



## ADVANTAGES AND DISADVANTAGES OF PAEDIATRIC CROWN PROSTHETIC TREATMENT

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### ABSTRACT:

Restoration of damaged deciduous teeth with the methods of prosthetic dental medicine represents a scientific interest. The various types of crown constructions have the relevant indications, methodologies and achieve different outcomes with respect to the three medical-biological requirements.

**The aim** of this review is to present and analyze current literature data on the advantages and disadvantages of crown restorations in childhood.

**Materials and methods:** From January 2018 to April 2019, an electronic search was conducted in PubMed, Google and Lilac databases.

**Results:** Crown restorations demonstrate an excellent prophylactic effect in cases of secondary caries and orthodontic deformities, improve masticatory and phonetic functions and children's aesthetic appearance. Almost all constructions are characterized by excellent mechanical properties and low degree of abrasion relative to natural deciduous teeth. Disadvantages are related to the possibility of gingival inflammation, unacceptable colour of metal crowns, the need for tooth preparation and hard tissue loss, and extended working time.

**Conclusions:** Prosthetic crown restorations of primary teeth demonstrate high functional and prophylactic value and improve the aesthetic parameters of dentition.

**Key words:** crowns, childhood, prosthetic treatment, advantages, disadvantages

### INTRODUCTION:

The treatment of caries and its complications in childhood is a topical issue of immense importance. Hard dental structure defects impair normal masticatory function and affect growth processes and the development of or facial structures. Moreover, deviations in aesthetics and speech may cause psycho-emotional disturbances in the social development of children. Restoration of large carious lesions and tooth fractures by conservative methods is frequently a challenge for the dental practitioner [1]. Therefore, a number

of studies [2, 3, 4] point to the search for alternative methods for treatment of severely damaged primary teeth. The introduction of digital technologies and the improvement of dental materials allow for the fabrication of fixed crown restorations in childhood with excellent results with respect to the three medical-biological parameters - prevention, function and aesthetics. Primary teeth with multi-surface carious lesions, extensive proximal caries, developmental defects, fractures, discoloration, erosion, and severe bruxism can be successfully restored using the clinical approaches and methods of prosthetic dental medicine.

With reference to scientific literature [5], various types of crowns are used in childhood: prefabricated metal crowns (PMCs), open prefabricated metal crowns (OPMCs), prefabricated metal-resin crowns (PMRCs), celluloid crowns, polycarbonate crowns, direct composite crowns, ceramic crowns and veneers, metal ceramic crowns (MCCs) and zirconium crowns (ZCs), manufactured on the basis of zirconium dioxide.

### OBJECTIVE:

The aim of this literature review is to present and analyze current literature data on the advantages and disadvantages of the use of various types of crown restorations in childhood.

### MATERIALS AND METHODS:

From January 2018 to April 2019, an electronic search was conducted in PubMed, Google, Lilac databases by using the following keywords: “crowns”, “childhood”, “prosthetic treatment”, “advantages”, “disadvantages” and the corresponding terms in English, German, Russian and French: „crowns”, „childhood”, „prosthetic treatment”, „advantages”, „disadvantages“ „kronen“, „kindheit“, „prothetische Behandlung“, „vorteile“, „Mängel“ „коронки“, „детство“, „протезирование“, „льготы“, „недостатки“, „couronnes“, „enfance“, „traitement prothétique“, „avantages“, „lacunes“. The final selection comprised 67 publications, the data of which were analyzed, summarized and presented in the main part of this review.

## RESULTS:

The advantages and disadvantages of different types of crown prosthesis should be considered in the main aspects of the three medical-biological parameters: prophylaxis, function and aesthetics.

### *Prophylactic value*

Vulicevic et al. [4] claim, the basic advantage of paediatric crown restorations is to protect the dental pulp from harmful external factors and preserve its vitality. The best results in this aspect were found with the use of PMCs according to the technique by Hall [6]. This biologically oriented method aims to preserve the maximum amount of dentin by hermetically sealing the carious lesion with glass-ionomer cements (GIC). Rotary instruments are not used and it reduces the risk of excessive hard dental tissue removal, overheating and damage to the dental pulp. Scientific data [7, 8] suggest that the isolation of the carious lesion from the oral plaque biofilm and the nutrients, needed for the micro organisms to perform the demineralization process, results in prevention or cease of microbial growth. A number of clinical and radiographic studies [9, 10, 11, 12] have observed healing processes with formation of tertiary dentine without any symptoms of pulpal inflammation. It is considered [5] that the use of GICs also has a beneficial effect on remineralization processes.

To provide the required thickness of the restoration for improved mechanical stability, in the cases with PMRCs, PMCs and ZCs, hard tissue preparation is required [13, 14, 15]. Bural et al. [16] have reported that this preparation significantly increases the risk of post-operative sensitivity, pain, and iatrogenic dental pulp damage. Another disadvantage is the need to use a local anaesthetic that causes negative emotions and anxiety in children [6, 8].

Crown restorations demonstrate high prophylactic value with respect to secondary caries and post-pulpotomy/pulpectomy recoveries, due to the marginal seal and absence of microleakage [17, 18]. To enhance the anti-cariogenic effect, Clark et al. [19] suggest the integration of fluoro-hydroxyapatite crystals on the internal surfaces of PMCs.

An advantage of the use of complete crowns is the protection of hard dental tissues from mechanical fractures in children with disorders of the normal composition of the enamel and dentine structures [15].

### *Prophylactic aspects in gingival and periodontal diseases*

The design of the finish line preparation and its location with respect to the gingival margin is another widely discussed issue [20, 21]. The improved retention of complete crowns on primary teeth is accomplished mainly through subgingival position of the finish line, which is frequently the cause of changes in the adjacent soft tissues [22]. According to Newcomb [23], the extent of gingival inflammation is directly related to the location of the marginal preparation – the more apically positioned finish line, the more is the reduction of gingival health parameters. Incorrect marginal contours of the crown and inappropriate adaptation to the finish line are a prerequisite for plaque retention, bacterial invasion of dentinal tubules, mechanical irritation of sulcus epithelium, caries-recurrence, and

inflammation of adjacent soft tissues [24].

In a study by Schüller et al. [21], 72.1% of the teeth, treated with PMCs, have been reported to present a positive papilla bleeding index (PBI). Other authors [25] have found higher values of gingivitis around metal crown-restored deciduous teeth. An increase in the gingival index has also been reported with PMRCs, probably due to plaque retention to the aesthetic veneering or excessive contouring [26]. Cement retention in the sulcus area may also compromise the health of the adjacent soft tissues.

Because of its high biocompatibility and smooth polished surfaces, plaque accumulation in ZCs is negligible and gingival inflammation is rarely detected [26, 27]. Values, reported for the modified gingival index are from 1.65 to 1.71.

Of particular importance in childhood is the prevention of orthodontic deformities. A high success rate of crown restoration has been reported for premature loss prevention of severely damaged and fractured deciduous teeth. According to Vulicevic et al. [4], the loss of one or more teeth may induce problems in occlusion, improper development of dental arches, maxillary and facial bones. Particular attention is paid to the position of the crown margin at the distal side of the second temporary molar. Excessive contouring in this area may affect the normal eruption and disposition of the first permanent molar, which is a prerequisite for the occurrence of orthodontic deformities [28, 29].

Regarding psycho-prophylaxis, it is known [30, 31] that distortions in the appearance of teeth and speech in children may lead to a change in their psychological status, development of emotional disorders and difficult social adaptation. Satisfaction with the psycho-prophylactic parameter is beneficial for the child's overall well-being, self-esteem and quality of life. A number of studies [32, 33, 34, 35] have reported that children affected by severe multiple caries, early childhood caries, amelogenesis, *dentinogenesis imperfecta* and/or MIH are frequently shy, avoiding smiles, communication and play with their peers. Feitosa et al. [36] have found that 31.2% of the children suffering from severe carious lesions feel sad and/or ashamed of their teeth and are more likely to be absent from school, to avoid social contacts. Another study [37] has reported that children suffering from dental diseases are significantly more irritable, have more sleeping problems, and are less likely to perform in learning activities than healthy and rehabilitated children.

The psycho-prophylactic effect of crown restoration is highly appreciated by numerous scientific studies [5, 6, 38, 39]. It has been found that [32] PMRCs, OPMCs, ZCs, MCCs and/or ceramic veneers successfully restore aesthetic defects of dentition and improve speech. Appropriately selected shapes and colours of paediatric crowns restore the harmony of smile, improve social activities, increase self-esteem, promote proper psychological development, and enhance the quality of life of children.

### *Functional value*

An important purpose of paediatric prosthetic constructions is to restore masticatory function and effectiveness. Achieving proper occlusion-articulation equilibrium is of particular importance to prevent possible occlusion-

related trauma and damage of the underlying dental germs [4]. A number of authors [3, 5, 10] have reported a high success rate for all types of paediatric crown restorations in the recovery of masticatory function. The ultimate goal is to provide adequate nutrition, normal growth and development of the children.

Some studies [9, 40] have found an increase in the occlusal vertical dimension (OVD) with the use of PMCs by the technique of Hall, due to the absence of preparation. Van der Zee [41] has analyzed occlusal interrelationships after placement of PMCs and has found a 0.5-mm increase in the OVD in the early post-treatment period of a few days. Within one month, a recovery of the initial vertical dimension was observed. It is assumed that this is a result of the intrusion of both the abutment tooth and the opposing tooth.

In other studies, [10,42] it has been stated that the equilibration of the parameters takes place within 1-2 weeks, and the children with PMCs do not report any pain or discomfort in the muscles or mandibular joints. These results have been associated with the great compensatory potentiality of the dental-alveolar complex at this age.

In Bulgaria, Dimitrov [28] conducted an occlusal analysis of 50 children with PMCs, aged 5-7 years. After visualization of the occlusion-articulation interrelationship in centric occlusion, a registration in maximum intercuspation (MIP) was performed by using the T-Scan 8 system (Tekscan, Boston). The results demonstrated balanced distribution of occlusal forces in the MIP, bilaterally symmetrical percentage ratios in the lateral sections of the dentition. This force balance reflects in a stable position of the centre of force marker in the target.

Another aspect of the functional value of crown restorations is to provide the conditions for proper sound pronunciation and speech [43, 44]. Missing and/or severely damaged teeth, especially in the anterior area, may result in improper pronunciation of dental ([d], [t], [n], [l]), sibilant fricative ([s], [z], [ʃ], [ʒ]) and affricate consonants ([tʃ], [dʒ], [tʃʃ]) [3]. O'Connell et al. [45] have reported their clinical results of anterior teeth complete crown restorations. These studies confirm the advantages of the crown restorations with respect to creating favourable conditions for the prevention of speech disorders.

#### **Aesthetic value**

The restoration of the aesthetic parameters of dentition is one of the main objectives in contemporary dental medicine. Personal care is especially important for adolescents [4]. There is evidence [46] that children aged 3-5 years already have an individual self-assessment. Therefore, it is necessary to achieve not only a healthy, but also a nice smile in children [3].

Widespread [3, 4, 14, 15] is the point of view that the best aesthetic results in pediatric crown restorations are realized through ZCs. They perfectly cover discolored teeth after endodontics treatment, and their translucency is close to that of the natural dentition [3]. Parents of children evaluate as "excellent" the color, shape and size of the placed ZCs [47].

Preformed metal-resin crowns (PMRCs) are also considered satisfactory in terms of aesthetics, but with some limitations. These crowns are manufactured in several basic

colours and the dental practitioner has no great choice as to the colour of the aesthetic veneering. This is frequently the reason why the PMRCs are lighter or darker and appear unnatural in the child's mouth [48]. Another disadvantage is the risk of fracturing of the aesthetic veneering material as a result of occlusal loading and revealing of the non-aesthetic metal surface [14].

Despite the time-consuming and sensitive procedure of their placement, OPMCs demonstrate good results in restoring damaged anterior teeth. They can be customized for each dentition, due to the wide colour variety of composite materials. The disadvantages include visible metal edges and colour changes in the oral environment [3, 5].

The limited use of PMCs, especially in the aesthetic area of the dentition, is due to their metallic color. Some authors [49, 50] declare that they are not aesthetic and difficult to be approved by parents and children. There is evidence [7] that the unacceptable silver colour of the crowns may negatively affect children's self-esteem. Many dental practitioners avoid the use of this type of crowns just because of poor aesthetics.

#### **Advantages and disadvantages of fixed crown restorations with respect to the mechanical, physical and chemical properties of materials**

In order to fully participate in the masticatory and speech function, crown restorations should possess certain qualities [51]. With sufficient material thickness and precise adaptation, most crowns in childhood successfully resist masticatory forces, pressure and traction forces in the oral cavity [52]. There are limitations for the PMRCs and OPMCs, where the aesthetic resin or composite veneering is relatively brittle and non-plastic, and is easily fractured by greater occlusal forces [3, 5]. The use of PMCs in cases of bruxism and deep overbite is also limited, due to the poor resistance of the material to abrasive forces [39]. Despite the excellent mechanical properties, a disadvantage of the zirconium dioxide material is its high rigidity. The absence of sufficient thickness or the presence of additional pressure and friction during adaptation may result in a fracture [4, 14].

Using complete crowns in children needs particular attention to the ability of materials to wear the opposing tooth surfaces [52, 53]. A study in this area [54] has indicated low abrasion values for the steel alloys. Although most of the data [44] have shown poor wearing of hard dental tissues by ZCs, a micro-morphological study [54] has found the most aggressive abrasion of enamel structures with the use of zirconium dioxide constructions.

A basic requirement to modern dental materials for crown restorations is that they should be biocompatible and hypoallergenic. All types of prefabricated metal crowns made of chromium-nickel alloys demonstrate a great disadvantage in this aspect. Nickel is a proven allergen for a major part of the population [48]. Despite the reduction of its quantity in modern alloys, there is evidence [55, 56] that certain irritations may provoke the release of ions in the surrounding oral environment, causing burning sensation, metallic taste, swelling of the tongue, etc. The study of Keinan et al. [57] has confirmed this evidence and has found high levels of deposited metal ions in the cement of PMC-restored decidu-

ous teeth.

#### Advantages and disadvantages with regard to the clinical protocol and the costs of restorations

Treatment of young patients is related to constant problems in managing their behaviour. Children are extremely eager, live in the present and sometimes it is difficult for them to understand the significance and benefits of the treatment [6]. It is therefore necessary to place the crown restorations as fast, easy, painless and effective, as possible. Except for the technique by Hall, the placement of the other types of pediatric crowns requires tooth preparation, prolonged working time, sometimes more than one visit, which may result in changes in the behaviour of negatively disposed children and difficulties in the work of the dental practitioner [3, 5, 6].

Crown restorations on primary teeth are actually temporary constructions, with regard to the forthcoming physiological shedding of the dentition [4]. In this aspect, some dental practitioners and parents consider the higher cost of crown treatment unreasonable, as compared to conventional methods [58, 59].

#### CONCLUSIONS:

The analysis of contemporary scientific evidence on

advantages and disadvantages of fixed crown restorations in childhood has made it possible to draw some significant conclusions. With regard to the medical-biological requirement “prophylaxis” or “prevention”, the complete coverage of the damaged hard dental structures demonstrates an excellent prophylactic effect on secondary caries and orthodontic deformities. A disadvantage in this aspect is the requirement for tooth preparation, as well the mild gingival inflammation observed around metal crowns. In respect of “function”, all crown restorations significantly improve masticatory function and speech. Concerning the “aesthetic parameter”, it is generally accepted that the restoration of teeth, damaged by caries and its complications, improves significantly children’s appearance, except for complete metal crowns. Almost all restorations demonstrate excellent mechanical properties and low degree of abrasion similar to natural deciduous teeth. Disadvantages of the prosthetic methods in childhood include the need for tooth preparation, prolonged working time, and the higher cost, as compared to conventional methods.

In conclusion, the prosthetic restoration of deciduous teeth with complete crowns demonstrate high efficacy in functional and prophylactic aspects and improve the aesthetic parameters of the primary dentition.

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