INTERNATIONAL JOURNAL OF MEDICAL SCIENCE AND DENTAL HEALTH
(ISSN: 2454-4191)
www.ijmsdh.org (2026)

Received: 08 July 2026
Revised: 26 July 2026
Accepted: 01 Aug 2026
Published: 11 Aug 2026

Volume 12 Issue 08, 2026
Page No - 67-75
DOI - 10.55640/ijmsdh-12-08-08

Article Citation: Reddy, D. K. S., Achanta, D. A. ., C. M., D. B., Alekya, D. K. ., Sukka, B. ., & Nagakishore, D. V. . (2026). Digital Prosthetic Rehabilitation for A Paediatric Patient Using CAD-CAM Fabricated PMMA Crown- A Case Report. International Journal of Medical Science and Dental Health, 12(8), 67-75. https://doi.org/10.55640/ijmsdh-12-08-08

Digital Prosthetic Rehabilitation for A Paediatric Patient Using CAD-CAM Fabricated PMMA Crown- A Case Report.

Dr. Kola Srikanth Reddy
Professor
Department of Pedodontics & Preventive Dentistry
Meghna Institute of Dental Sciences
Nizamabad, Telangana State, India.

Dr. Alekhya Achanta
Reader
Department of Pedodontics & Preventive Dentistry
Malla Reddy Institute of Dental Science
(Malla Reddy Viswavidyapeeth Deemed to Be University)
Suraram, Hyderabad, Telangana State, India.

Dr. Bhuvana C. M.
Assistant Professor
Department of Pedodontics & Preventive Dentistry
K.G.F College of Dental Science
Kolar, Karnataka State, India.

Dr. Korakoppula Alekya
Assistant Professor
Department of Pedodontics & Preventive Dentistry
Meghna Institute of Dental Sciences
Nizamabad, Telangana, India.

Bhavani Sukka
Pediatric Dentist.

Dr. V. Nagakishore
Associate Professor
K.G.F College of Dental Sciences
Kolar, Karnataka State, India.

Corresponding Author: - **Dr. Kola Srikanth Reddy**
Professor
Department of Pedodontics & Preventive Dentistry
Meghana Institute of Dental Sciences
Nizamabad, Telangana, India

Abstract

Aim: Crowns apply to primary teeth with extensive caries, cervical decalcification, developmental defects, interproximal caries extending beyond line angles, and following pulpotomy or pulpectomy.

Background description: 3D-milled polymethylmethacrylate (P-PMMA) crowns, which offer apperceptive and marginal

adaptation. Advancements in CAD/CAM glass-ceramic crowns have expanded their use in Aesthetic dentistry.

Case description: This case report illustrates a clinical use of computer-aided design and manufacturing technology (CAD/CAM) for the fabrication of a crown for a decayed primary molar using a study model as a reference. The material used was a hybrid ceramic CAD/CAM block.

Conclusion: This approach has the advantage of the customisation of the abutment tooth in contrast to previously mentioned pre-fabricated options.

Keywords: Computer-aided design (CAD), Computer-aided manufacturing technology, Digital-impression technique,3D Milled resin crown, Modern digital paediatric dentistry.

Introduction

Restoration of severely damaged carious primary molars is challenging in paediatric dentistry. As it must ensure functional durability along with growing aesthetic expectations, it must be over conventional restorative options.

Stainless steel crowns, also known as chrome steel or pre-fabricated metal crowns, are a widely preferred option for restoring severely Decayed primary teeth due to their strength, decayed primary teeth due to their strength, durability, cost-effectiveness, and long-term clinical success. [1]

However, their metallic appearance results in poor aesthetic acceptance among parents, and their rigid surfaces may contribute to wear of opposing teeth. While aesthetic alternatives offer improved appearance, they present certain drawbacks, such as complex tooth preparation, difficulty in achieving optimal marginal adaptation, higher costs, and an increased risk of veneer fracture. [2]

To further address aesthetic demands, Zirconium crowns, often referred to as ceramic steel, have been introduced. These crowns provide a natural-tooth coloured appearance along with strength comparable to stainless-steel crowns.

Advancements in digital dentistry, such as intra-oral scanners and computer-aided design and manufacturing (CAD/CAM) Technology, have revolutionised paediatric care by enabling metal-free, biomimetic restorations.

Since its inception in 1971, CAD/CAM has expanded from single crowns to Orthodontics, Prosthodontics and implants.

It involves additive manufacturing (3D printing) and subtractive manufacturing (Milling), with 3D printing using technologies such as Stereolithography and selective laser sintering (SLS). While milling sculpts restorations from prepolymerized resin blocks. [3,4]

Thus, 3D Milling technology digitally fabricates crowns, frameworks and models by precisely grinding resin or ceramic blocks, offering enhanced accuracy, efficiency, and patient comfort. [5,6,7,8]

While multiple studies have assessed the fit of 3D printed resin crowns relative to conventional crowns. [9,10]

The purpose of this paper is to illustrate a case report of the fabrication of a CAD/CAM crown for a Decayed primary maxillary molar in an 8-year-old boy.

Clinical examination;

An **8-year-old child**, accompanied by a parent, reported with a chief complaint of pain in the lower left posterior tooth region for 3 days. Pain was of moderate intensity, aggravated during massification and was associated with a history of nocturnal pain.

The child's medical history was non-contributory, with no history of systemic illness, medication use, or known allergies. Dental history revealed irregular dental visits and suboptimal oral hygiene practices. Frankl's behavior rating scale was noted as Positive. Intraoral periapical radiograph revealed Chronic irreversible pulpitis i.r.t 75 **(Fig 1).** A treatment plan was made as Pulpectomy and Intra-oral scanning followed by CAD-CAM milled Polymethyl methacrylate crown i.r.t 75. Informed consent was obtained from the parent before treatment.

Clinical Procedure: Tooth Preparation

Before tooth preparation, access opening, Biomechanical preparation, and obturation using Metapex were done under local anaesthesia (Lignocaine with vasoconstriction 1:80,000)**(Lidocaine),** and it was restored with Glass ionomer cement type II **(Neocem).** After a week, the patient was recalled **(Fig 2,3).**

Tooth preparation was done using a round-end tapered diamond bur.

Buccal, lingual, mesial and distal surfaces were reduced approximately by 0.8–1.0 mm**.**

Continuous chamfer line finish was established circumferentially to ensure proper marginal adaptation of the crown.

Occlusal reduction around 1.5 mm was performed to obtain sufficient clearance from the opposing tooth.

Occlusal convergence of approximately 6°, was given for retention and resistance of the crown **(Fig 4).**

All sharp line angles were rounded off to reduce stress concentration.

Crown preparation differentiation for stainless steel crowns is more aggressive than that of the Zirconium crown.

Crown preparation for Zirconium crowns is more conservative.

Intraoral scanning and Milling;

After tooth preparation, an intraoral scanner **(Prime scan, DENTSPLY SIRONA)** was used to make a digital impression **(Fig 5).**

Files were saved in OBJ format.

Converted into standard tessellation language (STL) files.

Crown design was completed using EXOCAD software **(Fig 6).**

The finalised designs were then transferred to the milling software.

PMMA disc and appropriate milling instruments were selected.

The milling process was done, completing fabrication of P-polymethylmethacrylate crowns using a CAD/CAM milling unit **(Fig 7).**

Milled crowns were checked for trial fit and marginal accuracy before cementation **(Fig 8).**

Duration is 20 sec per surface (Buccal crowns, white shade are available).

With the aid of digital workflow and chair-side CAD-CAM technology. Paediatric patients can create digital impressions utilising intraoral scanners for fast Zirconium crown production. According to research, Anil et al [11], the dental office has chances to create full contour restorations thanks to digital effect systems and chairside CAD/CAM equipment.

3D printed PMMA crowns were more accurate than PPMA interim crowns, which show larger internal dimensional variations. Fit variation among interim crowns fabricated by both procedures was statistically nonsignificant.

The major benefits of using CAD/CAM technology for restorations include shorter clinical times, faster restoration manufacturing, elimination of the need for traditional impression-taking technology, stable colony of ceramics, and good cosmetic results.

The editing time took 9 minutes, while the total chairside time was 50 minutes.

Follow up

Figure 9, depicts a follow-up photograph of the Polymethylmethacrylates crown. The crown was retained, with no marginal exposure of the crown, and no opposing tooth wear was noted.

The patient was recalled every 3 months for 1 year for evaluation (Loss of retention, loss of proximal contact, gingival inflammation, opposing tooth wear, and Marginal integrity). At the end of 1 year, radiographs were taken to check the interproximal bone.

The CAD-CAM technology has the advantages of needing less chair-side time, brisk production of restoration with increased precision, eliminating the need for classic methods of impression, high strength and aesthetic restorations and prosthesis.

Discussion;

Mechanical Properties

CAD/CAM-milled Polymethylmethacrylate crowns, as shown to adequately withstand paediatric masticatory forces (Al-Halabi et al., 2021)[12]

Various CAD-CAM materials were confirmed to have sufficient nano-hardness, nano-reduced elastic modules and elements and microstructural properties indicating their potential application in the restorative treatment of full crowns of deciduous teeth. That's why CAD-CAM materials were called Biomimetic materials.

Among printing techniques, Digital light processing (DLP) has shown slightly superior fracture resistance compared to stereolithography (SLA), due to improved polymerisation depth and resin cross-linking characteristics (Aktas and Bankoglu Güngör etal, 2024). [13]

As milled polymethylmethacrylates is reinforced with fibres, its uniform microstructure enables better crack resistance and load-bearing capacity. (Nguyen et al, 2025).[14]

In an in-vitro study by Nguyen et al [15], the milled polymethylmethacrylate crown showed fracture resistance exceeding 400N, whereas bite force is 289N and 433N in early and late mixed dentition stages.

While surface wear resistance is generally adequate for primary dentition, some studies have reported microcrack formation and filler particle loss following simulated mastication, indicating the need for continued refinement of resin formulations (Park et al., 2023).[16]

Digital Workflow

Digital workflows allow rapid fabrication, precise customisation to individual tooth morphology, and reduced dependence on prefabricated stock crowns. This results in improved fit, enhanced comfort, and reduced chairside time. Additionally, the cost-effectiveness and potential for on-demand production make these crowns particularly valuable in resource-limited settings and emerging tele dentistry models (Giridharan and Gopal etal 2024)[17]

Also, studies have shown that the digital precision of 3D printing enables crowns with reduced marginal and internal gaps compared to some subtractive milling techniques, minimising microleakage and enhancing retention (Aktaş et al., 2024).[13]

Clinical Perspective

Gingival health evaluation in this study shows low gingival inflammation arising from 3rd to 6 th month follow-up visits, and moderate with no statistical difference at the 12 th month follow-up. There was a better gingival response in 3D printed crowns at the 12 th month follow-up.

The result is likely from the manufacturing procedures for the crowns using a 3D printing system that employs a self-heated tray and ultraviolet polymerisation technique in the generation of crowns layer by layer to finally fabricate long-term provisional restoration for intraoral use with biocompatibility properties with a lower tendency of plaque buildup and thus a lower chance of gingival irritation.

Advantages over other crowns

Precise fit, eliminating the need for manipulation of the crown chairside

Reduced time consumption in treating children

Aesthetic in appearance

Cost-effective crowns

Biocompatibility

Optimum reduction of tooth structure for adequate crown retention.

Lack of damage to adjacent teeth after opening interproximal contacts.

Accurate marginal adaptation &gingival health.

Good functional occlusion.

Optimum cementation procedure.

The microbial colonisation of plaque on foreign restorative materials is the main reason for gingival inflammation on the foreign restorative, depending on the surface smoothness and microstructure. Therefore, the crowns made from photopolymer, therefore, the crowns made from resulted in less plaque accumulation & gingival inflammation than those made from preparing ready-made PMMA blocks using CAD/CAM manufacturing.

Marginal adaptation is very important for the long-term success of crowns; failure might result in microleakage, documentation, plaque accumulation and secondary caries. In case of stainless-steel crowns, marginal adaptation is timing consuming process and technique-sensitive, requiring crimping, festooning and final polishing. Even in prefabricated zirconia crowns, crimping is not possible for an adequate marginal fit. Limited shades are available; extensive tooth preparation, they have a subgingival finish line, and they can't be modified in any way, like in the case of stainless-steel crowns, as they have low flexural strength.

In vitro study by Elkhodary et al [17] showed vertical marginal gap distance was greater in Stainless steel crowns, followed by Prefabricated zirconia crowns and CAD-CAM produced zirconia crowns with 418.3μm, 341.7μm, and 86.7μm, respectively. CAD-CAM milling systems create an ideal marginal integrity, occlusal and proximal contact points, thereby contributing to better gingival health outcomes by limiting plaque accumulation and periodontal irritation, which is particularly important in young patients with limited oral hygiene compliance (Al-Halabi et al. 2021).[5]

Clinical study by Shanmugaavel et al. (2026) [18] mentioned that survival rate, fracture or dislodgement, and gingival irritation of CAD-CAM milled Polymethylmethacrylate crowns were not observed compared to Stainless steel crowns over a duration of 6 months.

Aesthetically, 3D [PPM crowns] printed Polymethylmethacrylates crowns often suffer from inferior colour stability and smoother surface characteristics, supporting their acceptance in paediatric patients (Viswanath et al., 2025).[19]

The major benefits of using CAD/CAM technology for restorations include;

Disadvantages of preformed Zirconium crowns are; Not high cost, Limited shades are available, Extensive tooth preparation, They have a subgingival finishline,They can't be modified in Anay way like in the case of S.S.C as they have low flexural strength. In order to overcome these disadvantages CAD-CAM crowns are an option now. Incorporating digitisation in paediatric dentistry reduces mean chair-side time and is comfortable for the child.

The CAD-CAM technology has its advantages of needing less chair-side time, brisk production of restoration with increased precision, eliminating the need for the classic method of impression, high-strength and aesthetic restorations and prostheses.

Impression taking in CAD-CAM is quicker, additionally & powdering is not necessary for modern equipment. Final cementation is 20 seconds for buccal crowns, white shade available

Shorter clinical times, faster restorations, and the manufacturing elimination of the need for traditional impression-taking technology, stable colour of ceramics and good cosmetic results.

The survival rate of 3D-printed crowns was 84% compared with 80% survival rate using CAD/CAM fabricated crowns at the end of a 12-month follow-up.

Conclusion

Although there is no published literature for CAD/CAM restorations for primary molars, there are dental clinics that use CAD/CAM for the fabrication of restorations for permanent dentition and occasionally for primary teeth.

This case report illustrates an alternative and reliable treatment option for primary molars with extensive caries, and possesses the advantages of limiting chairside time and full customisation of the crown restoration, together with a high level of aesthetic outcome.

Limitation

Expensive equipment's

Dislodgement of the crown, if proper isolation has not been done during cementation.

P-Polymethacrylate crowns (PMMA)need excess tooth reduction compared to a traditional stainless-steel crown.

Long-term clinical studies are required.

Clinical significance

This type of approach could be considered as an alternative option for primary molars with extensive caries, having the advantages of limiting chairside time and a customised procedure.

References

1. Mathew MG, Roopa KB, Soni AJ, et al. Evaluation of clinical success, parental and child satisfaction of stainless-steel crowns and zirconia crowns in primary molars. J Family Med Prim Care 2020;9(3):1418–1423.
2. Innes NP, Ricketts D, Chong LY, et al. Preformed crowns for decayed primary molar teeth. Cochrane Database of Syst Rev;2015(12): CD005512.
3. Clark L, Wells MH, Harris EF, et al. Comparison of the amount of primary tooth reduction required for anterior and posterior zirconia and stainless-steel crowns. Pediatr Dent 2016;38(1):42–46.
4. Tote J, Gadhane A, Das G, et al. Posterior esthetic crowns in paediatric dentistry. Int J Dent Med Res 2015;1(6):197–201.
5. Walia T, Salami AA, Bashiri R, et al. A randomised controlled trial of three aesthetic full-coronal restorations in primary maxillary teeth. Eur J Paediatr Dent 2014;15(2):113–118.
6. Atria PJ, Bordin D, Marti F, et al. 3D-printed resins for provisional dental restorations: comparison of mechanical and biological properties. J Esthet Restor Dent 2022;34(5):804–815.
7. Yu Y, Liao Y, Guo J, et al. Computer-designed surgical templates improve the extraction of impacted supernumerary teeth in the hard palate. J Clin Pediatr Dent 2022;46(5):38–43.
8. Scribante A, Gallo S, Pascadopoli M, et al. Properties of CAD/CAM 3D printing dental materials and their clinical applications in orthodontics: where are we now? Appl Sci 2022;12(2):551.

9. Lee S. Prospect for 3D printing technology in medical, dental, and pediatric dental field. J Korean Acad Pediatr Dent 2016;43(1):93–108.
10. Park S, Cho W, Lee H, et al. Strength and surface characteristics of 3D-printed resin crowns for the primary molars. Polymers 2023;15(21):1213072.
11. Viji AA, Reddy A.Using digital impressions to fabricate space maintainers. A case report Clin case Rep 2020;8:1274-6.
12. Al-Halabi MN, Bshara N, Nassar JA, Comisi JC, Rizk CK. Clinical Performance of Two Types of Primary Molar Indirect Crowns Fabricated by 3D Printer and CAD/CAM for Rehabilitation of Large Carious Primary Molars. Eur J Dent. 2021;15(3):463-468.
13. Aktaş N, Bankoğlu Güngör M. Evaluation of Wear on Primary Tooth Enamel and Fracture Resistance of Esthetic Pediatric Crowns Manufactured from Different Materials. Medicina (Kaunas). 2024;60(10):1678.
14. Van Ngoc-Thuy Nguyen, Nam Cong-Nhat Huynh, Thoai Quoc Kieu, Ninh Hai Truong, Hung Trong Hoang. In vitro study of fracture resistance and colour stability of 3D-printed, milled hybrid ceramic, milled PMMA and prefabricated zirconia crowns for restoration of primary incisors. Journal of Clinical Pediatric Dentistry. 2025;49(6):198-205
15. Park S, Cho W, Lee H, et al. Strength and surface characteristics of 3D-printed resin crowns for the primary molars. Polymers (Basel). 2023;15(21):4241.
16. Giridharan DL, Gopal S. Comparison of Fracture Resistance Force (Load-to-fractured Test) and Failure Type of 3D-printed Stainless Steel Crowns and Preformed Stainless Steel Crowns in Primary Molars: An *In Vitro* Study. Int J Clin Pediatr Dent. 2024 ;17(10):1129-1134
17. Elkhodary HM, Farsi NM, Abdelmeguid SM, Elbanna KA, Alshehri MR, Aldajani MB, Bhadila GY. Marginal Gap Distance and Dynamic Fatigue Performance of Esthetic Crowns for Primary Teeth. Int J Paediatr Dent. 2025;35(4):829-838.
18. Shanmugaavel AK, Balakrishnan P, Nandhini T, et al. Comparison of Clinical Performance of Preformed CAD/CAM Milled PMMA Crown and Stainless Steel Crown for Primary Molar Teeth Using Dental Operating Microscope. Int J Clin Pediatr Dent 2026;19(2):139–144.
19. Vislawath, O. S. P., et al. "Comparative evaluation of colour stability of conventional, 3d printed and cad cam fabricated provisional restorations- An in-vitro study." ResearchGate, 2025;11(1):40-5.

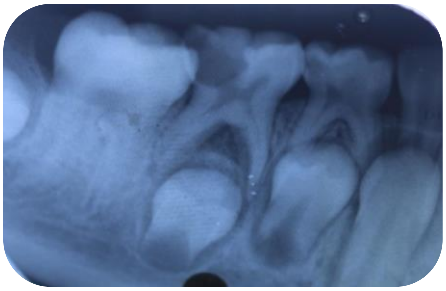

Fig 1: Preoperative IOPAR I.R.T 75.

Fig 2: Maxillary Occlusal View

Fig 3: Mandibular Occlusal View.

Fig 4: Preparation For The Crown I R T 75.

FIGURE NO 5.

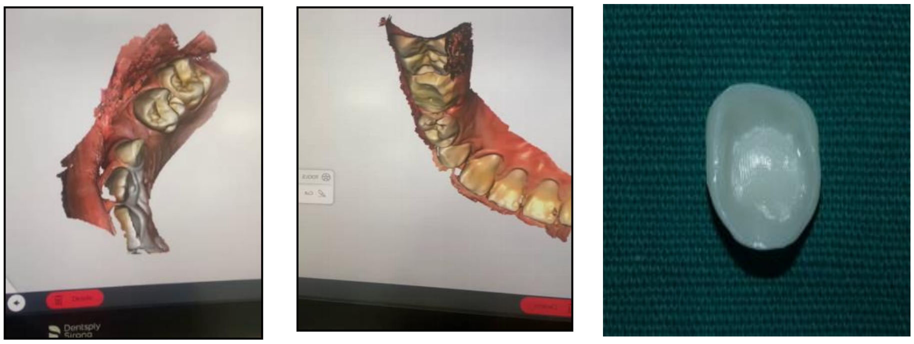

Figure NO; 6, The Files Were Saved In Sti Format And Exposed To Exocad Software..

Figure No 6 The File Was Saved To Stl Format And Exposed To Exocad Software.

Fig No; 7; Milling Of PMMA Crown And Milled PMMA Crown.

Figure No;8; Follow Up Photo Graph.

INTERNATIONAL JOURNAL OF MEDICAL SCIENCE AND DENTAL HEALTH
(ISSN: 2454-4191)
www.ijmsdh.org (2026)

Figure No; 9; Follow Up Photograph..