RESEARCH PAPER

# Clinical performance of 3D printed resin crowns in primary molars- a case series

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**Abstract**

**Aim and background**: Early childhood caries and extensive lesions in primary molars often require full-coverage restorations. With advances in digital dentistry, 3D-printed resin crowns have emerged as a customized, esthetic, and cost-effective alternative to conventional options. However, clinical evidence in primary teeth is limited. This case series presents the clinical considerations, fabrication protocol, and follow-up outcomes of 3D-printed resin crowns in rehabilitating primary molars. **Case description:** Case 1 ,2 and 3 describe children aged 6,5 and 7 years who presented with the chief complaint of pain in the lower left back tooth region. Based on the clinical and radiographic investigations, we came to the diagnosis of chronic irreversible pulpitis in lower left second primary molars. Following pulpectomy prefabricated 3D printed resin crowns were placed. Case 4 and 5 describe 5 years old children with chief complaints of pain in the lower right back tooth region and diagnosed chronic irreversible pulpitis in lower right second primary molars. After pulpectomy prefabricated 3D printed resin crowns were placed. All crowns were followed up and clinically evaluated for gingival health, crown debonding, loss of crown material and opposing tooth wear. **Conclusion:** The mechanical performance of 3D-printed resin crowns was inadequate, as all crowns fractured within 6 months. Improvements in material properties and printing parameters are needed to enhance fracture resistance. **Clinical significance**: 3D printed resin crown is an esthetic economic customizable full coverage restoration option for children of lower socioeconomic level.

**Key words:** 3D Printed resin, Esthetic crowns, Primary molars

**How To Cite This Article:** Aswathi R, Chamarthi Vr, Kalaivanan D, Krishnamoorthy S, Saleem S, Santhosh Priya Akr. Clinical Performance Of 3D Printed Resin Crowns In Primary Molars - A Case Series. Int J Drug Deliv Technol. 2026;16(27s):455-461. Doi: 10.25258/ijddt.16.27s.53

## Introduction

Restoration of carious primary teeth continues to be a clinical challenge. The American Academy of Pediatric Dentistry advocates full-coverage restorations for children presenting with extensive carious lesions, a high risk of caries, or those who have undergone pulp therapy procedures such as pulpotomy or pulpectomy. [1-3] Preformed stainless-steel crowns (SSCs) have traditionally been the most commonly utilized restorative option. They are favoured for their long-term durability, reduced incidence of recurrent caries, cost-effectiveness, and ease of preparation and placement. However, despite these advantages, both parents and patients often express dissatisfaction with their color due to the metallic appearance. [4] Aesthetic dentistry has become an essential component of contemporary pediatric dental practice. In recent times, there has been a rising demand among parents for esthetic restorative options for their children. Moreover, children themselves increasingly prefer restorations that closely mimic the natural appearance of their teeth. [4]

Prefabricated zirconia crowns for primary teeth have been introduced over the past few decades and have demonstrated superior outcomes compared to other esthetic crown options in terms of esthetics, strength, and biocompatibility, including favourable gingival and periodontal health. However, these crowns present certain disadvantages, such as elevated cost and the potential for increased wear of opposing dentition. [2]. Furthermore, they may be contraindicated in children

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with bruxism due to the increased wear they can cause on opposing teeth. [5]

In Pediatric dentistry, CAD/CAM and 3D printing technologies are introduced as a part of technical evolution. Three-dimensional printing (3DP), otherwise known as additive manufacturing, is the forerunner in today's digital dentistry. The inception of this technology dates back to 1983, when Charles Hull created the first three-dimensional object using a 3D printer. [6] 3D printing represents an additive manufacturing approach in which the final structure is built incrementally in layers, in contrast to traditional CAD/CAM milling, a subtractive manufacturing method that produces restorations by removing material from a solid block. Relative to CAD/CAM milling, 3D printing offers advantages such as shorter production time, reduced material wastage, and the absence of consumable milling burs. [7] Advancements have led to the development of newer tooth-colored crowns that can be used as semi-permanent restorations for primary molars. Although there are few studies evaluating their clinical performance in the literature, research specifically based in India is limited. Therefore, this case series gives an insight into the clinical performance of 3D printable resin crowns using resins available in India.

**Case description**

**Case 1** (Figure 1)

A 6 years old male patient came to the department with chief complaints of pain in the lower left back tooth region since 1 week. Upon correlating his clinical signs and symptoms with intraoral periapical radiograph, we came to the diagnosis of chronic irreversible pulpitis irt 75, dental caries irt 74,84,85,51,61. Following pulpectomy 3D printed resin crowns was luted with type 1 glass ionomer cement on 75. Same day caries excavated from 74 and preformed stainless steel crown luted on 74. During 3 months follow up gingival health was satisfactory without substance loss or crown debonding and opposing tooth wear. During 6 months follow up crown was fractured exposing the underlying tooth structure. Gingival health was satisfactory without opposing tooth wear. Fractured resin crown was replaced by stainless steel crown. Fractured proximal glass ionomer cement restoration was replaced by stainless steel crowns.

**Case 2** (Figure 2)

5 years old male child with Frankl's positive behaviour rating scale came to the department with chief complaints of pain in the lower left back tooth region since 3 days and diagnosed chronic irreversible pulpitis in 75. Following pulpectomy 3D printed resin crown was luted on 75 with type I glass ionomer cement. During 3 months follow up crown was intact without substance loss and debonding. There was no gingival inflammation and opposing tooth wear. At 6 months follow up crown fractured exposing the underlying tooth structure. Gingiva appeared normal without opposing tooth wear. Fractured crown was replaced by stainless steel crown in 75. There was pain with periapical lesion and root resorption irt 54 and diagnosed chronic irreversible pulpitis irt 54 and proximal caries in 55. Stainless steel crown was given for proximal decay irt 55 and 54 extracted. Band and loop space maintainer in the place of extracted 54 was luted on 55. Glass ionomer cement restoration was done on 64 and 65.

**Case 3** (Figure 3)

7 years old male child with Frankl's behaviour rating scale positive came to the department with the chief complaints of pain in the lower left back tooth region since 5 days. Correlating the clinical and radiographic findings we came to the diagnosis of chronic irreversible pulpitis irt 75 and pulpectomy was done in 75. 3D printed resin crown was luted on 75 with type I glass ionomer cement after review. During 3 months follow up there was no gingival inflammation and opposing tooth wear. But crown was fractured exposing the underlying tooth structure. On radiographic investigation there was periapical lesion and root resorption. So patient is under observation.\

**Case 4** (Figure 4)

5 years old male child came with the chief complaints of pain in the lower right back tooth region since 2 days and diagnosed chronic irreversible pulpitis irt 85. Pulpectomy done in 85 followed by 3 D printed resin crown was luted with type I glass ionomer cement. Glass ionomer cement restoration was done in 84. During 3 months follow up crown was chipped in the occlusal surface without exposing the underlying tooth surface. Gingiva appears normal without opposing tooth wear. Chipped area repaired with composite resin and polished.

**Case 5** (Figure 5)

A 5 years old boy with definitely negative behaviour in Frankl's definitely negative behaviour rating scale was reported to the department with the chief complaints of pain in the lower right back tooth region since 3 days. Child was diagnosed early childhood caries with chronic irreversible pulpitis irt 85. Following pulpectomy, 3D printed resin crown was luted with type 1 GIC on 85 after 1 month review. Caries excavated and SDF was applied in decayed 51,52,61,62,53,63, 64,65, 55 and advised definitive restoration. There were dentoalveolar abscess irt 54 and 75. Access opening done and open dressing was given in 54 and 85. Calcium hydroxide intracanal medicament was placed and dressing was changed after review. But swelling doesn't subsided even after 3 months of dressing. So, 54 and 75 were extracted under local anesthesia. During 3 months follow up resin crown on 75 was intact without substance loss and debonding. There were no opposing tooth wear and gingiva appeared normal without any inflammation. During 6 months follow up crown fractured exposing the underlying tooth structure. There was no gingival inflammation and opposing tooth wear. Stainless steel crown was given in 75 and 84 and band and loop space maintainer in the place of 75 was luted

on 36. SDF reapplied on 51,52,61,62,53,63,64,65,55 and advised definitive restoration.

**Discussion**

This case report discusses of full coverage restoration with 3 D printing resin material. Three-dimensional printed resin crowns were designed using Exocad software with a standardized thickness of 0.6 mm on all surfaces, corresponding to the dimensions of prefabricated Propedo zirconia crowns in sizes 75 and 85 (A, B, C, and D). Resin crowns were printed using Elegoo DLP printer at 45 degree[8] orientation with PrestoCraft temporary crown and bridge resin material. The post-curing process was conducted in UV chamber with 385-405 nm light for 5-10 minutes and polished as per manufacture instructions. Although the makers have not revealed specific chemical information of resin, printable 3D resins are mostly Methacrylate oligomer based on polyurethane resin. [5, 4, 9, 7, 10] In this case series three of them survived without fracture till 6 months and two crowns reported fracture in 3 months follow up. In one case, crown was chipped without exposing the underlying tooth structure and we repaired with composite resin. None of the case was reported gingival inflammation and opposing tooth wear.

In literature, only few in vivo studies have been reported evaluating the clinical performance. Mohammed Nour Al-Halabi et al.[11] evaluated the retention rate, marginal integrity, and gingival health of 3D-printed resin crowns and direct composite celluloid crowns. The findings indicated that both types of crowns serve as suitable esthetic alternatives for restoring pulp-treated primary molars, with direct composite crowns demonstrating a higher retention rate. However, 3D-printed resin crowns exhibited superior gingival health along with improved marginal integrity. Ko Eun Lee et al.[5] conducted a clinical evaluation comparing 3D-printed resin crowns with stainless steel crowns (SSCs). The results showed that 3D-printed resin crowns were esthetically superior to SSCs and easier to repair clinically. However, the gingival index at 12 months and occlusal wear were significantly higher in the resin crowns. Additionally, cracks and discoloration were observed in the resin crowns. The survival rate was 100% for SSCs and 82.1% for resin crowns. These results were contradictive to the current study and the reason may be due to different material of choice, thickness of crown and different printing parameters.

Various in vitro studies have evaluated the mechanical properties of resin crowns. Nayoung Kim et al.[4] assessed mechanical properties of two 3D-printed resin crowns and prefabricated zirconia crowns, concluding that both exhibited comparable fracture resistance, with resin crowns (Graphy and NextDent) demonstrating sufficient strength to withstand pediatric bite forces, E. I. A. Elnagar et al.[12] conducted an in vitro study evaluating the marginal gap and fracture resistance of 3D-printed microfilled hybrid resin crowns compared with prefabricated zirconia crowns, reporting significantly higher fracture resistance in the 3D-printed group, while marginal gaps were comparable between groups. Nandini R.D. et al.[13] evaluated the compressive and flexural strength of conventional resin (GC Tempron) and two 3D-printed resins (3D Accuprint C&B and Freeprint Temp), finding that 3D Accuprint C&B exhibited superior strength to GC Tempron and comparable properties to Freeprint Temp. Maqbul Alam et al.[14] conducted an in vitro study comparing the fracture resistance of anterior provisional crowns fabricated by conventional and digital techniques, finding that 3D-printed crowns had the highest fracture resistance, followed by CAD/CAM and conventional methods. Roope Salonen et al.[7] evaluated the mechanical, surface, and optical properties of CROWNTEC and Temp PRINT, materials intended for the fabrication of permanent and temporary crowns and bridges, respectively. The study concluded that Temp PRINT demonstrated superior mechanical performance, whereas CROWNTEC exhibited more favourable optical properties.

Evidence suggests that milled prostheses exhibit superior physicomechanical properties compared with 3D-printed prostheses.[15,16,17] It has been reported that the properties of printed objects are influenced by factors such as the choice of resin material, printing technology, and parameters including layer thickness, polymerization depth, degree of shrinkage, and the volume and angulation of the light source. [15,18] However, the presence of cracks and fractures within a year may reflect an inability of the crown to perform adequately, indicating the need for enhancements in its physical properties. In these cases, variations in patient factors such as occlusal forces, oral hygiene, and parafunctional habits were not standardized. Factors related to the 3D-printing process, including material composition, printing orientation, and post-processing protocols, may also have influenced the outcomes but were not independently evaluated. Future research is required to improve the mechanical properties by material modification with appropriate additives, optimal crown thickness and shape, optimizing printing parameters.

**Conclusion**

Within the limitations of this case series, 3D-printed resin crowns in primary molars demonstrated early fracture within six months, raising concerns regarding their durability under functional load. Further research focusing on material enhancement, optimized printing parameters, and extended clinical evaluation is required before routine clinical application can be recommended.

**Clinical significance**

3D Printed resin crowns offer advantages in terms of customization, esthetics, and cost-effectiveness, making them a potential alternative for full-coverage restoration of primary teeth in developing countries and among populations with varying socioeconomic status.

**References**

1. Hutcheson C, Seale NS, McWhorterA, Kerins C,WrightJ. Multi-surface composite vs stainless steel crown restorations after mineral trioxide

aggregate pulpotomy: a randomized controlled trial. Pediatric Dentistry. 2012; 34: 460–467.
2. Seale NS, Randall R. The use of stainless steel crowns: a systematic literature review. Pediatric Dentistry. 2015; 37: 145–160.
3. Talekar AL, Waggoner WF, Silotry TMH, Musale PK, Chaudhari GS. Prospective, randomized, clinical evaluation of preformed zirconia crowns and stainless steel crowns on permanent first molars: 12-month results. Pediatric Dentistry. 2023; 45: 232–239.
4. Kim N, Kim H, Kim IH, Lee J, Lee KE, Lee HS, Kim JH, Song JS, Shin Y. Novel 3D Printed Resin Crowns for Primary Molars: In Vitro Study of Fracture Resistance, Biaxial Flexural Strength, and Dynamic Mechanical Analysis. Children (Basel). 2022 Sep 22;9(10):1445. doi: 10.3390/children9101445. PMID: 36291379; PMCID: PMC9600781.
5. Lee KE, Kang HS, Shin SY, Lee T, Lee HS, Song JS. Comparison of three-dimensional printed resin crowns and preformed stainless steel crowns for primary molar restorations: a randomized controlled trial. J Clin Pediatr Dent. 2024 May;48(3):59-67. doi: 10.22514/jocpd.2024.060. Epub 2024 May 3. PMID: 38755983.
6. Prasad, S., Kader, N. A., Sujatha, G., Raj, T., & Patil, S. (2018). 3D Printing in Dentistry. Journal of 3D Printing in Medicine, 2(3), 89–91. https://doi.org/10.2217/3dp-2018-0012
7. Salonen R, Garoushi S, Vallittu P, Lassila L. Characterization of temporary and permanent 3D-printed crown and bridge resins. Biomater Investig Dent. 2025 May 2;12:43584. doi: 10.2340/biid.v12.43584. PMID: 40475376; PMCID: PMC12138257.
8. Sfondrini, M.F.; Gariboldi, F.; Cerri, M.; Todaro, C.; Pascadopoli, M.; Casiraghi, G.; Scribante, A. Influence of Printing Orientation on the Flexural Strength of Different Light-Cured Resins Manufactured with Two 3DPrinters: In Vitro Study. Materials 2025, 18, 3029. https:// doi.org/ 10.3390/ma18133029
9. Alageel, O.; Alhijji, S.; Alsadon, O.; Alsarani, M.; Gomawi, A.A.; Alhotan, A. Trueness, Flexural Strength, and Surface Properties of Various Three-Dimensional (3D) Printed Interim Restorative Materials after Accelerated Aging. Polymers 2023, 15, 3040. https://doi.org/ 10.3390/polym15143040
10. Alageel O, Alsadon O, Almansour H, Alshehri A, Alhabbad F, Alsarani M. Assessment of effect of accelerated aging on interim fixed dental materials using digital technologies. J Adv Prosthodont. 2022 Dec;14(6):360-368. doi: 10.4047/jap.2022.14.6.360. Epub 2022 Dec 22. PMID: 36685789; PMCID: PMC9832148.
11. Al-Halabi MN, Bshara N, Nassar JA, Comisi JC, Alawa L. Comparative assessment of novel 3d printed resin crowns versus direct celluloid crowns in restoring pulp treated primary molars. J evid based dent pract. 2022 mar;22(1):101664. Doi: 10.1016/j.jebdp.2021.101664. Epub 2021 nov 13. Pmid: 35219462.
12. Elnagar, E.I.A., Allam, G.G. & Khattab, N.M.A. Novel 3D printed resin crown versus prefabricated zirconia crown for restoring pulpotomized primary molars: in vitro evaluation of fracture resistance and marginal gap. *Eur Arch Paediatr Dent* (2025). https://doi.org/10.1007/s40368-025-01038-1
13. R D N, R N, Hegde C. Compressive and flexural strength of provisional crown materials fabricated by conventional and 3D printing techniques: An in vitro study. J Oral Biol Craniofac Res. 2026 Mar-Apr;16(2):101405. doi: 10.1016/j.jobcr.2026.101405. Epub 2026 Jan 27. PMID: 41658371; PMCID: PMC12874558.
14. Alam M, Chugh A, Kumar A, Rathee M, Jain P. Comparative evaluation of fracture resistance of anterior provisional restorations fabricated using conventional and digital techniques –An in vitro study. J Indian Prosthodont Soc 2022;22:361-7.
15. Al-Dulaijan, Y.A.; Alsulaimi, L.; Alotaibi, R.; Alboainain, A.; Alalawi, H.; Alshehri, S.; Khan, S.Q.; Alsaloum, M.; AlRumaih, H.S.; Alhumaidan, A.A.; et al. Comparative Evaluation of Surface Roughness and Hardness of 3DPrinted Resins. Materials 2022, 15, 6822. https://doi.org/10.3390/ma15196822
16. Aati, S.; Akram, Z.; Shrestha, B.; Patel, J.; Shih, B.; Shearston, K.; Ngo, H.; Fawzy, A. Effect of post-curing light exposure time on the physico–mechanical properties and cytotoxicity of 3D-printed denture base material. Dent. Mater. 2021, 38, 57–67.
17. Iwaki, M.; Kanazawa, M.; Arakida, T.; Minakuchi, S. Mechanical properties of a polymethyl methacrylate block for CAD/CAM dentures. J. Oral Sci. 2020, 62, 420–422.
18. Puebla, K.; Arcaute, K.; Quintana, R.; Wicker, R.B. Effects of environmental conditions, aging, and build orientations on the mechanical properties of ASTM type I specimens manufactured via stereolithograph

**Figures:**

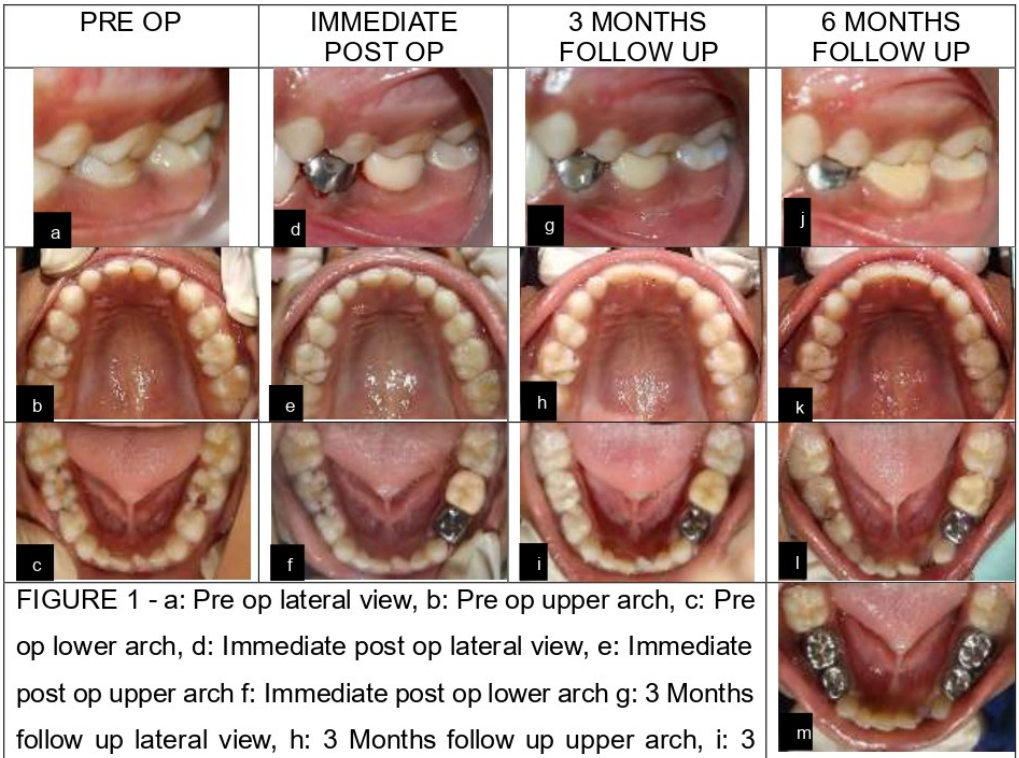



FIGURE 1 - a: Pre op lateral view, b: Pre op upper arch, c: Pre op lower arch, d: Immediate post op lateral view, e: Immediate post op upper arch f: Immediate post op lower arch g: 3 Months follow up lateral view, h: 3 Months follow up upper arch, i: 3 Months follow up lower arch, j: 6 Months follow up lateral view, k: 6 Months follow up upper rch, l: 6 Months follow up lower arch, m: Resin crown replaced by stainless steel crown

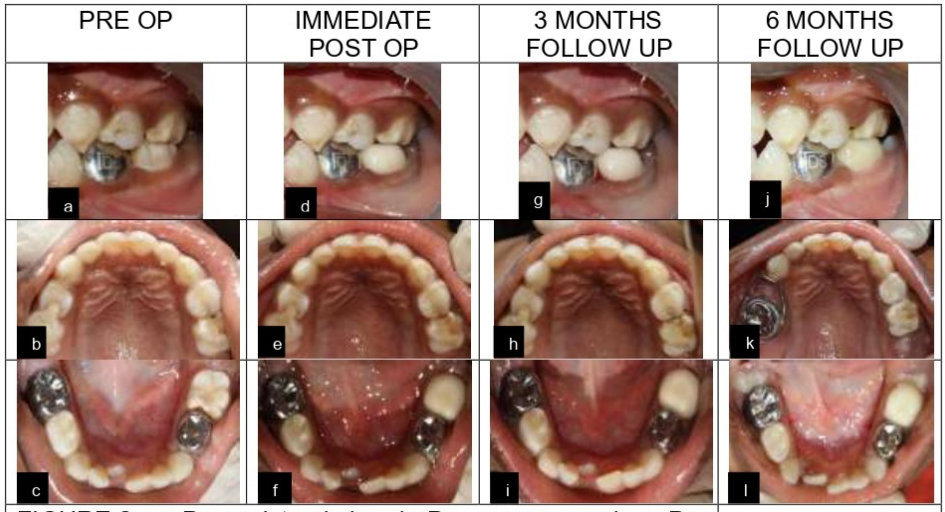



FIGURE 2 - a: Pre op lateral view, b: Pre op upper arch, c: Pre op lower arch, d: Immediate post op lateral view, e: Immediate post op upper arch, f: Immediate post op lower arch, g: 3 Months follow up lateral view, h: 3 Months follow up upper arch, i: 3 Months follow up lower arch, j: 6 Months follow up lateral view, k: 6 Months follow up upper arch, l: 6 Months follow up lower arch, m: Resin crown replaced by stainless steel crown

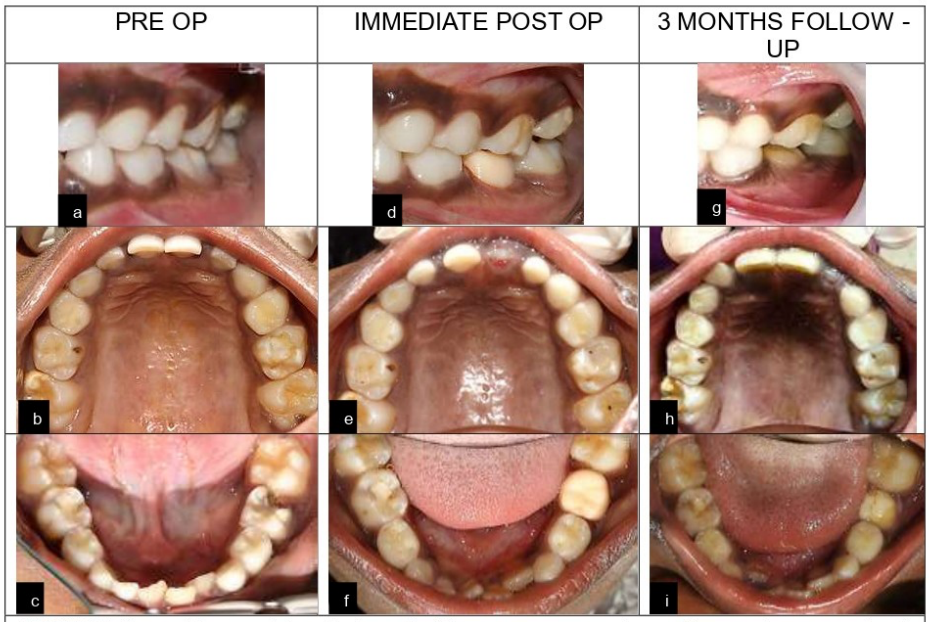



FIGURE 3 - a: Pre op lateral view, b: Pre op upper arch, c: Pre op lower arch, d: Immediate post op lateral view, e: Immediate post op upper arch, f: Immediate post op lower arch, g: 3 Months follow up lateral view, h: 3 Months follow up upper arch, i: 3 Months follow up lower arch

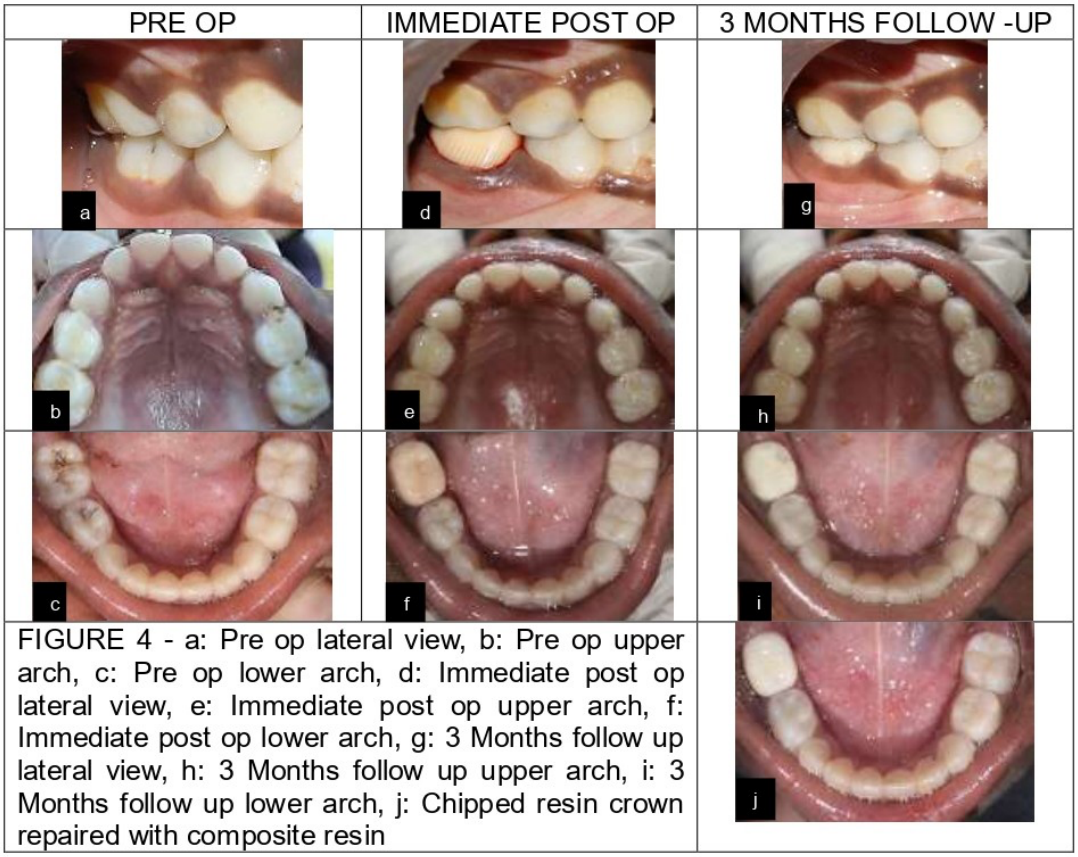
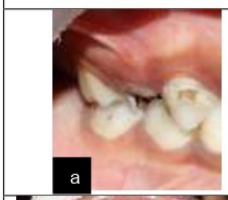



FIGURE 4 - a: Pre op lateral view, b: Pre op upper arch, c: Pre op lower arch, d: Immediate post op lateral view, e: Immediate post op upper arch, f: Immediate post op lower arch, g: 3 Months follow up lateral view, h: 3 Months follow up upper arch, i: 3 Months follow up lower arch, j: Chipped resin crown repaired with composite resin

| PRE OP | IMMEDIATE POST OP | 3 MONTHS FOLLOW UP | 6 MONTHS FOLLOW UP |
|---|---|---|---|
|   |   |   |   |
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| FIGURE 5 - a: Pre op lateral view, b: Pre op upper arch, c: Pre op lower arch, d: Immediate post op lateral view, e: Immediate post op upper arch f: Immediate post op lower arch g: 3 Months follow up lateral view, h: 3 Months follow up upper arch, i: 3 Months follow up lower arch, j: 6 Months follow up lateral view, k: 6 Months follow up upper rch, l: 6 Months follow up lower arch, m: Resin crown replaced by stainless steel crown | | |   |