CASE REPORT

DOI: 10.62838/ASMJ.2024.1.05

Digital workflow in pediatric dentistry. A case report.

Moldovan Marcieana[1], Laios Daria[2], Miches Marina Adriana[3], Muntean Alexandrina[3]
[1] George Emil Palade University of Medicine, Pharmacy, Science, and Technology of Târgu-Mureș, Romania
[2] County Hospital Cluj
[3] Iuliu Hațieganu University of Medicine and Pharmacy, Cluj-Napoca, Romania

Abstract
Introduction. This study aims to discuss the diagnosis, treatment plan, and results from the esthetic point of view and the patient's adaptability and acceptability of prosthetic and orthodontic restorations performed using CAD-CAM technology on the mandibular arch of a child patient.
Case presentation. A 6-year-old patient presented to our dental clinic, subjectively asymptomatic but desiring to improve her esthetic appearance and achieve oral health. She was diagnosed with caries of various sizes, simple as well as complicated, some teeth being therapeutically irrecoverable, others requiring endodontic treatments and extensive crown restorations. Thus, treating the mandibular arch teeth using esthetic materials and CAD-CAM technology was decided.
Conclusions. At the 6 months evaluation after cementing the prosthetic crown on tooth number 7.4 and 3 months after cementing the space maintainer on tooth number 8.5, the digitized fabricated pieces have increased esthetics, no cracks or other physical/mechanical damage appeared, and the patient, accepting them from the first day, is happy with their presence in the oral cavity.
Keywords: digital workflow, digitalization in pediatric dentistry, pedodontic crowns, individualized crowns.

Introduction

This study aims to discuss the diagnosis, treatment plan and results from an esthetic point of view and the patient's adaptability and acceptability of prosthetic and orthodontic restorations performed using CAD-CAM technology on the mandibular arch of a child patient.

Primary teeth are small and require retentive, esthetic restorations that are resistant to fracture and wear, making them difficult to treat. The main reasons for caries treatment failure in primary teeth are relapses, crown fractures, endodontic complications, and lack of restorations [1]. It is well known that restoring primary teeth with different dental materials is difficult, with quite high failure rates - up to 29.9% (for RMGIC) - at one year [1]. However, more and more effective treatment options are emerging to ensure adequate esthetics and retention of restorations in such cases [2]. It has been shown that the best method of restoration is a crown [1].

As digital technologies rapidly advance, there is always something new to learn from while redefining current trends in dentistry. Although digitalization is not a new concept in dentistry, it is only starting to be used in pediatric dentistry. The curiosity to explore and improve has led to the development of digitalization, which seems to have potential in pediatric dentistry due to the advantages of accuracy, convenience, and shortening of the time spent in the dental office. This workflow helps reduce fear and improve children's cooperation and enthusiasm for dental treatments [3].

Premature loss of a primary tooth is one of the causes of loss of space or dental arch length. When a primary tooth is lost prematurely, adjacent teeth migrate into the edentulous space, leading to dental crowding and other dental malocclusions. Various researchers have developed several devices to manage the space in case of early loss of a deciduous tooth [4]. Space maintenance concepts have been developed, and more recently, these are being produced digitally. These devices, known as "Digital Space Maintainers", use CAD-CAM or 3D printing technology together with modern, biocompatible materials to solve the challenges and drawbacks encountered in traditional manufacturing [5]. The CAD-CAM method

can virtually design and machinate restorations on an automated milling machine [6].

Typically, prosthetic/orthodontic parts are produced in a dental laboratory. The CAD-CAM process starts with a traditional impression made by the dentist, which is then converted to digital format in the lab [7]. Sirona introduced the first chairside CAD-CAM technology, the CEREC system, which allows the dentist to scan, design, and fabricate restorations directly in the dental office [8].

Case presentation

The current study presents the case of a 6-year-old patient who presented to the dental clinic with multiple carious lesions on her primary teeth. She had no dental pain, but after clinical and radiographic examination, teeth number 5.4, 5.5, 6.4, 6.5, and 8.4 were found to be therapeutically unrecoverable, with pathological root resorption and/or untreatable coronal destruction, the dental diagnosis being deep acute occlusal-proximal caries complicated with apical periodontitis. Also, 7.4 shows a deep acute disto-occlusal decay complicated with total chronic pulpitis with a closed pulp chamber. Endodontic and prosthetic treatment of the tooth was decided. Teeth 7.5 and 8.5, on examination, were diagnosed with deep, simple, occluso-proximal caries and incipient cervical caries.

Behaviorally, the patient met the specific cooperation criteria 3+ on the Frankl scale.

Prior to the implementation of treatment, the patient was instructed regarding hygiene and diet, the use of toothpaste with 1450 particles per million of Fluoride, and regular professional fluoridations for remineralization of the affected teeth (especially superficial caries at the cervical level of the 2nd primary molars) was recommended.

The following treatment plan was decided, in this order, taking into account the patient's adaptability to the evolution of the treatment difficulty, the order of exfoliation of the primary teeth (prioritizing the symptomatic teeth, which will be exfoliated last, then those with the possibility and indication of treatment, the last being the teeth that are irrecoverable from a therapeutic point of view): obturation of the mandibular 2nd molars, endodontic treatment of teeth with pulp involvement and their coronal restoration, extraction of irrecoverable teeth and ortho-prosthetic treatment of the edentulous space. Permanent 1st molars erupted during treatment and it was recommended to have them sealed for carious preventive purposes.

1. Digitized prosthetic restoration of a primary tooth

As mentioned above, tooth 7.4 is affected by deep, acute disto-occlusal caries. The tooth is in developmental stage II, a mature tooth with no visible root resorption. Differential diagnosis of caries of the first primary molar was made with deep, simple caries and deep caries complicated with apical periodontitis. Since vitality tests in children are irrelevant due to their subjectivity and non-differentiation of pain complaints, it was decided to diagnose the tooth positively during treatment. Cleaning the carious process, the pulp chamber was reached, where the vital and inflamed pulp was observed. Due to the lack of symptomatology at the time of the patient's presentation to the office or history and the signs observed in the tooth, the diagnosis of acute, deep disto-occlusal caries complicated with chronic pulpitis with closed pulp chamber was made. Endodontic and prosthetic treatment of the tooth was decided.

Endodontic treatment was performed using dam isolation, mechanical-antiseptic treatment with 21mm manual Kerr and Hedstrom files, 2% taper and 16mm rotary Kerr files (AF Baby rotary, FANTA), 4% taper, sodium hypochlorite 2%, EDTA 17% gel and saline. Root canals were filled with calcium iodoform in the commercial form of Forendo Paste, and Equia Forte HT was used for the coronal filling (figure 1).

In a separate session, tooth 7.4 was prepared with a 1.5 mm tangential shoulderless preparation, and a digital impression using the CEREC Primescan AC with CEREC Software Sirona intraoral scanner was performed. The crown was milled from Cerasmart to CAD-CAM (figure 2). Due to the isolation conditions and the need to limit the cementing time to preserve the patient's cooperation, it

was decided to cement the pedodontics crown using the glassionomer Fuji Plus (figure 3).

Figure 1. Appearance of tooth 7.4 following endodontic treatment and tangential tooth preparation.

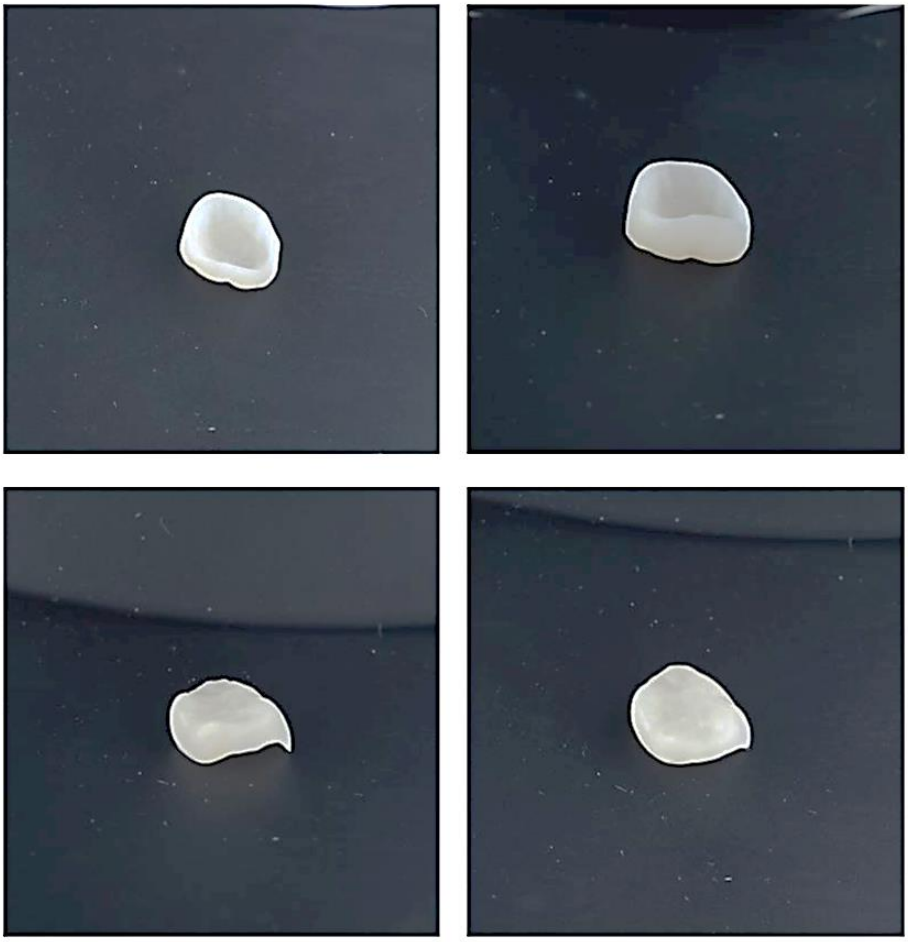

Figure 2. Esthetic appearance and crown thickness before cementation, different angles.

Figure 3. Crown appearance immediately after cementing.

The treatment was evaluated for symptoms and signs 3 and 6 months after the procedure. The patient experienced no painful symptoms at 7.4 following treatment and during the 6 months (figure 4). No fistula, abscess, or other sign indicating pathological tooth relapse was observed. The dental crown does not present cracks or fractures. As for the appearance and outcome of the treatment, both the patient and we, the authors of the study, consider the treatment a success so far. Thus, the current individualized pedodontics crown is at least as effective as a preformed one, but its individuality gives it a more esthetic and natural appearance than a preformed zirconia crown. However, from a hygiene maintenance point of view, the patient shows plaque-induced gingivitis at the time of the check-up, dental hygiene improvement did not occur during or after the treatment, and the material, although hybrid ceramic, retains plaque.

Figure 4. Appearance of the cemented crown on tooth number 7.4, 3-6 months after cementation. A and B - smile appearance, 3 months after crown cementation.
C and D – appearance of the crown on tooth 7.5, 6 months after crown cementation.

2. Preservation of esthetics and space by fixed, esthetic, digitized space maintainer

The diagnosis for tooth number 8.5 was deep D-O caries complicated with apical periodontitis. The tooth was in stage 3, showing pathological resorption predominantly in the distal root. The differential diagnosis was made with simple caries and complicated caries with chronic pulpitis, but the radiological appearance, the presence of the gingival lesion, the absence of vitality in the pulp chamber, and the discharge of secretion specific to purulent infection during endodontic drainage led to the conclusion of the above positive diagnosis.

Initially, stabilization of the condition was attempted by endodontic drainage with hydrogen peroxide, then saline. Following drainage, a mixture of antibiotics (ciprofloxacin, metronidazole, and doxycycline in a ratio of 1:3:3) was applied to the pulp chamber as local antibiotic therapy, filled with glassionomer (Equia Forte HT), treatment was maintained for 1 month. Following treatment, the dental abscess disappeared, and extraction could be performed (figure 5).

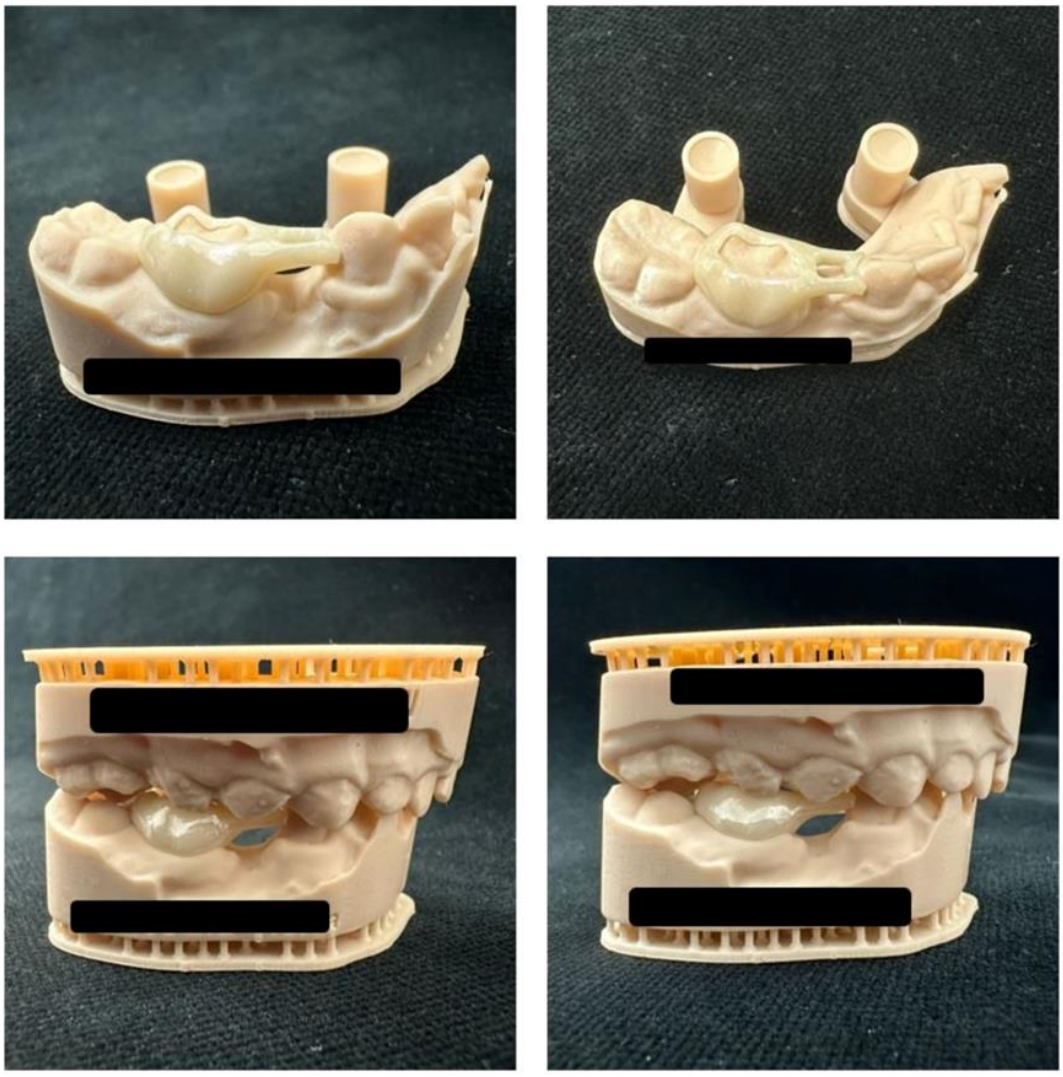

Figure 5. The appearance of the space maintainer on the digitally printed model.

For the same reasons listed above for the cementing of the crown on tooth number 7.4, but also because the space maintainer will require debonding at the time of the eruption of premolar 4.4, it was decided to cement the maintainer with glassionomer (Fuji Plus) (figure 6).

Figure 6. Clinical appearance of the space maintainer immediately after cementing.

The space maintainer was inspected 3 months after cementing (figure 7). The patient adapted to the situation very easily, and the space maintainer was unaffected esthetically or functionally. However, although the permanent 1st molar is still erupting, it requires follow-up so that the thickness of the space maintainer does not affect/block its eruption.

Figure 7. Clinical appearance of the space maintainer 3 months after cementing.

Discussions

Applying prefabricated metal crowns (SSC) is the preferred method of treatment of primary molars, with a success rate of about 96% [3]. Prefabricated zirconium oxide crowns are also used, which, although esthetically pleasing, have some important disadvantages: they require a greater sacrifice of hard substance, and according to the VICKERS classification, their hardness is 3 times higher than that of the enamel of primary teeth (900mpa vs 350 mpa), thus abbrazing the antagonists, and their adaptation in the patient's oral cavity is often difficult [3]. We fabricated a Cerasmart (hybrid ceramic) crown and a Zirconium Oxide space maintainer, taking into consideration that the patient's antagonistic natural teeth were therapeutically unrecoverable. Thus, although digital impressions were also made at the level of the

antagonist arch and occlusion, due to maxillary coronal destruction, no occlusion/occlusal adaptation problems of the prosthetic devices occurred. However, it is intended to perform the treatment of the maxillary teeth as well, and this treatment plan will be made and implemented together with the orthodontic department of the dental clinic. In this respect, it will be necessary to consider the hardness of the materials used at the mandibular level.

Kist S. et al. simulated masticatory forces in several pedodontic, preformed, individualized CAD-CAM crowns made of different materials and concluded that the aging of materials had a significant influence on preformed crowns, and except for the Kinder Krowns, preformed zirconium oxide crowns and those produced at CAD-CAM were not affected in this respect. The reasons for failure were fatigue cracks or holes on the occlusal surface. However, their study proved that the differences in resistance to masticatory forces between the materials were insignificant and of no clinical importance [9].

Despite the technological ease, survivability and successful outcomes of CAD-CAM technology, it requires long-term study, with current studies not yet reaching a common agreement on these issues. Rodrigues et al., through a meta-analysis, concluded that the longevity of a ceramic prosthesis fabricated by CAD-CAM may be less than that of conventional crown fabrication [10]. Almukhlis et al., through their retrospective study, observed that the success rates of CAD-CAM versus conventionally fabricated restorations may not be significantly different [11]. Papadiochou S. et al state that the existing scientific evidence does not allow concluding on the superiority of CAD-CAM over conventional crown fabrication technique in relation to marginal fit. They consider that the restorative material influences the marginal fit and the performance of the CAD-CAM system [12].

Compared to metal, preformed, or conventionally fabricated space maintainers in the dental laboratory, ceramic ones produced by CAD-CAM technology have several advantages: increased esthetics, reduced deformations, decreased errors produced by the human hand, low risk of fracture and disintegration (being produced in one piece), fast fabrication time, has a low bacterial and plaque retentivity, thus being suitable for young patients, who have poorer hygiene than adults and increased susceptibility to caries, the proof being the need for extraction of the primary tooth replaced by the space maintainer. Also, the lack of metal in the oral cavity means fewer allergic reactions, less weight, and less gum trauma [13,14,15].

However, CAD-CAM fabricated space maintainers also have disadvantages: they are financially expensive for both professionals and patients and require laboratory assistance and dental technician involvement and expertise in their fabrication [16].

Conclusions

Early loss of a deciduous tooth can lead to displacement of adjacent teeth, resulting in loss of space, dental crowding, and malocclusion.

The digital workflow in dentistry is continually evolving and revealing new techniques. Digitally fabricated devices are considered reliable and durable but comparable in physical and mechanical properties to conventionally produced devices. CAD-CAM technology eliminates time-consuming manual manufacturing steps, making it more suitable and interesting for children.

So far, we consider the treatment through a digitized workflow appropriate, effective, and successful for our patient. The patient is to be treated at the maxillary level as well and followed up by inviting her for regular check-ups, hygiene, and fluoridation every 3 months, having very high carioreceptivity.

Conflict of interest: None to declare.

Acknowledgments

We thank Prof. Univ. Dr. Bica Ioana Cristina for her guidance and support in writing this article.

In addition, we also thank Dent Complet dental clinics and Ortodesign dental laboratory for their active involvement in the implementation of the digitized design and workflow and for providing the necessary equipment to implement the treatment plan.

References

1. Mittal, Gaurav & Verma, Aviral & Pahuja, Hansika & Agarwal, Shashank & Tomar, Himani. (2016). Esthetic Crowns in Pediatric Dentistry: A review. International Journal of Contemporary Medical Research. 3. 2393-915.
2. Gao SS. The longevity of posterior restorations in primary teeth. Evid Based Dent. 2018 Jun;19(2):44.
3. Dhanotra KG, Bhatia R. Digitainers-Digital Space Maintainers: A Review. Int J Clin Pediatr Dent. 2021;14(Suppl 1):S69-S75. doi: 10.5005/jp-journals-10005-2040. PMID: 35082471; PMCID: PMC8754270.
4. Brothwell DJ. Guidelines on the use of space maintainers following premature loss of primary teeth. J Can Dent Assoc 1997;63(10):753–766.
5. Fasbinder DJ. Clinical performance of chairside CAD/CAM restorations. J Am Dent Assoc 2006;137(suppl):22S–31S. DOI: 10.14219/ jada. archive.2006.0395;
6. Christensen GJ. Impressions are changing deciding on conventional, digital or digital plus in-office milling. J Am Dent Assoc 2009;140(10):1301–1304. DOI: 0.14219/jada.archive.2009.0054.
7. Fasbinder DJ. The CEREC system: 25 years of chairside CAD/CAM dentistry. J Am Dent Assoc 2010;141(suppl 2):3S–4S. DOI: 10.14219/ jada. archive.2010.0354.
8. Kist S, Stawarczyk B, Kollmuss M, Hickel R, Huth KC. Fracture load and chewing simulation of zirconia and stainless-steel crowns for primary molars. Eur J Oral Sci. 2019 Aug;127(4):369-375. doi: 10.1111/eos.12645. Epub 2019 Jul 10. PMID: 31293020.
9. Rodrigues SB, Franken P, Celeste RK, et al. CAD/CAM or conventional ceramic materials restorations longevity: A systematic review and meta-analysis. J Prosthodont Res 2019;63(4):389–395. DOI: 10.1016/j. jpor.2018.11.006
10. Almukhlis S. Clinical Performance of CAD/CAM Versus Conventional Ceramic Restorations on Posterior Teeth: A Retrospective Study. Student Theses, Dissertations and Capstones 2018. Available from: https://nsuworks.nova.edu/hpd_cdm_stuetd/114
11. Papadiochou S, Pissiotis AL. Marginal adaptation and CAD-CAM technology: A systematic review of restorative material and fabrication techniques. J Prosthet Dent. 2018 Apr;119(4):545-551. doi: 10.1016/j.prosdent.2017.07.001. Epub 2017 Sep 28. PMID: 28967399.
12. Ierardo G, Luzzi V, Lesti M, et al. PEEK polymer in orthodontics: a pilot study on children. J Clin Exp Dent 2017;9(10):e1271–e1275. DOI: 10.4317/jced.54010;
13. Kun J, Dinggui Z, Wei L, et al. Clinical application of digital space maintainer fabricated by polyetherketoneketonefor premature loss of deciduous teeth [J/CD]. Chin J Stomatol 2019; 13:368–372;
14. Guo H, Wang Y, Zhao Y, et al. Computer-aided design of polyetheretherketone for application to removable pediatric space maintainers. BMC Oral Health 2020;20(1). DOI: 10.1186/s12903-020-01184-6;
15. Soni HK. Application of CAD-CAM for fabrication of metal-free band and loop space maintainer. J Clin Diagn Res 2017;11(2): ZD14–ZD16. DOI: 10.7860/JCDR/2017/23459.9246.

Corresponding author:
Moldovan Marcieana
IOSUD of George Emil Palade University of Medicine, Pharmacy, Science and Technology of Târgu Mureș, 38 Gheorghe Marinescu street, Târgu Mureș, 540139, Romania
Email: marcieana_oniga@yahoo.com

Received: April 18, 2024 / Accepted: May 10, 2024