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CASE REPORT

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Digital workflow for a space maintainer in a pediatric patient: a case report

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ABSTRACT

This case report describes the use of digital technology in pediatric dentistry to fabricate a space maintainer for a 6-year-old patient with dental anxiety and fear related to previous traumatic experiences. An intraoral scanner and computer-aided design software were used to generate a three-dimensional digital model of the dental arch, on which the space maintainer was designed and fabricated. The device was made from polymethyl methacrylate using a subtractive dry-milling process. Incorporating a digital workflow into clinical care may provide a less invasive and more comfortable alternative for managing children with dental anxiety and fear of dental treatment.

Keywords: anxiety; child; dental arch; pediatric dentistry; digital technology.

INTRODUCTION

Digital dentistry has achieved significant advances in recent years, improving both the precision and comfort of dental treatments. In this context, intraoral scanning and digital impression techniques have demonstrated considerable advantages for both dentists and patients, as they reduce procedure time and enhance the overall care experience, particularly in pediatric dentistry (1).

CAD/CAM technology (computer-aided design and computer-aided manufacturing) has revolutionized dentistry by enabling the fabrication of dental restorations with high precision and shorter production times. This technology has opened new opportunities for faster, more personalized, and high-quality treatments (2). In pediatric dentistry, the implementation of a digital workflow has expanded treatment options, facilitating the creation of three-dimensional dental arch models that better adapt to the needs of patients (3).

A space maintainer is a device, either fixed or removable, primarily used to preserve the space generated by the premature loss of one or more primary teeth until the eruption of the permanent successor(s) (4). Its function is to maintain arch length, preventing potential malocclusion problems such as crowding, tooth impaction, ectopic eruption, among others (5,6). In addition, it saves time and minimizes the need for complex orthodontic treatments in the future (7,8).

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This case report describes the use of digital technologies in the fabrication of a space maintainer for a pediatric patient, highlighting how their application can improve care for children with a history of dental anxiety. The objective is to propose a digital workflow alternative for the management of pediatric patients with previous negative dental experiences.

This study received approval from the Research Bioethics Committee of the Faculty of Dentistry of the Universidad de Concepción, Chile. The treatment was explained to the patient using age-appropriate language, and verbal assent was obtained from the patient, along with written informed consent from the legal guardian.

CASE PRESENTATION

A 6-year-old patient attended the Pediatric Dentistry Clinic at the Universidad de Concepción with his mother. According to the mother, the reason for the consultation was the "presence of multiple carious lesions in the child's teeth and the need to restore his oral health." She also reported a previous traumatic dental experience, which led the child to reject any dental treatment, manifesting as poor cooperation, anxiety, and fear. After conducting a thorough medical history review and clinical and radiographic examination of the patient, a diagnosis, prognosis, and treatment plan were established. The treatment plan included the indication for extraction of the maxillary right primary first molar and the placement of a space maintainer. Given the context of anxiety and resistance to treatment, the use of advanced digital tools was recommended as part of an integrated treatment strategy.

The intraoral records were obtained using an Aoralscan 3 intraoral scanner (SHINING 3D®, Wenyan, Xiaoshan, Hangzhou, Zhejiang, China). The records were then imported into Exocad® software (Darmstadt, Germany), where a three-dimensional digital model was created and used to fabricate a resin maxillary model through a Form 3+ 3D printing system. After that, the space maintainer was designed and fabricated using a subtractive manufacturing process with a P53 dental milling machine from the UP3D system (3DBiotech®, Córdoba, Spain), for which a polymethyl methacrylate (PMMA) disc (Prolab, Turin, Italy) was selected due to its high mechanical strength (5) (Figure 1A). Finally, the fit of the device was verified on the resin maxillary model before placement in the patient's mouth to reduce the likelihood of errors (Figure 1B).

During the clinical session with the patient, the correct fit and placement of the device was verified after securing it with dental floss to prevent the risk of ingestion or aspiration. As a final step, it was cemented using 3M Unitek™ multi-cured glass ionomer orthodontic band cement (3M, Saint Paul, Minnesota, USA). (Figure 2). A follow-up visit was conducted one week later, confirming that the space maintainer was well positioned, with adequate hygiene and no alterations in the tissues or structures adjacent to the device. The esthetic appearance was well accepted by the patient, showing a significant change in attitude towards the treatment and willingness to continue with it. After three months of follow-up and monitoring, it was observed that the device remained in good mechanical, physical, and aesthetic condition, and the patient continued to demonstrate good oral hygiene. The patient is currently enrolled in a periodic follow-up and monitoring program.

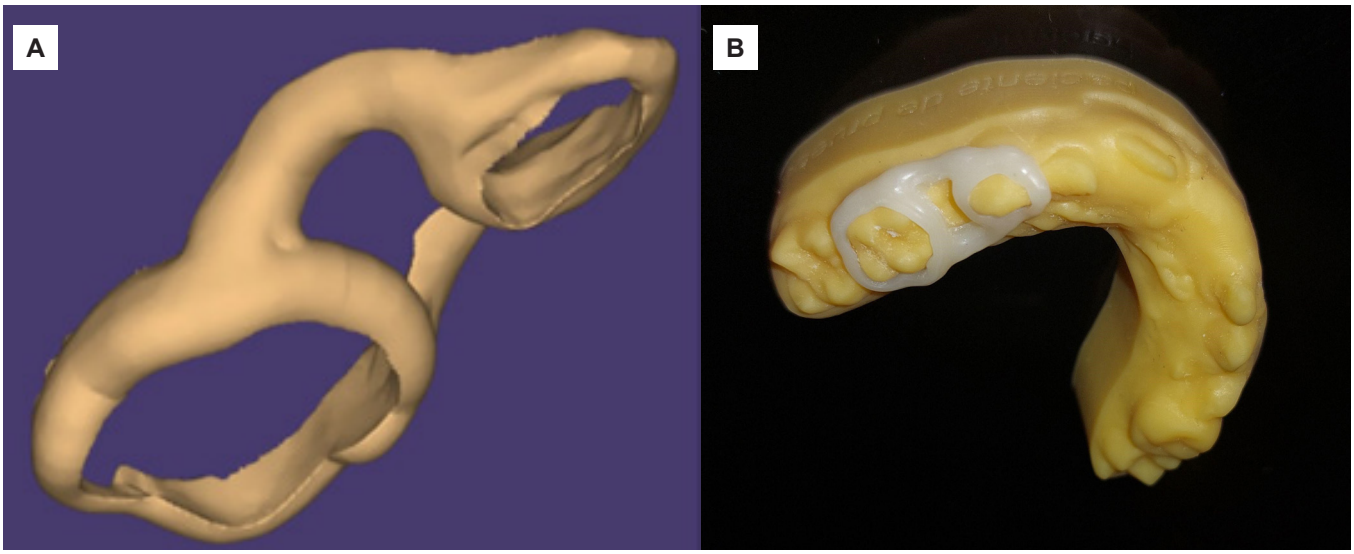

Figure 1. A) Three-dimensional model of the space maintainer in Exocad® software. B) Preliminary fitting of the space maintainer on the resin maxillary model.

Figure 2. Occlusal view of the space maintainer cemented in the patient's oral cavity.

DISCUSSION

The use of digital technologies in dentistry has enabled significant advances in pediatric dental care, especially for patients with anxiety or fear of treatment. Intraoral scanning and digital impressions have been shown to be superior to traditional impression techniques in terms of comfort and preference, particularly in those with gag reflexes or high sensitivity (9-11). A study conducted by Yilmaz et al. (9) confirmed this observation using an adapted version of the Visual Analog Scale (VAS) designed to assess the perceived intensity of sensations in children, based on the results of a questionnaire on printing method preferences, revealing a majority choice among children in favor of the intraoral scanning technique. This case report highlights that the use of this technique improved comfort and accuracy while reducing patient stress during the clinical procedure. Moreover, rapid adaptation to the digital workflow promoted a more positive attitude toward treatment. This highlights the importance of digital technology in improving the pediatric patient experience and enhancing treatment adherence.

The use of CAD/CAM software in the creation of space maintainers allows for a more precise and conservative design, with better adaptation and retention of the device, reducing the risk of debonding. The ability to customize the color of the material, as in the case of polymethyl methacrylate (PMMA), provides optimal esthetics that are often preferred by patients and their families compared with traditional metallic materials. In addition, in patients requiring endodontic treatment, this approach facilitates access to the pulp chamber without requiring removal or perforation of the stainless-steel crown (12).

In terms of material selection, PMMA was chosen because of its biocompatibility, durability, and mechanical stability. Although the use of polyetheretherketone (PEEK) has been proposed, previous studies have shown that, due to its lower elastic modulus, this material generates greater stress on underlying structures, making it less suitable for this type of device (13). In this case, subsequent clinical follow-ups confirmed the durability of the design, with no evidence of fracture or material failure. However, digital flow allows the creation of exact replicas of the space maintainer, facilitating its rapid replacement if necessary. This contributes to increased treatment efficiency and reduced fabrication time (1,14,15).

CONCLUSIONS

This report highlights the importance of integrating digital technologies into the fabrication of PMMA-based space maintainers, given their high level of patient acceptance, preservation of physical and mechanical properties, and reduction of dental fear as a result of improved procedural tolerance. This advancement contributes significantly to enhanced treatment acceptance among pediatric dental patients who experience anxiety. The use of CAD/CAM technology enables the precise production of these devices with a lower likelihood of error, allowing for accurate reproduction of tooth color and optimization of mechanical and biological properties. These results pave the way for broader studies in clinical practice. Finally, this technological advancement warrants further in-depth exploration and rigorous analysis to enhance its impact on pediatric dental treatments and improve patients' quality of life.

Conflict of interest:
The authors declare no conflict of interest.

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Ethics approval:
This case has the approval from the Ethics Committee of the Faculty of Dentistry of the Universidad de Concepción, Chile, under CEC Certificate No. 10/23, dated November 10, 2023.

Authorship contribution:
APF: conceptualization, research, methodology, resources, supervision, validation, writing of the original draft, writing – review & editing.
JHS: conceptualization, research, methodology.
CBF: writing – review & editing.
FAS: conceptualization, research.
CFM: methodology, writing – review & editing.

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REFERENCIAS

1. Rodrigues LP, Dourado PH, De Araújo CA, No-Cortes J, Pinhata-Baptista OH. Digital workflow to produce esthetic space maintainers for growing patients. J Prosthet Dent [Internet]. 2024; 131(5): 800-803. Available from: https://doi.org/10.1016/j.prosdent.2022.02.026
2. Suganna M, Kausher H, Tarek Ahmed S, Sultan Alharbi H, Faraj Alsubaie B, DS A, et al. Contemporary evidence of CAD-CAM in dentistry: a systematic review. Cureus [Internet]. 2022; 14(11): e31687. Available from: https://doi.org/10.7759/cureus.31687
3. Sikdar R, Bag A, Shirolkar S, Gayen K, Sarkar S, Roychowdhury S. 3D printing: its application in pediatric dental practice. Acta Scient Dent Scien [Internet]. 2022; 6(2): 103-111. Available from: https://doi.org/10.31080/ASDS.2022.06.1306
4. Khalaf K, Mustafa A, Wazzan M, Omar M, Estaitia M, El-Kishawi M. Clinical effectiveness of space maintainers and space regainers in the mixed dentition: a systematic review. Saudi Dent J [Internet]. 2022; 34(2): 75-86. Available from: https://doi.org/10.1016/j.sdentj.2021.09.025
5. Zhao J, Jin H, Li X, Qin X. Dental arch spatial changes after premature loss of first primary molars: a systematic review and meta-analysis of split-mouth studies. BMC Oral Health [Internet]. 2023; 23(1): 430. Available from: https://doi.org/10.1186/s12903-023-03111-x
6. Chandak P, Baliga S, Thosar N. Space regainers in pediatric dentistry. Int Dent Med J Adv Res. 2015; 1(1): 1-5.
7. Law CS, Fields H. Space maintenance in the primary dentition. In: Nowak AJ, Christensen JR, Mabry TR, Townsend JA, Wells MH, editors. Pediatric Dentistry: Infancy through adolescence. 6th ed. Philadelphia: Elsevier; 2019. pp. 379-385.e2. Available from: https://doi.org/10.1016/B978-0-323-60826-8.00026-2
8. Singh PH. Simplify your space maintenance with the new H-appliance: a case report. Int J Med Dent Case Rep. 2019; 6: 1-3.
9. Yilmaz H, Aydin MN. Digital versus conventional impression method in children: comfort, preference and time. Int J Paediatr Dent [Internet]. 2019; 29(6): 728-735. Available from: https://doi.org/10.1111/ipd.12566
10. Kravitz ND, Groth C, Jones PE, Graham JW, Redmond WR. Intraoral digital scanners. J Clin Orthod. 2014; 48(6): 337-347.
11. Burzynski JA, Firestone AR, Beck FM, Fields HW, Deguchi T. Comparison of digital intraoral scanners and alginate impressions: time and patient satisfaction. Am J Orthod Dentofacial Orthop [Internet]. 2018; 153(4): 534-541. Available from: https://doi.org/10.1016/j.ajodo.2017.08.017
12. Lee JH. Fully digital workflow for the fabrication of a tooth-colored space maintainer for a young patient. J Esthet Restor Dent [Internet]. 2023; 35(4): 561-566. Available from: https://doi.org/10.1111/jerd.12939
13. Barua SL, Poduval TS, Rani S, Jain N, Thakur S. Stress distribution in bone around an implant-supported three-unit fixed dental prosthesis using two different computer-aided designing/computer-aided milling provisional crown materials: milled polymethylmethacrylate and milled polyetheretherketone - A finite element analysis. Dent Res J (Isfahan) [Internet]. 2023; 20: 33. Available from: https://pmc.ncbi.nlm.nih.gov/articles/PMC10166750/
14. Raszewski Z, Nowakowska-Toporowska A, Nowakowska D, Więckiewicz W. Update on acrylic resins used in dentistry. Mini Rev Med Chem [Internet]. 2021; 21(15): 2130-2137. Available from: https://doi.org/10.2174/1389557521666210226151214
15. Al-Dharrab A. The residual monomer content and mechanical properties of CAD\CAM resins used in the fabrication of complete dentures as compared to heat cured resins. Electron Physician [Internet]. 2017; 9(7): 4766-4772. Available from: https://doi.org/10.19082/4766