USE OF CAD/CAM TECHNOLOGIES IN PEDIATRIC DENTISTRY

Milena Georgieva[1], Evgeni Dimitrov[1], Radosveta Andreeva[1], Teodora Nikolova[1], Boris Borisov[2], Elitsa Sabeva[3]

[1]Department of Pediatric Dentistry, Faculty of Dental Medicine, Medical University of Varna
[2]Department of Prosthetic Dentistry, Faculty of Dental Medicine, Medical University of Varna
[3]Department of Periodontology and Dental Implantology, Faculty of Dental Medicine, Medical University of Varna

ABSTRACT

AIM: The aim of this article is to present a review of the literature data about the possibilities of CAD-CAM technology usage in pediatric dentistry.

METHODS: An electronic search of the literature from 2005 to 2018 was performed using two databases: Medline/PubMed and Embase.

RESULTS: The first computer system helping with restorations – CEREC (initially Siemens, now Sirona) was implemented about 30 years ago. Many systems are already available to use both in the dental office and the technician's laboratory. Now every type of ceramic material can be used in a restoration for almost all indications of aesthetic dentistry. The functional and aesthetic restorations for severely damaged primary and permanent children's teeth require materials which must be biocompatible, mechanically durable during mastication and with unchanging colour. In the literature data there are evidences about Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) technology usage in pediatric dentistry for dental restorations of extensive carious lesions, eroded and abraded teeth, primary teeth with absence of a permanent successor, dental dysplasia or dental trauma of hard tooth tissues.

CONCLUSION: Ceramic materials and CAD/CAM technologies are increasingly being used in aesthetic dentistry both in adults and children.

Keywords: *CAD/CAM technology, inlay, ceramics, pediatric dentistry*

Address for correspondence:
Milena Georgieva-Dimitrova
Faculty of Dental Medicine
84. Tsar Osvoboditel Blvd.
9000 Varna
e-mail: dr.milena.georgieva89@gmail.com

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INTRODUCTION

The oral environment, the dental health condition and the treatment needs of different patients vary significantly, which demands high aesthetic level of the restorative materials (1). The type, the rate and the velocity of abrasion of teeth and the restorations are not the same for the different teeth in the dentition. In dental practice, most of the restoration

failures happen as a result of caries, fracture, peeling off or changes in the colour (2). The bonded with adhesive systems partial crowns (3) and the indirect single restorations are more durable and with higher longevity compared with the direct restorations (2). Factors concerning the patient, which may raise the rate and velocity of abrasion, include strong masticatory forces – parafunctional bad habits, incorrect oral hygiene/toothpastes, abrasive and acid diets, reduced saliva flow, abnormal saliva content and defective tooth structure (4). The right choice of restorative material is important to keep the normal function and the masticatory harmony. Excluding the required aesthetics, gold alloys are considered to be the best restorative material, because they are durable and cause a minimal abrasion of the antagonist's natural enamel. Ceramic materials are used as an alternative option for gold alloys due to the high aesthetics. However, the main disadvantage of these constructions is the high rate of abrasion caused to the antagonist (5).

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METHODS

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RESULTS

The porcelain inlays and overlays have become more popular as an alternative option for distal composite restorations. They have better durability and abrasion resistance compared to composites and thus they have higher longevity. However, the occlusal adjustment is difficult and may cause functional abrasion of the antagonist if not polished properly. The marginal gap is acceptable, although it is bigger than the one in gold inlays/overlays (6-9). Reinforced ceramics of aluminum and zirconium oxide are rarely used for partial restorations in the distal area, because of the lack of adequate etching. The clinical success of dental ceramics depends on numerous factors, not only on the physical properties of the material and the production technique, but also on the clinical procedures, which may damage these fragile materials as well as the conditions in the oral cavity (10). Thus, there is insufficient data about their usage as a restorative material in molars (11).

In the last decade yielding ceramic restorations with Computer Aided Design/Computer Aided Manufacturing (CAD/CAM) have significantly raised their quality. The idea of bad marginal integrity of porcelain restorations made with CAD/CAM is already in the past. The improvements in the digital impressions, software design and cutting technique, alongside material improvement, have their contribution to excellent clinical results. The right choice of patient, the good marginal design and the retraction of the tissues are important factors as they must be strictly followed in all restorative procedures (12,13). The main advantages yielding restorations with the CAD/CAM technology are: less clinical time in the dental office, fast production of the restoration, the classic methods of impressions are not necessary, stable colour of the ceramics, excellent aesthetic result (14,15). As a disadvantage of these restorations the high price may be mentioned, as well as the necessity of special education of the dentist, who works with the CAD/CAM system and the mandatory occlusal adjustment of the inlay (14).

Due to the high awareness of proper oral hygiene and better preventive measures, including fissure sealing of the newly erupting distal teeth, and fluoride prophylaxis, the caries distribution in developing countries has decreased. However, the rate of non-carious lesions has increased - functional abrasion and erosion of hard tooth tissues (16,17). Due to enamel loss and dentin exposure, the affected teeth may lose their occlusal, vestibular or lingual surface, which affects the normal function and aesthetics in the oral cavity. This may be considered as an indication to use full ceramic inlays to restore the hard tooth tissues. The changes in the colour of the exposed dentin, the high sensitivity, the complications connected with the pulp and the increased risk of development, carious processes are the most common consequences of losing the susceptible enamel (18-20). The distribution of the erosion in 6-16-year-old children varies from 7.2% to 26% (21-23). It has been found that nutrition habits have a significant role for the oral health. They are strong risk factor for tooth decay (24) and a main source of acids as well, partic-

ipating in the development of the erosion (25). It is considered that children with caries can be predisposed to erosion as well (26). Many types of food and soft drinks are not only acidic, but also contain high amount of sugar (27).

Retention of primary teeth beyond their expected exfoliation date is encountered relatively frequently. Most commonly this is due to absence of a permanent successor. Even when the permanent tooth is present it may fail to erupt leaving the primary tooth in situ. This can be a consequence of crowding, ankylosis of the primary tooth or the presence of supernumeraries or other obstructions (28). Careful assessment is essential for all patients with retained primary teeth. Following consideration of general issues, such as the patient's health, motivation, expectations and oral health, a local assessment should be made. Clinically this should focus on the coronal shape, colour and structural integrity of the primary teeth (29). Where root and crown structure of the tooth are good but infra-occlusion has occurred or aesthetic improvement is required, the primary tooth may be retained and reshaped. The simplest approach is the addition of a direct composite. Indirect restorations, such as composite, porcelain or gold onlays, have been described for an infraoccluded primary molar (30,31). Small cavities may be incorporated within the preparation and restored with a combined inlay/onlay (29).

A case report presents the clinical use of a resin nanoceramic CAD/CAM restoration of a primary second molar without successor in the form of a permanent second premolar tooth in a patient. Three-year follow-up of the case revealed that resin nanoceramic CAD/CAM restoration of the primary molar without successor achieved both aesthetics and function. Despite the high cost of treatment, this type of restoration should be considered if the retained tooth is expected to maintain functionality over the long term (32).

Amelogenesis imperfecta is a genetically transmitted disease consisting of a structural defect of the enamel that gives rise to changes at the level of both morphology and biomechanics of the teeth (33). The clinical management of this condition poses a great challenge in view of the quality of the tissues and the patient's age and compliance level. Typical treatment for amelogenesis imperfecta in young people entails the use of direct anterior composite resin and prefabricated nickel-chromium crowns in the posterior teeth (34-36). The use of the in-office CAD/CAM technology to treat amelogenesis imperfecta in a young patient yielded satisfactory results. The treatment allowed for smile restoration, reduction of the number of clinical work sessions, and tooth structure preservation. The quality of life of the young patient has greatly improved (37). The complete dental rehabilitation of patients with a vertical dimension loss caused by structural enamel deficits associated with amelogenesis imperfecta represents a difficult challenge for restorative teams. Accurate analysis and treatment planning that includes aesthetic and functional evaluations and adequate material selection are important prerequisites for successful results. Long-term provisional restorations play an important role in exploring and elucidating the patients' aesthetic demands and functional needs. Restorative treatment options can vary from requiring only oral hygiene instructions to extensive dental restorations that include composite fillings, ceramic veneers, metal-ceramic, or all-ceramic crowns (38).

Traumatic dental injuries (TDI) are very common, they mainly originate from blows caused by objects or due to falls, sports injuries as well as injuries sustained during leisure activities and car accidents. Most cases involve the anterior teeth, of which the upper central incisors are more frequently affected. Special care patients are defined as patients "whose medical, physical, psychological, or social situations make it necessary to modify normal dentistry routines in order to provide dental treatment for that individual." Although it has been known for many decades that prosthodontics treatment makes a significant contribution to improving impaired oral health, treating special needs patients with prosthodontics is somewhat difficult as they often cannot be treated using "conventional" protocols of oral care. Difficulties of communication and consequences linked to their different situations (mental retardation, physical impairment, motor, visual, or hearing impairment, etc.) often make long chairside oral care complicated. And when treatment has to take place, people with disabilities are more likely to have teeth removed than receive fillings, crowns, or bridges. CAD/CAM technology can help to find prosthodon-

tics and conservative solutions for a special care patient, in only one clinical session (39).

Aesthetic treatment of severely decayed primary teeth is one of the greatest challenges for pediatric dentists. The use of aesthetic restoration has become an important aspect of pediatric dentistry. Over the years, numerous techniques for restoring primary teeth have been attempted. Some techniques used for restoring complete crown coverage include polycarbonate crowns, acid etched crown, stainless steel crown (SSC), open–faced SSC with veneer placed on chair side, and commercially available pre-veneered SSC. The effective and efficient usage of these techniques is complicated due to technical, functional, or aesthetic hurdles. Prefabricated zirconia crown (EZ-Pedo, Loomis, CA, USA; NuSmile ZR Primary Crowns, Houston, TX, USA; Hu-Friedy Mfg. Co., LLC, Chicago, IL, USA; Kinder Krowns, St. Louis Park, MN, USA; Cheng Crown, Exton, PA, USA; Zirkiz-Hass Corp. Korea) is an exceptionally strong ceramic crown and offers more aesthetic and biocompatible full coverage for primary incisors and molars. They are anatomically contoured, metal-free, completely bio-inert, and resistant to decay (40).

When new technologies are incorporated into dental practice, CAD/CAM provide the restorative clinician with new treatment options, thus improving design and application of metal-free ceramic restorations, which, along last decade, have been proven to provide suitable clinical performance (41).

CONCLUSION

The ceramic materials and CAD/CAM technologies, are increasingly being used in aesthetic dentistry for both adults and children. There are many evidences in the literature for CAD/CAM technology usage in primary and permanent dentition in childhood age. This gives the possibility to restore children's dentition with contemporary metal-free ceramic constructions, providing better adhesive, aesthetic and functional restorations.

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