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Case Series

Alternative esthetic pediatric crowns using digital approach: A case series

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ABSTRACT

Pediatric digital dentistry incorporates computer-aided designing and manufacturing of the crowns which enhances their marginal and internal adaptation. This allows the application of newer materials for the fabrication of crowns. Most importantly, digital workflow makes the procedure easy and comfortable for pediatric patients. The objective of this case series was to evaluate the clinical appearance and success of custom-made esthetic crowns for pediatric population. The case series presents two cases of PMMA crowns using subtractive manufacturing and two of photopolymer resin crowns using additive manufacturing. Both subtractive manufacturing and additive manufacturing have shown better marginal integrity and improved aesthetics in this case series. According to the current literature available and the present case series, these crowns have good biocompatibility, are esthetic, and more importantly relatively inexpensive.

1. Introduction

Stainless steel crowns (SSC) are a choice of full coverage restorations for primary molars with multi-surface caries and after any pulpal procedure.[1] Due to the increase in demand for esthetics, SSC has a major disadvantage of poor esthetics. Recently, the development of esthetic crowns like prefabricated zirconia crowns have shown advantages but their use is limited due to high cost.[2] Also, they cannot be contoured due to the incapability of withstanding flexural force and may fracture.[3] Certain risks of using preformed crowns like SSC and zirconia are compromised gingival health due to inadequate contours of the margins of the crown.[4]

To overcome these risks, customization with computer-aided designing and manufacturing (CAD/CAM) with different types of biocompatible restoration materials are being used. CAM is carried out in two ways, subtractive manufacturing (SM) and additive manufacturing (AM). In this case series, we discuss low-cost esthetic alternative pediatric dental crowns using CAD/CAM technology.

2. Case Series

All the cases presented in this series were treated in the department of pedodontics and preventive dentistry in collaboration with the team of digital dentistry. Medical history, extra-oral examination, allergy to medications for all the included cases were not remarkable.

2.1. PMMA crown using subtractive manufacturing

2.1.1. Case 1

Eight-year-old patient reported to the department with the chief complaint of mal-aligned teeth. On hard tissue and radiographic examination, an intact post-obturation restoration was present with 85. (Figure 1) The treatment plan was custom-made polymethyl methacrylate crown with 85 followed by orthodontic referral.

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Fig. 1: Pre-operative intra-oral photograph of Case 1.

Fig. 2: Pre-operative intra-oral photograph of Case 2.

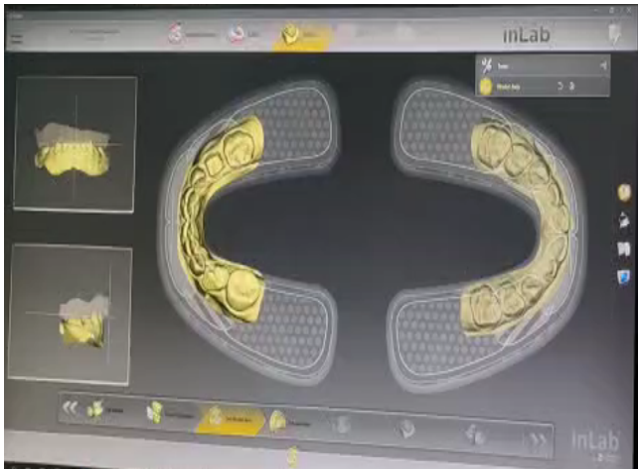

Fig. 3: Crown designing software in lab 19.0.

Fig. 4: Post-operative intra-oral photograph of Case 1.

Fig. 5: Post-operative intra-oral photograph of Case 2.

Fig. 6: Pre-operative intra-oral photograph of Case 3.

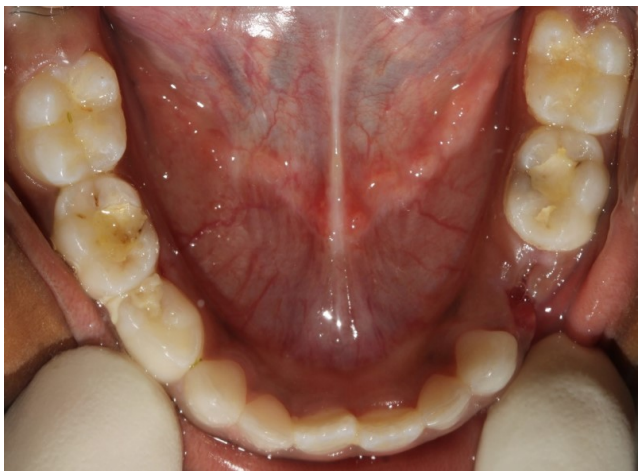

Fig. 7: Pre-operative intra-oral photograph of Case 4.

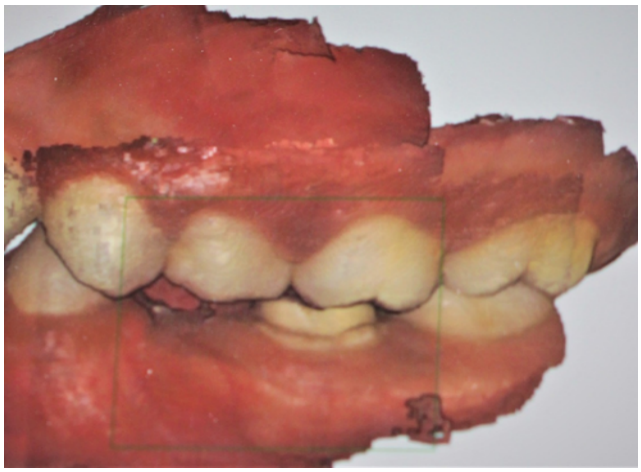

Fig. 8: Intra-oral scanning after tooth preparation.

Fig. 9: Post-operative intra-oral photograph of Case 3.

Fig. 10: Post-operative intra-oral photograph of Case 4.

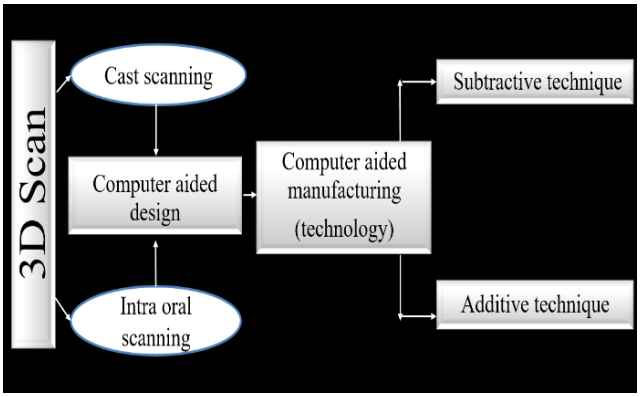

Fig. 11: Digital workflow for crown fabrication.

2.1.2. Case 2

Five-year-old patient reported to the department for regular follow up. On hard tissue and radiographic examination, intact post-obturation restoration was present with 64 and class III caries with 51 and 61. (Figure 2) The treatment plan formulated was custom-made polymethyl methacrylate crown with 64 and restoration with 51 and 61.

2.2. Clinical and laboratory procedure for both the cases for PMMA crown was similar

The occlusal surface was reduced to provide a clearance of 1.5 mm and a convergence angle of 6 degrees. Diamond round-end tapered bur was used for buccal, lingual, mesial, and distal wall preparation of 0.8 to 1.0 mm, followed by a chamfer margin circumferentially. A two-step putty/ light body elastomeric impression was made and a dental cast was obtained. Cast was scanned (inEOS X5 scanner), data were exported into standard tessellation language (STL) files and transferred to crown designing software (inLab 19.0). (Figure 3) As the software library does not contain the design for primary molar crowns, a permanent premolar

crown was selected and adapted to fit in primary molars. The command from the milling software was transferred to the machine and the milling was done to obtain the crown. These crowns were then cemented using type I GIC luting agent. (Figures 4 and 5)

2.3. 3d printed photopolymer resin crown using additive manufacturing

2.3.1. Case 3

Nine-year-old male patient reported to the department with the chief complaint of missing teeth in lower left back region since 3 months. On hard tissue examination and radiographic examination, clinically missing 74 and pulpotomized tooth followed by intact GIC restoration with 75. (Figure 6) Custom made photopolymer resin crown was planned in relation to 75 was present whereas space maintainer was not required for missing tooth.

2.3.2. Case 4

Eight-year-old female patient reported to the department for regular follow up. On hard tissue examination, intact post-obturation restoration with 75 and clinical missing with 74. (Figure 7) Custom-made photopolymer resin crown was planned with 75 whereas space maintainer was not required for missing tooth.

2.4. Clinical and laboratory procedure for both the cases of photopolymer resin crown was similar

Teeth were prepared in a similar way as for PMMA crown. Digital impression was made with an intraoral scanner (HERON-3Disc). (Figure 8) Files of each digital impression were saved in OBJ format and digital model was obtained. The crowns were then designed in a similar way as for PMMA crown and saved in STL format. The STL files were exported in the 3D printer software (Halot box) and slicing of the files was done to determine the thickness of each layer to be printed. The crowns were fabricated using Curo Resin using digital light processing (DLP) printing technique. Once the crowns were obtained, they were cemented using type I GIC luting agent. (Figures 9 and 10)

3. Discussion

Incorporating digitization in pediatric dentistry reduces mean chairside time and is comfortable for the child.[5] Digital workflow for crown fabrication involves various steps (Figure 11).

Intra-oral scanners are optical devices that capture images of dento-gingival tissues via the imaging sensors present on them. These images are processed and triangulated by the same software to create a 3D mesh which is converted to a 3D digital model.[6]

The case series of PMMA crowns were performed using SM (provide space between using and SM). Various materials used for SM are titanium metal block, zirconia block, casting wax block, PMMA block, etc.[7] They improve the dimensional stability, mechanical strength, higher marginal and internal adaptation, and have superior esthetics. The disadvantages of SM are that it is hard to accomplish perfect three-dimensional milling due to the bur size and limits of the motion range of the cutter. As it is subtractive milling, there is an increased material wastage thus it is less economical and non-eco-friendly.[8]

The case series of photopolymer resin crowns were performed using AM using the digital light processing (DLP) technique. In DLP printing the light source is a laser that uses projection technology where the laser source is projected towards the VAT polymer resin tank via a digital micro-mirror device. AM has various advantages, it creates smooth prosthetic structures than the milling method and is more accurate. The occlusal anatomy was better reproduced in AM than in SM. It is more economical and has superior esthetics. Although, its manufacturing is more complex and has comparatively low mechanical strength.[8]

These custom-made crowns are esthetic and have a good flexural strength which exceeds the mean maximum bite force of the children in primary molars. They have a better marginal fit than the preformed zirconia crown as it cannot be contoured and crimped. Most importantly they are more economical than the preformed zirconia crowns. Further clinical studies are needed to evaluate the long-term clinical performance of these crowns.

4. Conclusion

Both subtractive manufacturing and additive manufacturing have shown better marginal intergrity and improved esthetics in this case series. The occlusal anatomy and the esthetics were superior for additive manufacturing but comparable to subtractive manufacturing. Further long-term trials assessing the clinical success rate and acceptability by the patient and parents is warranted.

5. Highlights

1. This case series describes a digital approach for the customization of esthetic crowns in pediatric practice with the help of two cases depicting the use of subtractive manufacturing for polymethylmethacrylate crowns and two cases using additive manufacturing with 3D printing for photopolymer resin.
2. Subtractive manufacturing involves the wastage of material and cannot provide proper anatomy due to its limits of motion range cutter in contrast to additive manufacturing which works on the principle of layer-by-layer technique.

3. Customization of crowns using both techniques improves marginal adaptation and has good acceptance by parents as well as children. Most importantly it reduces the cost in contrast to commercially available prefabricated esthetic crowns.

6. Conflicts of Interests

The authors have no financial interests or conflicts of interests.

7. Source of Funding

None.

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