International Journal of Contemporary Pediatrics
Reddy KS et al. Int J Contemp Pediatr. 2026 Nov;13(11):2362-2366
https://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20263827

Case Report

Digital dentistry in pediatric rehabilitation: CAD/CAM printed polymethyl methacrylate crown

Kola Srikanth Reddy[1]*, A. Alekhya Achanta[2], A. Aravind Kumar[3], Korokoppula Alekhya[4], Mallavarapu Haripranathi[5], B. Vijendar[3]

[1]Department of Pedodontics & Preventive Dentistry, Meghna Institute of Dental Sciences. Nizamabad, Telangana State, India
[2]Malla Reddy Institute of Dental Sciences, Malla Reddy Vishwavidyapeeth (Deemed to be University), Suraram, Hyderabad, Telangana, India
[3]Department of Periodontics, Meghna Institute of Dental Sciences, Nizamabad, Telangana State, India
[4]Department of Pedodontics, Meghna Institute of Dental Sciences, Nizamabad, Telangana State, India
[5]Government Dental College, Hyderabad, Telangana State, India

Received: 09 September 2026
Accepted: 06 October 2026

***Correspondence:**
Dr. Kola Srikanth Reddy,
E-mail: kolasrikanthreddy@gmail.com

Copyright: © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

ABSTRACT

Pulpectomized primary teeth need full coverage restorations to restore function, maintain arch integrity and prevent secondary caries. Digital dentistry has significantly improved pediatric care by enabling metal-free, biomimetic restorations through intraoral scanning and CAD/CAM technology. An 8-year-old patient was diagnosed with chronic irreversible pulpitis w.r.t 75, a treatment plan was made as pulp therapy followed by milled polymethyl methacrylate crown (PMMA). Advanced digital technologies, including an intraoral scanner and CAD-CAM, were utilised in the process, making the process child-friendly. Milled PMMA crowns enables precise fit, allows comfort and helping positive experience for children. Signifying utility of digital technology.

Keywords: 3D Milled resin crown, Multi surface carious lesions, Digital -impression technique, Modern digital pediatric 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.[5-8]

While multiple studies have assessed the fit of 3D printed resin crowns relative to conventional crowns.[9,10] This case report highlights the use of CAD-CAM-milled PMMA crowns for the restoration of an extensively carious primary molar.

CASE REPORT

Patient information

An 8-year-old child, accompanied by a parent, presented with a chief complaint of pain in the lower left posterior tooth region for 3 days. Pain was of moderate intensity, aggravated during mastication, 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. IOPAR revealed Chronic irreversible pulpitis w.r.t 75 (Figure 1). A treatment plan was made as Pulpectomy and Intra-oral scanning followed by a CAD-CAM milled Polymethyl methacrylate crown w.r.t 75. Informed consent was obtained from the parent before treatment.

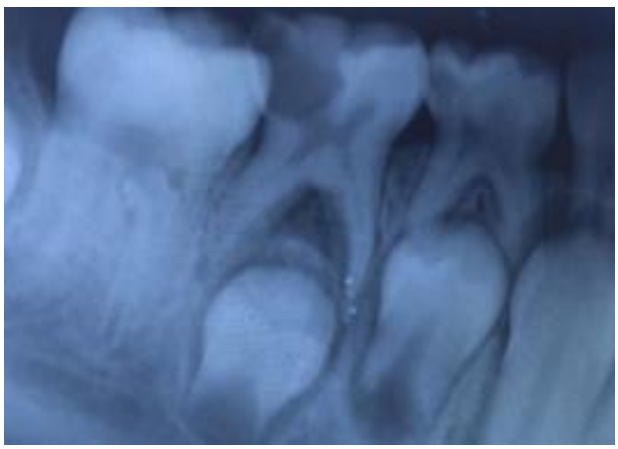


Figure 1: Preoperative IOPAR i.r.t 75.

Clinical procedure: tooth preparation

Before tooth preparation, access opening, BMP, 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 (Figure 2 and 3).



Figure 2: Maxillary occlusal view.



Figure 3: Mandibular occlusal view.



Figure 4: Preparation for the crown i.r.t 75.

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. A feather-edge subgingival finish line 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 (Figure 4). All sharp line angles were rounded off to reduce stress concentration.

CAD/CAM fabrication of polymethyl methacrylate crown

After tooth preparation, an intraoral scanner (Prime scan, Dentsply Sirona) was used to make a digital impression (Figure 5). Files were saved in OBJ format. Converted into standard tessellation language (STL) files. Crown design was completed using EXOCAD software (Figure 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 PMMA crowns using a CAD/CAM milling unit (Figure 7). Milled crowns were checked for trial fit and marginal accuracy before cementation (Figure 8).



Figure 5: An intra oral scanner (prime scan, Dentsply Sirona) was used to obtain digital impression.



Figure 6: (A-C) The files were saved in STL for forma and exposed to EXOCAD software.



Figure 7: The file was saved to STL format and exposed to EXOCAD software.



Figure 8: Milling of PMMA crown and milled PMMA crown.

Follow up

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



Figure 9: Follow up photograph.



Figure 10: Post-cementation photograph i.r.t 75.

Post procedure, all the samples underwent clinical evaluation at 24 months, 1 week, 1 month, 3 months and 6 months to assess their performance and longevity. (Loss of retention, loss of proximal contact, Gingival inflammation, opposing tooth wear, and marginal integrity) at the 1 year, radiographs were taken to check the interproximal bone.

DISCUSSION

Mechanical properties

CAD/CAM-milled PMMA crowns have been shown to adequately withstand pediatric masticatory forces (Al-Halabi et al.[11] Various CAD-CAM materials were confirmed to have sufficient nano-hardness, nano-reduced elastic moduli and microstructural properties indicating their potential application in the restorative treatment of full crowns of deciduous teeth. 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 by Aktas et al.[12]

As milled PMMA is reinforced with fibres, its uniform microstructure enables better crack resistance and load-bearing capacity (Nguyen et al).[13] In an in vitro study by Nguyen et al a milled PMMA crown had fracture resistance exceeding 400N, whereas the bite force is 289N and 433N in the early and late mixed dentition stages.[13] 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 by Park et al.[14]

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 teledentistry models by Giridharan et al.[15] 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 by Aktaş et al.[12]

Clinical perspective

Marginal adaptation is very important for the long-term success of crowns; failure might result in microleakage, documentation, plaque accumulation and secondary caries. In the case of stainless-steel crowns, marginal adaption is timing consuming process and technique-sensitive, requiring crimping, festooning and final polishing. Even in prefabricated zirconia crowns, crimping is not possible for adequate marginal fit. An in vitro study by Elkhodary et al showed vertical marginal gap distance was greater in SSC, followed by Prefabricated zirconia crowns and CAD-CAM produced zirconia crowns, with 418.3µm, 341.7µm, and 86.7µm, respectively.[16] CAD-CAM milling systems create 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 by Al-Halabi et al.[5]

A clinical study by Shanmugaavel et al mentioned that survival rate, fracture or dislodgement, and gingival irritation of CAD-CAM milled PMMA crowns were not observed compared to SSC over a duration of 6 months.[17] Aesthetically, 3D printed PMMA crowns often suffer from inferior colour stability and smoother surface characteristics, supporting their acceptance in paediatric patients by Viswanath et al.[18]

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 cementation procedure and lack of damage to adjacent teeth after opening interproximal contacts. The major benefits of using CAD/CAM technology for restorations include; Shorter clinical times, faster restorations, and the 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.

Limitation

Expensive equipment's; dislodgement of the crown, if proper isolation has not been done during cementation. PMMA crowns need excess tooth reduction compared to a traditional stainless-steel crown. Long-term clinical studies are required.

CONCLUSION

Utilization of digitalized technology as improved treatment in paediatric patient increasing comfort. PMMA crown with good mechanical properties and clinical satisfaction can be considered as a treatment option as full coverage restoration in primary molars.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Mathew MG, Roopa KB, Soni AJ, Khan MM, Kauser A. 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):1418-23.
2. Innes NPT, Ricketts D, Chong LY, Keightley AJ, Lamont T, Santamaria RM. Preformed crowns for decayed primary molar teeth. Cochrane Database Syst Rev. 2015;(12):CD005512.
3. Clark L, Wells MH, Harris EF, Lou J. Comparison of amount of primary tooth reduction required for anterior and posterior zirconia and stainless steel crowns. Pediatr Dent. 2016;38(1):42-6.
4. Bhuyan L, Dhull KS, Pattnaik S, Devraj IM, Nishat R, Panda A. CAD-CAM in pediatric dentistry: A brief insight. Bangladesh J Med Sci. 2024;23:538-42.
5. Walia T, Salami AA, Bashiri R, Hamoodi OM, Rashid F. A randomised controlled trial of three aesthetic full-coronal restorations in primary maxillary teeth. Eur J Paediatr Dent. 2014;15(2):113-8.
6. Atria PJ, Bordin D, Marti F, Nayak VV, Conejo J, Benalcázar Jalkh E, et al. 3D-printed resins for provisional dental restorations: comparison of mechanical and biological properties. J Esthet Restor Dent. 2022;34(5):804-15.
7. Yu Y, Liao Y, Guo J, Zhang Y, Khan M, Lin X. 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, Canzi P, Marconi S, Montasser MA, 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 SH. 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, Bae J, Jeong T, Huh J, et al. Strength and surface characteristics of 3D-printed resin crowns for the primary molars. Polymers (Basel). 2023;15(21):4241.
11. 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):463-8.
12. 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.
13. Nguyen VN-T, Huynh NC-N, Kieu TQ, Truong NH, Hoang HT. In vitro study of fracture resistance and color stability of 3D-printed, milled hybrid ceramic, milled PMMA and prefabricated zirconia crowns for restoration of primary incisors. J Clin Pediatr Dent. 2025;49(6):198-205.
14. Yuce M, Yondem I, Aykent F, Eraslan O. Influence of the supporting die structure on the fracture strength of all-ceramic materials. Clin Oral Investig. 2012;16:1105-10.
15. 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):1129-34.
16. Elkhodary HM, Farsi NM, Abdelmeguid SM, Elbanna KA, Alshehri MR, Aldajani MB, et al. Marginal gap distance and dynamic fatigue performance of esthetic crowns for primary teeth. Int J Paediatr Dent. 2025;35(4):829-38.
17. Shanmugaavel AK, Balakrishnan P, Nandhini T, Iyer RAS, Srinivasan D, Eagappan ARS. 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):139-44.
18. Anulekha CK, Pulagam M, Kondareddy SD, Seelam SK, Tahseen SA, Vislawath OSP. Comparative evaluation of colour stability of conventional, 3D-printed and CAD/CAM fabricated provisional restorations: an in vitro study. IP Ann Prosthodont Restor Dent. 2025;11(1):40-5.

Cite this article as: Reddy KS, Achanta AA, Kumar AA, Alekhya K, Haripranathi M, Vijendar B. Digital dentistry in pediatric rehabilitation: CAD/CAM printed polymethyl methacrylate crown. Int J Contemp Pediatr 2026;13:2362-6.