CASE REPORT

3D Printed Denture for a Pediatric Patient with Complete Anodontia: A Case Report

Priyanka V Agrawal[1], Krishna R Lahoti[2], Nilesh Rathi[3], Amit Jagtap[4], Aditi Tasgaonkar[5], Ritu Kotnis[6]

Received on: 02 September 2024; *Accepted on:* 09 October 2024; *Published on:* 14 February 2025

Abstract

Aim: This is a case report of a 4-year-old patient with complete anodontia due to ectodermal dysplasia (ED) using digital planning and printing of a complete denture.

Background: ED is a hereditary disorder characterized by the abnormal development of ectodermal tissues, often resulting in anodontia. Traditional treatment methods for anodontia in pediatric patients are challenging and often less effective. Recent advancements in digital technologies offer promising alternatives, providing better outcomes for patients with ED.

Case description: A 4-year-old patient diagnosed with complete anodontia due to ED underwent treatment using a three-dimensional (3D) printed complete denture. Advanced digital technologies, including the intraoral scanner and the 3D printer, were utilized in the treatment process. The application of these technologies led to significant improvements in the patient's oral functions, psychological well-being, and overall health.

Conclusion: The use of a 3D printed complete denture for a pediatric patient with ED resulted in notable enhancements in oral functionality and quality of life. This case signifies the utility of digital planning and scanning in the fabrication of a denture for pediatric patients with ED.

Clinical significance: This case underscores the benefits of 3D printing technology over conventional methods in the treatment of anodontia in pediatric patients with ED. The successful application of these advanced digital technologies demonstrates their potential to revolutionize dental care, providing improved outcomes and enhancing the overall well-being of affected individuals.

Keywords: 3D printing, Case report, Complete denture, Digital dentistry, Ectodermal dysplasia, Pediatric dentistry, Pediatric prosthodontics.

International Journal of Clinical Pediatric Dentistry (2025): 10.5005/jp-journals-10005-3027

Introduction

Ectodermal dysplasia (ED) is a hereditary disorder characterized by the abnormal development of ectodermal structures, including the skin, hair, nails, teeth, and sweat glands. The prevalence of ED varies widely in different geographical locations, with estimates suggesting it affects between 1 in 10,000 and 1 in 1,00,000 individuals globally.[1] Among the dental manifestations of ED, complete anodontia is one of the most severe, profoundly impacting a child's oral health, function, and overall quality of life. Children with complete anodontia lack all primary and permanent teeth, leading to significant difficulties in mastication, speech development, and esthetics, which can, in turn, affect their psychological and social well-being.[2]

Pediatric dentists play a crucial role in managing children with ED and anodontia. Their expertise is vital in early diagnosis, comprehensive treatment planning, and the provision of prosthetic solutions to restore function and esthetics. Conventional dentures, while commonly used, pose several challenges in young children, including difficulty in achieving optimal fit and retention, frequent adjustments due to growth, and limited acceptance by the child. These challenges necessitate innovative solutions that can provide better adaptability, comfort, and effectiveness. The advent of three-dimensional (3D) printing technology in dentistry offers a promising alternative to traditional prosthetic methods. 3D printed dentures can be precisely tailored to the patient's anatomy, providing superior fit and comfort, and can be easily modified as the child grows.[3]

In this case report, we present the successful management of a 4-year-old patient with complete anodontia and ED using a 3D printed complete denture. This case highlights the advantages of 3D printed dentures over conventional methods, demonstrating enhanced fit, esthetics, and patient acceptance, marking a significant advancement in pediatric prosthodontics and setting a precedent for future treatments in similar cases.[4]

[1,3,5,6]Department of Pediatric and Preventive Dentistry, Dr D Y Patil Dental College and Hospital, Dr D Y Patil Vidyapeeth, Pune, Maharashtra, India

[2,4]Department of Prosthodontics, Crown and Bridge and Implantology, Dr D Y Patil Dental College and Hospital, Dr D Y Patil Vidyapeeth, Pune, Maharashtra, India

Corresponding Author: Nilesh Rathi, Department of Pediatric and Preventive Dentistry, Dr D Y Patil Dental College and Hospital, Dr D Y Patil Vidyapeeth, Pune, Maharashtra, India, Phone: +91 9960100010, e-mail: nilesh.rathi@dpu.edu.in

How to cite this article: Agrawal PV, Lahoti KR, Rathi N, *et al.* 3D Printed Denture for a Pediatric Patient with Complete Anodontia: A Case Report. Int J Clin Pediatr Dent 2025;18(1):114–118.

Source of support: Nil

Conflict of interest: None

Patient consent statement: The author(s) have obtained written informed consent from the patient's parents/legal guardians for publication of the case report details and related images.

Case Description

A 4-year-old male reported to the Department of Pediatric and Preventive Dentistry at Dr D Y Patil Dental College and Hospital, Pune, with a chief complaint of missing teeth and difficulty in eating and speaking. The medical history revealed a diagnosis of ED. The patient had sparse hair, dry skin, reduced sweating, and a distinctive facial appearance due to underdeveloped midface and nasal bridge. There was no relevant family history associated with the patient. Intraoral

examination confirmed complete anodontia, with no evidence of primary or permanent tooth buds on CBCT evaluation. The oral mucosa appeared healthy, with no signs of infection or inflammation. The maxillary ridge had a flat surface with an underdeveloped alveolar process. The mandibular ridge featured a knife-edge appearance, with the retromolar pad area being subtly defined (Fig. 1). The patient was diagnosed with ED. The knife-edge ridges presented significant challenges in achieving denture retention and stability due to their sharp, narrow crests and poor bone quality. Given the patient's age and condition, fabricating a complete denture was deemed the most appropriate treatment for oral rehabilitation.

The intraoral scanner (Trios 3, 3Shape, Denmark) was used to record the edentulous arches digitally (Fig. 2). The scanner's ability to produce immediate visual feedback also played a significant role in gaining the young patient's trust and cooperation. During this step, we employed behavior management techniques such as the "tell-show-do" method, where we explained the procedure and demonstrated the scanner on a model.

Following the digital impressions, the master cast along with the record base were printed, and the occlusal rims were prepared using modeling wax. The record base provided a stable platform, while the occlusal rims allowed us to determine the vertical dimension and the spatial relationship between the maxilla and mandible. The horizontal jaw relation was first recorded using a fox plane, ensuring the occlusal plane was parallel to the interpupillary line and the ala-tragus line. Next, the vertical dimension was determined by calculating the freeway space, aiming for a 2–4 mm space for comfort. The centric relation was then recorded using a wax bite

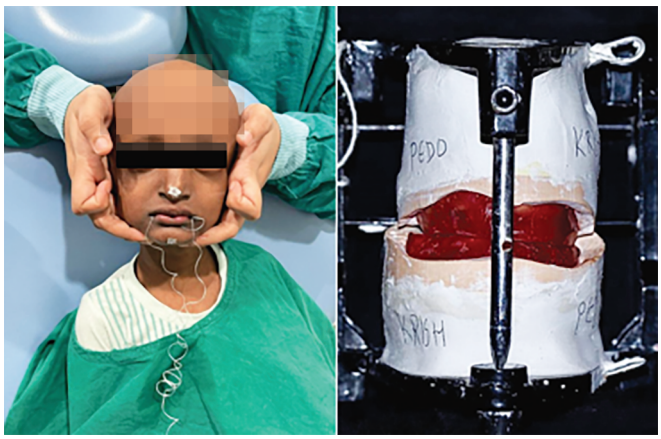

Fig. 3: Recording JR using pin and floss method and transferring it to articulator

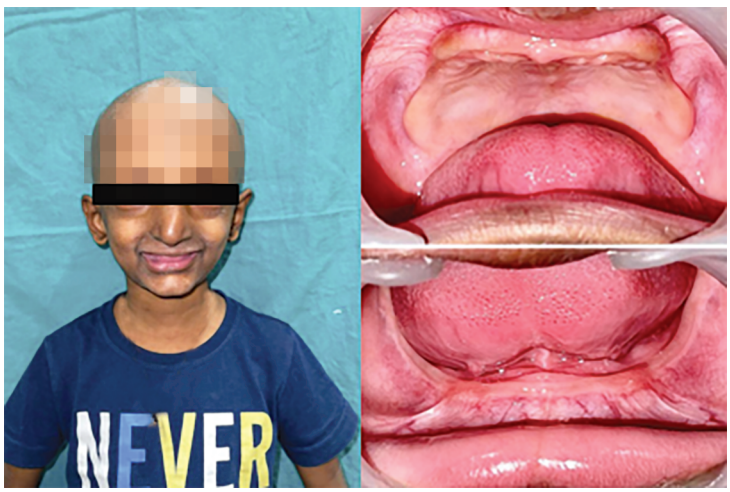

Fig. 1: Intraoral and extraoral photograph showing complete anodontia

Fig. 2: 3D digital impression of the edentulous arch using intraoral scanner

registration, guiding the patient gently into centric occlusion. This registration was crucial for ensuring stable and repeatable jaw positioning. To transfer these relations to an articulator, the pin and floss method was employed, which involved stabilizing the wax rims in the patient's mouth using pins and floss to mimic the patient's recorded jaw relations accurately (Fig. 3).

The articulated jaw relation was scanned using the scanner, and the data was processed for further utilization. A denture was designed for the patient using DentalCAD® 3.2 Elefsina (Exocad GmbH, Darmstadt, Germany) software. Primary teeth were meticulously designed to fit the digital model, ensuring proper size, shape, and alignment. The monoplane occlusion was then incorporated into the design, where the teeth were set on a flat plane without any cuspal interdigitation, promoting even and balanced contact. The digital model was reviewed and adjusted for accuracy before being fabricated using a 3D printer (Fig. 4).

With the design finalized, we proceeded to print a trial denture using the 3D printer (SprintRay Pro 95, U.S.A.). The denture base and teeth were printed separately using SprintRay Denture Base Resin (Polylactic acid) and SprintRay Crown™ resin, respectively, and were cemented together using cyanoacrylate (Fig. 5). For speech assessment, we engaged the child in conversation and asked him to repeat simple sentences and phrases that included a variety of phonetic sounds, such as "The cat is on the mat." To assess retention, we observed the fit and stability of the denture while the child was speaking, eating soft foods, and performing various mouth movements like smiling and opening wide. Any signs of slippage or discomfort were noted, and adjustments were made accordingly to ensure a secure and comfortable fit. After a successful try-in and the required adjustments, the final denture was printed with monoplane occlusion to facilitate ease of use for the young patient using denture base and crown resin. The final step involved the delivery of the denture to the patient, along with detailed post-operative instructions to ensure proper

Fig. 6: Preop and postop pictures

Fig. 4: Design of the complete denture

Fig. 5: Final 3D printed complete denture

maintenance and adaptation of the denture, along with emphasis on regular follow-up appointments (Fig. 6). The patient showed good compliance, and the denture exhibited excellent retention, significantly improving speech, psychological confidence, and nutrition on follow-up after 1 month.

Discussion

Oral rehabilitation for patients with complete anodontia due to ED presents unique challenges and requires specialized approaches.[5] Traditional options include removable complete dentures, fixed prostheses supported by dental implants, and hybrid prostheses combining both methods. Removable complete dentures, while effective, often pose significant difficulties for pediatric patients due to their physical and psychological development. Fixed prostheses supported by dental implants provide a more stable and permanent solution but may not be feasible in all cases, particularly for young children with insufficient volume of jawbone. Advances in digital technology, particularly 3D printing, offer new and promising solutions for these patients, enabling more precise and patient-friendly approaches to oral rehabilitation.[6]

The successful delivery of the denture marked a significant milestone in the patient's treatment, offering improved function, esthetics, and overall quality of life. The psychological confidence of the patient was notably enhanced, as evidenced by increased social interactions and overall happiness. Over the course of 1 month, the patient experienced significant weight gain and improved nutrition. The 3D printed denture demonstrated excellent retention and stability, contributing to these positive outcomes. Dentures play a crucial role in the growth and development of jaws in pediatric patients, especially those with conditions such as ED, which can cause anodontia or missing teeth. The presence of dentures provides the necessary stimulation to the jawbones and surrounding tissues, promoting healthy bone growth and preventing atrophy. In the absence of natural teeth, dentures act as a substitute, helping maintain the normal dimensions of the dental arches and supporting facial structures. This is essential for the proper alignment of the jaws, which in turn influences the development of speech and chewing abilities.[7]

The use of intraoral scanning technology in edentulous pediatric patients with ED offers numerous advantages over traditional impression-taking methods.[8] Intraoral scanners provide a quick, comfortable, and noninvasive way to capture detailed digital impressions, significantly reducing the discomfort and anxiety often experienced by young patients.[9] The ergonomic design and smaller size of intraoral scanners, compared to bulky traditional impression trays, minimize the gag reflex, a common issue in pediatric dentistry. This technology allows for the creation of accurate digital models without the need for messy impression materials, further enhancing patient comfort.[10]

Three-dimensional printing technology revolutionizes the fabrication of complete dentures for pediatric patients with ED by offering precision, efficiency, and improved patient outcomes. The primary advantage lies in the ability to create dentures with high accuracy using digital impressions and CAD/CAM technology.[11] Dental acrylic resins used for fabricating denture bases must exhibit several key qualities, including mechanical strength, chemical inertness, high biocompatibility, and excellent esthetic properties. Resins used for printing denture bases exhibit superior properties when compared to conventional denture base resins.[12] This precision ensures better retention and stability of the dentures, reducing the need for frequent adjustments and minimizing discomfort. The streamlined process of 3D printing allows for faster fabrication and fitting, significantly reducing overall treatment time.[11] In growing pediatric patients, the use of intraoral scanners and 3D printers offers significant advantages for denture adjustments due to jaw growth. Digital scanners quickly and comfortably capture the current oral anatomy on which dentures can be designed using dedicated apps available in the software.[13]

In this case, the intraoral scanner and 3D printer were utilized to fabricate the complete denture for the pediatric patient. The combination of these advanced digital technologies ensured that the dentures were tailored to the unique needs of the patient, hence providing a more effective and comfortable solution compared to traditional methods. Monoplane occlusion was selected for its flat-plane design, reducing cuspal interferences and accommodating natural jaw growth. This type of occlusion minimizes trauma to oral tissues and allows for easy adjustments as the child grows. Benefits include enhanced stability, comfort, and effective chewing without complex occlusal schemes. Monoplane occlusion ensures even distribution of masticatory forces, reducing irritation and sore spots, and promotes natural and balanced jaw function.[14] This case demonstrates significant improvements in the patient's oral functions, psychological well-being, and overall health, underscoring the advantages of utilizing advanced digital methods.[15]

Conclusion

The use of 3D printed complete dentures in pediatric patients with ED and anodontia offers significant advantages over conventional methods. This case report highlights the successful implementation of digital dentistry techniques, resulting in improved functional and psychological outcomes for the patient. Further research and clinical trials are warranted to establish standardized protocols and long-term benefits of this innovative approach.

Clinical Significance

The successful use of 3D printing technology in fabricating complete dentures for a pediatric patient with ED sets a precedent for future treatments and highlights the potential of digital technologies in pediatric prosthodontics.[15] Future research and clinical practice can build on this success by exploring the broader application of 3D printing in managing complex dental conditions in pediatric patients. The ability to customize and quickly produce precise prostheses holds promise for improving patient outcomes and reducing treatment burdens. The positive outcomes observed in this case underscore the potential of 3D printing technology to revolutionize pediatric prosthodontics.

Orcid

Priyanka V Agrawal https://orcid.org/0000-0002-7660-0550
Krishna R Lahoti https://orcid.org/0009-0007-8293-370X
Nilesh Rathi https://orcid.org/0000-0003-0595-5191
Amit Jagtap https://orcid.org/0000-0002-2966-165X
Aditi Tasgaonkar https://orcid.org/0009-0001-2522-3871

References

1. Clarke A. Hypohidrotic ectodermal dysplasia. J Med Genet 1987;24(11):659–663. DOI: 10.1136/jmg.24.11.659
2. Niemiec BA. Oral pathology. Top Companion Anim Med 2008;23(2):59–71. DOI: 10.1053/j.tcam.2008.02.002

3. Dusmukhamedov S, Lee CN, Jeong SM, et al. Digital denture fabrication: a technical note. Appl Sci 2021;11(17):8093. DOI: 10.3390/app11178093
4. Satpathy A, Ranjan R, Priyadarsini S, et al. Diagnostic imaging techniques in oral diseases. Med Imaging Methods 2019:59–95. DOI: 10.1007/978-981-13-9121-7_3
5. Deshpande SN, Kumar V. Ectodermal dysplasia—maxillary and mandibular alveolar reconstruction with dental rehabilitation: a case report and review of the literature. Indian J Plast Surg 2010;43(1):92–96. DOI: 10.4103/0970-0358.63969
6. Lee DJ, Saponaro PC. Management of edentulous patients. Dent Clin North Am 2019;63(2):249–261. DOI: 10.1016/j.cden.2018.11.006
7. Roessler DM. Complete denture success for patients and dentists. Int Dent J 2003;53(S5):340–345. DOI: 10.1111/j.1875-595x.2003.tb00908.x
8. Thalji G, Jia-mahasap W. CAD/CAM removable dental prostheses: a review of digital impression techniques for edentulous arches and advancements on design and manufacturing systems. Curr Oral Health Rep 2017;4:151–157. DOI: 10.1007/s40496-017-0137-z
9. Amornvit P, Rokaya D, Sanohkan S. Comparison of accuracy of current ten intraoral scanners. BioMed Res Int 2021;2021:2673040. DOI: 10.1155/2021/2673040
10. Varghese AA, Xavier AM, Ramanarayanan V. Removable prosthetic management for tooth agenesis in the pediatric population: a systematic review of case reports and case series. J Prosthet Dent 2024;132:1250.e1–1250.e8. DOI: 10.1016/j.prosdent.2023.02.005
11. Alhallak K, Hagi-Pavli E, Nankali A. A review on clinical use of CAD/CAM and 3D printed dentures. Br Dent J 2023;9:1–5. DOI: 10.1038/s41415-022-5401-5
12. Prpić V, Schauperl Z, Ćatić A, et al. Comparison of mechanical properties of 3D-printed, CAD/CAM, and conventional denture base materials. J Prosthodont 2020;29(6):524–528. DOI: 10.1111/jopr.13175
13. Anadioti E, Musharbash L, Blatz MB, et al. 3D printed complete removable dental prostheses: a narrative review. BMC Oral Health 2020;20:343. DOI: 10.1186/s12903-020-01328-8
14. Bidra AS, Martin JW, Feldman E. Complete denture prosthodontics in children with ectodermal dysplasia: review of principles and techniques. Compend Contin Educ Dent 2010;31(6):426–433.
15. Schnabl D, Grunert I, Schmuth M, et al. Prosthetic rehabilitation of patients with hypohidrotic ectodermal dysplasia: a systematic review. J Oral Rehabil 2018;45(7):555–570. DOI: 10.1111/joor.12638