients. They are also highly customizable, allowing for trimming in all directions, which ensures a better clinical fit. A defining feature is their repairability-clinicians can easily repair chipped areas using composite resin, extending the crown's clinical life. Furthermore, they enable direct bonding of orthodontic appliances like brackets and buccal tubes, which is not possible with most esthetic crowns. PedoCrown are radiopaque, autoclavable, and can be used in a wide range of clinical scenarios such as after pulp therapy, in children with bruxism, for grossly carious or fractured teeth, and in developmental enamel defects. Their unique combination of affordability, repairability, and functionality makes them particularly attractive in resource-limited or high-volume pediatric practices.

Propedo Crowns

Propedo crowns are a recent addition to the esthetic pediatric crown market, introduced in 2025. Manufactured from high-grade zirconium dioxide, these crowns aim to offer a more economical alternative without compromising on esthetics or performance. Propedo crowns are particularly noted for their high flexural strength-double that of stainless steel-and strong resistance to fracture and corrosion. Their physical properties closely match those of natural teeth, with an elasticity like steel. These crowns are fully autoclavable, non-

magnetic, and provide excellent biocompatibility. Clinically, they are indicated for esthetic restorations in children, particularly in cases where patients have nickel allergies or require long-term coverage of restored teeth. However, their limitations include the need for significant tooth preparation due to crown thickness, and their inability to be trimmed or reshaped once fabricated. Contraindications include use in subgingival soft caries, crowded dentition, or in uncooperative children. Despite these limitations, ProPedo crowns offer a premium zirconia option for practitioners seeking high-quality, durable, and esthetic restorations in pediatric cases.

CONCLUSION

The evolution of esthetic pediatric crowns over the past decade illustrates a significant shift from traditional stainless-steel crowns to more biocompatible, esthetically superior, and functional alternatives. Each system-Kids-e-Crown, BioFlx, PedoCrown, and Propedo-addresses different clinical needs and resource settings. As material sciences and pediatric restorative philosophies continue to evolve, the ideal pediatric crown must offer not only durability and esthetics but also ease of use, safety, and adaptability to the unique anatomical and behavioural characteristics of children.

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