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BioFlx Crowns in Pediatric Dentistry: Current Evidence, Clinical Applications, Advantages, and Future Perspectives

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Abstract

Recent advancements have been made within pediatric restorative materials. BioFlx crowns are a relatively new addition to the range of prefabricated restorations available. This narrative review discusses the composition, physical properties, clinical handling, cementation, and clinical performance of the BioFlx crown. Emphasis will be placed on their flexibility, retention, strength, gingival response, patient acceptability, and comparison against other crown systems. The limitations of the literature and areas that require further research will also be discussed. By understanding more about these crowns, clinicians can be informed about whether they would be suitable for use and how they could be used to contribute to modern pediatric restorative dentistry.

Categories: Dentistry
Keywords: bioflx, early childhood caries, pediatric dentistry, preformed crowns, stainless steel crowns (sscs)

Introduction And Background

Maintaining primary teeth is an essential part of overall pediatric dental care. Primary teeth are crucial to maintaining the arch form and ensuring normal craniofacial growth. They allow for efficient mastication and contribute to speech development [1]. They also help guide the eruption of the permanent dentition. Therefore, early loss or extensive destruction can lead to abnormal occlusion, poor nutrition, speech difficulties, and can negatively impact the child's quality of life. As a result, current pediatric dentistry focuses on preventing dental disease and preserving teeth for as long as possible [2].

Early childhood caries (ECC) can cause significant destruction to the primary dentition. Trauma, developmental defects, and pulpal pathologies can also cause damage to teeth. Restorative treatments remain an appropriate treatment choice for small lesions. However, if they have significant multi-surface damage, insufficient tooth structure, or have had pulpal treatments, the predictability of restorative treatments can decrease. Full coverage restorations can therefore be considered [3,4].

Over recent years, there has been an increase in moving away from using restorations with a focus on strength to treatments that are a balance between strength and esthetics. Stainless steel crowns have historically been a reliable treatment due to their increased longevity, cost-effective nature, and ability to withstand forces within the primary dentition. However, the metal nature may cause esthetic issues, especially in the anterior region. With increased awareness of dental esthetics in children and parents, alternative restoration options have been developed. These include polycarbonate crowns, resin composite strip crowns, pre-veneered stainless-steel crowns, and zirconia crowns [5].

Despite a variety of esthetic restorations becoming available for children, choices must be made based on various factors. These include physical properties, clinical effectiveness, preparation, longevity, and patient acceptance. Therefore, it is important to consider new options such as the BioFlx crown. BioFlx crowns may be used as an esthetic alternative for restoring deciduous teeth. As they are made of polymers, they are flexible and adaptable. In addition, they are tooth-colored as opposed to stainless steel crowns, which makes them suitable as a full- coverage restoration for children. This can increase parental acceptance and improve children's satisfaction. Therefore, it is important to understand how clinically relevant they are by considering material properties, placement, retention, strength, biocompatibility, and clinical outcomes [6].

There has been an increase in interest around esthetic crown restorations; however, there is currently

limited information in the literature about BioFlx crowns. By critically analyzing information, we can determine what is known clinically, what the advantages of the materials are, and what areas require further research. This review will discuss the material properties, indications, placement, advantages, limitations, and evidence to support BioFlx crowns in pediatric dentistry. It will identify areas where research is lacking.

Review

A narrative literature search was carried out to find relevant publications on BioFlx crowns and their uses in pediatric dentistry. Searches were performed in the electronic databases PubMed/MEDLINE, Scopus, Embase, Web of Science, and Google Scholar, using combinations of the following keywords: “BioFlx crowns,” “Bioflex crowns,” “pediatric crowns,” “primary teeth,” “polymer crowns,” “esthetic crowns,” “flexible crowns,” “mechanical properties,” “fracture resistance,” “wear resistance,” “retention,” and “microleakage.” Search terms were combined using Boolean operators such as AND and OR. The inclusion criteria covered original research articles, in vitro studies, finite element analysis studies, clinical trials, randomized controlled trials, and relevant review articles dealing with the composition, mechanical properties, clinical performance, retention, wear resistance, marginal adaptation, and esthetic characteristics of BioFlx crowns and other pediatric restorative materials. Articles that discussed the clinical application of these crowns in primary teeth were also taken into account. Duplicate publications, studies not related to pediatric restorative dentistry, articles lacking relevant information, and publications with insufficient accessible data were excluded. Titles and abstracts were screened for relevance, and this was followed by a full-text assessment of potentially eligible articles. The reference lists of relevant publications were also reviewed to identify additional studies. The selected literature was critically reviewed and organized by material characteristics, biomechanical properties, clinical performance, advantages, limitations, and future perspectives. Since this was a narrative review, no formal risk-of-bias assessment or quantitative data synthesis was carried out.

Overview of the BioFlx crown

As the demand for esthetically pleasing and durable restorations in pediatric dentistry increases, new innovative preformed crowns have been developed. One such example is the BioFlx crown. This is a newer type of crown that uses a polymer material to restore the entire crown of the primary tooth. This crown has many advantages. It is designed to look like a natural tooth, but with added flexibility, strength, and adaptability. As it is metal-free and completely Bis-GMA (Bisphenol A-glycidyl Methacrylate) free, it can be sterilized and therefore is an alternative to existing crowns for pediatric patients. The idea behind this crown is to not only provide a convenient restoration, like stainless steel crowns (SSCs), but also provide an esthetically pleasing restoration [7].

The BioFlx crown is made from a flexible, hybrid, highly impact-resistant resin. The polymer in the crown means it can bend slightly on occlusion. These crowns have radiopaque properties. They also contain laser markings within them, as well as a sandblasted interior surface. In dental practice, polymers with a low elastic modulus and good tensile properties can have favourable biomechanical properties. This crown takes advantage of the properties that polymers have to create a flexible crown. A unique property of this crown is that it claims to be adaptable. When extra pressure is applied during occlusion, small dents can occur in certain areas of the crown. This allows the crown to adapt to the pressure from occlusion without causing traditional wear. Other features of this crown include radiopaque material so the crown margin can be seen on X-ray, laser-etched inner crown identification, and sand-blasted inner crown [6].

The crown has been developed by NuSmile Corporation, Houston, Texas, USA, and Kids-e-Dental LLP, Mumbai, India. It was first implemented in clinical practice in India in 2021 and was then introduced to the US in 2022. Both companies have followed the same key principles of creating a flexible crown that looks like a natural tooth. However, Kids-e-Dental offers anterior and posterior crowns for primary teeth, whereas NuSmile only offers posterior crowns. NuSmile crowns have been adapted to have different-sized crowns for certain primary molars. They offer smaller crowns for primary first molars. Both crowns follow the same sizing principles as stainless steel crowns [8,9].

Overall, BioFlx crowns are a new method for restoring the teeth of pediatric patients using polymer technology. They have been developed to create a good balance between durability, conservation, ease of use, and patient acceptance. Due to being a newer crown, more research needs to be done to determine how well they will stay in place, how resistant they are to breaking, how they behave during occlusion, how good the margins are, and how they will interact biologically (Table *1*).

Parameter	Description
Durability	Long-term durability not yet established
Cost-effectiveness	Moderate
Esthetic	Tooth-colored appearance
Risk of hypersensitivity	Expected to be low; clinical evidence is limited
Material composition	Flexible polymer-based material
Biocompatibility	Good
Caries Prevention	Good, with effective marginal adaptation and full coverage
Tooth Preparation Required	More than SSCs
Parental satisfaction	Generally favorable in available clinical studies
Indications	Hypoplastic or malformed primary teeth, extensive multi-surface caries, high esthetic demands, traumatized primary teeth, and post-pulpotomy/pulpectomy teeth
Contraindication	Bruxism or parafunctional habits, severe subgingival caries

TABLE 1: Clinical characteristics of the BioFlx crown

BioFlx, flexible polymer-based esthetic pediatric crown; SSCs, stainless steel crowns

BioFlx crown placement procedure

The placement of a BioFlx crown involves several clinical steps to ensure optimal adaptation, retention, and occlusion. Initially, the occlusal relationship should be evaluated before rubber dam placement. The mesiodistal width of the tooth should be measured, and the smallest crown that provides adequate proximal contacts should be selected. Local anesthesia may be administered as required, followed by uniform occlusal reduction of approximately 1.5-2 mm while maintaining the natural occlusal anatomy. A flame-shaped bur is used to reduce the buccal and lingual cusps, central groove, and marginal ridges. Proximal reduction is subsequently performed using a tapered fissure bur to eliminate mesial and distal contacts without damaging adjacent teeth or creating ledges. The proximal surfaces should exhibit slight convergence towards the occlusal aspect. Buccal and lingual convexities are then reduced to facilitate proper crown adaptation. All sharp edges and line angles should be rounded and smoothed before the final preparation assessment.

The selected BioFlx crown should be evaluated for proper adaptation without crimping, as excessive manipulation may compromise its structural integrity. Minor contour adjustments can be performed using Howe pliers. If the crown appears too small, the next larger size should be selected, or additional circumferential tooth reduction may be performed. Hyperocclusion should be corrected by checking for preparation ledges, inadequate occlusal reduction, or excessively tight proximal contacts. Excessive gingival blanching indicates that the crown may be too long or bulky. The crown should extend approximately 1 mm into the gingival sulcus, and any necessary trimming should be performed using scissors or a finishing stone. Other areas of the crown should not be adjusted or crimped.

During trial fitting, posterior crowns should initially be seated from the lingual towards the buccal aspect. The crown should remain securely seated without springing back, with its margins positioned approximately 0.5-1 mm sub-gingivally. A properly fitted crown should demonstrate slight resistance to dislodgment. Occlusal assessment is essential to ensure that the crown does not become the first point of contact during occlusion.

For cementation, the prepared tooth and internal surface of the crown should be thoroughly cleaned and dried, ensuring adequate control of saliva, blood, and gingival bleeding. Self-setting resin-modified glass ionomer cement (RMGIC) or glass ionomer cement (GIC) may be used for luting. The crown should be filled approximately two-thirds with cement to facilitate adequate cement distribution and minimize void formation. Following complete seating, excess cement should be removed, particularly from the interproximal areas using knotted dental floss. Finally, the occlusion and marginal adaptation should be

reassessed to ensure optimal clinical outcomes [6,10,11].

Clinical performance and evaluation of BioFlx crowns

Mechanical Properties and Biomechanical Performance

BioFlx crowns have been tested using finite element analysis) and mechanical testing techniques. A study by Lath et al.(2024) showed BioFlx crowns performed best in terms of maximum axial stresses when loaded under simulated occlusal forces of 245 N (newton). BioFlx showed the lowest stress value (14,009 megapascals (MPa)) compared to SSCs (39.331 MPa) and zirconia crowns (40.91 MPa). While the results showed differences in stresses depending on the loading direction, they also showed that the angle of loading had a larger effect on the deformation than the material composition of the crown [12]. Another study by Deolikar et al. (2024) showed that BioFlx crowns had lower Von Mises stresses in the crown and dentin at varying angles of loading as compared to zirconia. However, deformation was higher in BioFlx crowns [13].

Singh et al. (2025) performed testing on BioFlx and SSCs with different luting cements. They looked at the shear bond strengths of conventional GIC and RMGIC. The highest bond strength was seen in SSCs using RMGIC (0.908 ± 0.20 MPa), while BioFlx showed much lower values using GIC (0.506 ± 0.25 MPa) and RMGIC (0.362 ± 0.21 MPa). This suggests that the choice of luting cement may affect the BioFlx crowns' retention [14].

Overall, the studies show BioFlx crowns have favorable stress distribution and biomechanics. However, they did show greater deformation than zirconia crowns, which should be looked into further. Cyclic fatigue testing, fracture resistance, long-term clinical performance, and retention should be tested. Most of the studies are lab-based and computational, so further work is needed to show the clinical relevance.

Wear Resistance and Fracture Strength of BioFlx Crowns

The mechanical behaviour of BioFlx crowns, such as wear resistance and fracture strength, was compared to stainless steel and zirconia crowns. A study by Ateşçi et al. (2026) revealed that zirconia crowns exhibited the lowest wear scores, followed by the SSCs, and then BioFlx crowns, whereas the highest mean fracture load was observed with BioFlx crowns (3148.4 ± 643.4 N), followed by the SSCs (2703.4 ± 243.1 N) with no significant difference between the groups. Hence, it appears that BioFlx crowns demonstrate good fracture resistance; however, wear resistance performance may depend on the protocol used and comparator material [15].

The wear properties, surface properties, and color changes of BioFlx and zirconia crowns after thermomechanical aging were investigated by Abdou et al. (2025). Results showed that BioFlx crowns had an increased volume loss when compared to zirconia crowns (0.095 ± 0.091 and 0.039 ± 0.046). This indicated that BioFlx crowns have a lesser wear resistance. However, BioFlx crowns resulted in a significantly lower amount of antagonist tooth wear when compared to zirconia crowns (0.095 ± 0.091 and 0.534 ± 0.163). The crowns made from BioFlx also had significantly increased surface roughness when compared to zirconia crowns (1.148 ± 0.832 and 0.185 ± 0.17). There was no significant difference in color change. This suggests BioFlx crowns may have increased wear but improved surface roughness, which could make them more beneficial for reducing antagonist tooth wear [16].

Clinical Performance and Parental Acceptance

Clinical studies have shown promising results with BioFlx crowns on primary molars. In a 12-month split-mouth randomized controlled trial with 40 children, Singh et al. (2025) reported 92% clinical success rates for BioFlx crowns and 95% for stainless steel crowns. Esthetic satisfaction was significantly higher for BioFlx crowns ($p < 0.01$) than for stainless steel crowns. Retention and marginal integrity were slightly better in the stainless steel crowns. Gingival health showed no significant difference between the groups [17]. Similarly, a prospective clinical trial carried out by Abudawood et al. on 28 patients and 71 BioFlx crowns showed good short-term clinical outcomes, with 98.4% of crowns retained, 91.8% being stain-free, and 93.4 having ideal marginal integrity after six months. Patients and parents were very satisfied with the esthetics, scoring 9.8 (± 0.4) and 9.5 (± 0.8) on average. Surface depressions were seen in 59% of crowns and occasional perforation occurred in 4.9%. Overall, BioFlx crowns have shown good short-term clinical outcomes and high esthetic acceptance. Further work is needed to compare crowns over the longer term [18].

Retention of the BioFlx Crown

Al Mawash et al. evaluated the retention strength of BioFlx crowns and SSCs cemented on resin dies with different luting agents, including GIC, RMGIC, self-adhesive resin cement, and polycarboxylate cement. The results showed that the retention strength of SSCs was significantly higher than BioFlx crowns in most groups of the tested cements. However, for self-adhesive resin cement, BioFlx crowns exhibited better retention strength (657.72 ± 20.60 N) compared to SSCs (560.29 ± 8.74 N). The findings of this study suggest

that the retention of BioFlx crowns may be influenced by the selection of luting cement, highlighting the significance of choosing a suitable cementation protocol [19].

Microleakage of BioFlx Crowns

Microleakage is an important factor that influences the clinical longevity of crowns, because leakage at the tooth-cement-crown interface can lead to secondary caries, pulpal irritation, and restoration failure. In this context, Baldawa and Ramakrishnan (2025) evaluated the microleakage of BioFlx crowns cemented with GIC and RMGIC. 42 extracted human mandibular second molars were randomly divided into two groups and thermocycled. Then they were immersed in 2% methylene blue dye for 24 hours. Micro-leakage assessment was undertaken using a stereomicroscope (10X). The results showed there was significantly less microleakage in the RMGIC group when compared to the conventional GIC group. It was shown that there was less area and volume of dye penetration in the RMGIC group. It would appear that RMGIC provides a superior marginal seal and could be a more appropriate luting agent for BioFlx crowns [20].

Gingival and Periodontal Response

A split-mouth study was conducted by Metwally NM et al. on 20 children to compare the periodontal effects of BioFlx and stainless-steel crowns. After seven days, significantly less IL-1β was found in the gingival crevicular fluid for BioFlx crowns; however, periodontal health after 90 days showed no significant differences in results. The plaque index and gingival index were very similar between the two techniques [9]. In another study conducted by Shaji et al. on 20 children, BioFlx crowns were reported to have higher patient satisfaction, improved esthetics, and reduced chair time compared to stainless steel crowns. Conversely, stainless steel crowns had significantly better retention, control of plaque, and healthy gingiva. It appears BioFlx crowns provide an esthetically pleasing restoration with good periodontal compatibility in the short term. However, long-term studies are required to determine the periodontal response of these restorations and how long they will last clinically [21].

Comparative characteristics of pediatric crowns

In pediatric dentistry, the full-coverage crowns used most often are stainless steel crowns, zirconia crowns, and BioFlx crowns. These restorations vary in material, esthetic qualities, clinical indications, preparation needs, and mechanical properties. Stainless steel crowns have long been regarded as the standard choice for restoring primary teeth that are extensively decayed or structurally compromised, owing to their durability, cost-effectiveness, and ease of placement. Zirconia crowns provide superior esthetics, excellent biocompatibility, and high strength, which makes them an increasingly popular alternative to conventional metal crowns. Mechanical characteristics, retention, and clinical performance will affect which choice is most appropriate in certain clinical situations. The main differences between them can be seen in Table *2*.

Parameters	Stainless Steel Crown	Zirconia Crown	BioFlx Crown
Material	Stainless steel alloy	Zirconium dioxide ceramic	Flexible, polymer-based material
Appearance	Metallic, silver-colored	Tooth-colored,	Tooth-colored
Patient acceptance	Low	High	High
Tooth preparation	Relatively conservative;	More extensive occlusal and circumferential tooth reduction	Moderate
Cost	Economical	Expensive	Expensive
Biocompatibility	Generally good; may contain nickel	Excellent; highly biocompatible	Generally good; metal-free and Bis-GMA-free
Risk of hypersensitivity	Possible in patients with nickel or other metal sensitivities	Very low due to metal-free composition	Expected to be low due to metal-free composition; long-term evidence is limited
Major advantages	High durability, excellent retention, cost-effectiveness, and established clinical success	Excellent esthetics, biocompatibility, and smooth surface	Excellent esthetics, flexibility, adaptability, and metal-free composition
Ease of placement	Relatively easy; can be contoured and crimped	Technique-sensitive; requires precise tooth preparation and cannot be crimped	Flexible and adaptable, facilitating crown placement

TABLE 2: Comparative characteristics of pediatric crowns

BioFlx – Flexible polymer-based esthetic pediatric crown; Bis-GMA – Bisphenol A-glycidyl methacrylate

Advantages and limitations of BioFlx crowns

BioFlx crowns provide many benefits, including flexibility, light weight, increased comfort, and great esthetics. As they are biocompatible and do not contain any metals, there is less risk of causing hypersensitivity. The flexibility also makes the crown easier to adapt to the teeth. Nevertheless, their expense and restricted availability could limit how widely they are used. In addition, clinical evidence on their long-term durability, retention, and wear resistance is still limited. Even though BioFlx crowns have a tooth-colored look, their esthetic results might not equal those of zirconia crowns, which provide a glossy, translucent, enamel-like finish.

Future perspectives

Future research should focus on large randomized, multi-centre trials with long-term follow-up. This should focus on investigating crown retention, marginal fit, wear, fracture strength, occlusion, and soft-tissue response. Further research into how different luting agents affect crowns and how they behave under various oral conditions could help produce standard cementation protocols. Research into improving polymer composition and surface features could improve the mechanical and clinical properties. Cost-effectiveness and patient-reported outcomes should also be considered.

Conclusions

The BioFlx crowns offer a novel restorative choice for primary teeth. Clinical and laboratory results show positive results with regard to crown retention, fracture resistance, and patient satisfaction. However, there were variations in wear, surface features, and crown retention based on the cement used. Although they can prove to be a useful option when esthetics are a concern, there is currently not enough evidence to determine if they offer a long-term benefit over traditional stainless steel and zirconia crowns. They will need further scientific evidence and proven clinical success to become widely accepted within clinical practice.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

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