



## PROSTHETIC TREATMENT WITH CROWNS AND IMPLANTS IN CHILDREN – LITERATURE REVIEW

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### ABSTRACT:

Fixed prosthetic treatment in children is indicated in cases with caries and his complications, genetic aetiology, etc. when extensively destructed tooth structures cannot be completely restored with the methods of conservative dentistry. In these cases, prosthetic treatment is planned and performed following certain requirements, with respect to age and the occurring growth changes.

The **aim** of this study is to analyse and summarize the scientific data on the use of fixed prosthetic treatments in children.

**Materials and methods:** An online keyword database search was performed in PubMed, Google, Lilac, Yandex, eLibrary.ru from December 2017 to February 2018.

**Results:** Modern scientific studies have documented high functional and aesthetic results in cases of prosthetic treatments on implants, mini-implants in children aged 3 to 17 with the presence of partial or total edentulism. Practice proven method for restoring severely injured primary teeth is the different types of performed stainless steel crowns (conventional, pre-veneered, open-face stainless steel crowns) and aesthetic performed crowns (polycarbonate, zirconium crowns).

**Conclusion:** The recovering of the masticatory and speech function and normal appearance is of particular importance for the growth of the jaws and facial bones, the general physical development, the psycho-emotional state and the social adaptation of the children.

**Keywords:** paediatric prosthetic treatments, implants, primary crowns

### INTRODUCTION:

Despite the efforts of preventive dentistry, caries and its complications remain one of the most common diseases that affect, according to data of the World Health Organization, between 60 and 90% of school-aged children [1]. Progression of carious lesions may lead to tooth loss and a number of disorders that affect the masticatory function, speech, esthetics, and the normal development of dental

arches. These have its unfavorable effect on the child's overall well-being, self-esteem and quality of life.

Other reasons for the impaired integrity and loss of teeth may be mechanical trauma, various genetic and hereditary diseases, such as ectodermal dysplasia, amelo- and dentinogenesis imperfecta. [2, 3].

In a number of cases, direct restorations with conventional methods of dentistry fail in primary dentition. The reasons for this may include the insufficient hardness of dental tissues that provide the retention of the restoration, decreased resistance after pulpitis treatment, inability to ensure a dry operating field, etc. All of these lead to the need for the development of prosthetic pediatric dentistry [4].

### OBJECTIVE:

The aim of this review is to present and analyze current literature data on the use of fixed prosthetic constructions in children.

### MATERIALS AND METHODS:

From December 2017 till February 2018, an electronic search was conducted in the PubMed, Google, Lilac, Yandex, eLibrary.ru databases by using the following keywords: “детско протезиране”, “имплантати”, “детски корони” and the corresponding terms in English, German, Russian and French: “pediatric prosthetic treatment”, “implants”, “primary crowns”, “pädiatrische prothetische Behandlung”, “Implantate”, “Kronen für Kinder”, “педиатрическое протезирование”, “имплантаты”, “короны для детей”, “traitement prothétique pédiatrique”, “les implants”, “couronnes pour lesenfants”. The final selection included 55 scientific researches, the data of which were analyzed, summarized and presented in the main part of this review.

### RESULTS:

Due to the specifics of the child's organism and consciousness, planning and applying of dental prosthetic constructions should be consistent with the anatomical fea-

tures, physiological changes and the emotional state of the treated child. Dental prosthesis provides the opportunity to restore the effective masticatory and speech function, to achieve an acceptable appearance, ensure the unimpeded growth of oral structures and normal physical, mental and social development of the child [5, 6, 7, 8].

Fixed prosthetic treatment in childhood includes dental implant restorations and crown reconstructions.

#### *Use of implants in children*

Insertion of intraosteal retaining structures in children with incomplete bone growth or lack of sufficient volume of alveolar bone has a high probability of failure. Prosthetic treatment on osseointegrated implants is recommended in children with partial or total tooth loss only after completion of bone maturation [9, 10].

Valle et al. [11] and Worsaae et al. [12] suggest the use of implants as an effective method of restoring the masticatory and speech function in children aged 17 years and over.

Mishra et al. [13] explore the possibilities of successful prosthesis with dental implants in adolescents and summarize the following main factors: implantation should be performed after completion of the skeletal growth; the exact inverse age of each child should be subjected to a cephalometric study with orthodontic monitoring; the minimum age for treatment is 15 years for girls and 18 years for boys; the only possible site for prosthesis before reaching the skeletal maturation is the lower frontal area, due to the lowest number of registered changes in this area.

These findings are also confirmed by the studies by Balut et al. [14] and Kramer et al. [15]. The authors have found that the insertion of implants during jaw development may lead to trauma of dental follicles, impaired tooth eruption and delayed development of orofacial structures.

However, there are data available in the literature on the use of the implant-supported treatment in the case of incomplete growth, outside the recommended area. This is the case presented by Durstberger and Watzek [16] of a 10-year-old boy with oligodontia, where implants were inserted for the purposes of prosthetic restoration with a fixed prosthetic construction. During the procedure of surgical exploration, a cranial movement of the inserted intraosteal retaining devices was observed as a result of growth. Frequently, this is considered an obstacle in achieving optimal esthetic results.

Of particular interest is the report of Guckes et al. [17], where the case of a 3-year-old child with 2 implants in the upper incisor area and 4 implants in the lower incisor area is presented. During the 5-year follow-up period, there was no change in the lower jaw, while one of the implants in the upper jaw required surgical removal. In this connection is also the study of Filius et al. [18], the results of which show the possibility of implantation in childhood only in cases of anedentulous lower jaw. The authors recommend the insertion of 2 implants in the lower canine area and a removable denture for children aged 6 to 13 years.

Also, of interest is the report of Sadashiva et al. [19]. The authors suggested preservation of the available deciduous and permanent teeth and prosthesis with conventional

partial dentures until the age of 21 years. The aim was to preserve the structure of the alveolar bone and to create favorable conditions for the insertion of fixed implant-supported constructions. The final result was highly appreciated by the patient in terms of function and esthetics.

According to Cronin [20], dental implants inserted prior to completion of craniofacial growth imitate the effect of ankylosing teeth. Their use in an inappropriate age period, especially in the upper jaw, may lead to interruption of the alveolar bone development and the fall of constructions into infra-occlusion. Temporary removable prosthesis, prior to implant insertion, significantly increases the patient's confidence in the treatment plan and improves cooperation [21, 22].

Subject of interest is the study of Heuberger et al. [23], which aims to find a lasting treatment that addresses the problems associated with growth changes, multiple missing teeth, underdeveloped alveolar bones, and the younger age of patients. As a suitable method for restoring subtotal tooth loss, Onplants (individually made titanium discs with a thickness of 3.3 mm and a diameter of 7.7 mm) for the upper jaw and traditional implants with a conical, root-shaped geometry for the lower jaw were presented. After the final osseointegration, removable partial dentures were made, which were separated along the line of the bone suture to ensure the unimpeded development of the upper jaw. For additional retention of the lower dentures, implant-supported telescopic crowns were used.

#### *Use of mini-implants in the prosthetic treatment of children*

Due to the partial success with regard to the retention of removable dentures in children, it is necessary to include alternative methods of prosthetic restoration. Mello et al. [24] and Sfeir et al. [25] recommend the insertion of mini-implants in the lower canines of children. The supraosseous part is used for additional retention of the removable constructions or as replacements of the missing teeth, with fixed constructions made on them. Patients' satisfaction with this type of prosthesis has been reported to be higher compared to that with conventional dentures [26].

Apart from cases of systemic and genetic diseases, a cause for the loss of deciduous or permanent teeth may be different types of mechanical injury. Traumas may often lead to expulsion and premature tooth loss. In these situations, methods of re-implantation are generally applied, in most cases, unsuccessfully. This requires the search for alternative techniques in order to achieve higher functional and esthetic results [27]. Subject of interest is the study of Sousa de Oliveira et al. [28], which has shown that artificial tooth-supporting orthodontic implants can be successfully used to restore missing permanent teeth in children.

The simplicity of insertion of mini-implants, the lack of a recovery period and their low cost, compared with conventional implants, make them extremely suitable for temporary prosthetic treatment in children during the period of jaw bone growth [29].

#### *Use of crown prosthesis in children*

Fixed crown prosthesis is considered to be a safe and successful method of restoring injured teeth in children [30,

31]. A number of authors [5, 32, 33] point out the indications for the use of children's crowns - cases of large, multi-surface carious lesions, approximal caries, high risk of caries, defects in the development of dental structures, conditions after pulpotomy or pulpectomy, fractured teeth, discolored teeth, erosions, need for a retainer for a space maintainer, preventative restorations, and severe bruxism. The purpose of the crowns is to preserve the underlying tooth structures, to protect the dentine-pulp complex from contamination from the surrounding oral environment, to promote the healing processes and to preserve the vitality of the dental pulp in case of inflammation [34].

In recent years, due to the development of technologies and manufacturing processes, children's prosthetic constructions have undergone significant advances in terms of design, method of application and materials used [35]. The main factors [36] influencing the selection of a crown type are endurance, esthetics, retention, adaptability, time for insertion, the potential for sensitization to the material used and the cost.

The fixed prosthetic constructions used in children include metal preformed crowns, preformed open metal crowns, preformed blend (metal and plastic) crowns, celluloid composite crowns, polycarbonate crowns, directly constructed composite crowns, ceramic crowns and veneers, metal-ceramic crowns, preformed zirconium crowns [32].

Preformed metal crown (PMC) is one of the first crowns used in dentistry to restore children's teeth [37]. It is an extra-coronal restoration that is pre-cut, contoured and shaped, and usually does not require additional corrections from the operator. It is adapted and cemented to the corresponding tooth [38].

Their insertion requires caries removal, pulp treatment (if necessary), and pre-treatment [36, 38, 39, 40, 41]. According to Kindelan et al. [38], an occlusal reduction of 1.5-2 mm, following the relief outlines, is required to avoid deviations in the vertical parameters of occlusion. It is assumed [41, 42, 43, 44] that the presence of prematurity of less than 1 mm is tolerated by the child's organism and the adaptation occurs within a few weeks, due to a compensation of the dental-alveolar complex. Regarding the approximal reduction [45, 46], minimum grinding is required to ensure the crown passage along the proximal bulges of the tooth. To avoid marginal over-contouring, it is necessary to grind the medial and distal wall of the tooth, even in the presence of tremas and diastemata, characteristic for the deciduous dentition. The position of the marginal edge of the crown outside the preparation finish line in the distal region of the second deciduous molar may affect the normal eruption of the first permanent molar [47]. The reduction of the buccal and lingual surfaces is aimed at increasing the retention and is not always necessary [39]. All margins of the prepared tooth should be smooth.

By pre-assessing, the medial-distal size of the tooth with prosthesis or that of the opposite tooth with a caliper or periodontal probe, an appropriate size of PMC [38, 48] is selected. During the trial insertion, the crown holds the tooth firmly, and its edges are located at 1 mm below the gingival margin. Over-correction of the crown length may

result in retention impairment [38, 39, 49].

The fixation of the adapted crown should be done with self-polymerizing cement. The construction is filled with the material and placed on the prepared tooth. The excess is removed, and the child is asked to grip the teeth for about 2 minutes until the final cementing, to avoid any disposition of the crown [42, 49].

The insertion of PMC on a carious deciduous molar without any pre-treatment is a method popularized by Norna Hall in 1980, known as the "Hall Technique" [44]. The indications for use include early or moderate active carious lesion affecting the approximal wall of the tooth. Of particular importance is the exact pulp diagnosis - the presence of clinical or radiographic symptoms or signs of irreversible pulpitis is a contraindication. The sealing of the pulp inflammation may lead to its aggravation and the development of a dental abscess [50].

In order to facilitate the insertion of PMC according to the Hall Technique, it is necessary to adapt orthodontic separators for a period of 3-5 days [44, 50]. After releasing the necessary space in the approximal areas, a crown of suitable size, filled with self-hardening cement, is inserted. The final fixation [40, 51] is accomplished by pressing the teeth in a central occlusion until the complete hardening of the binding material. With alveolar growth, accommodation occurs against the slightly elevated vertical parameters of occlusion [42, 43, 44].

Another type of children's crowns is the preformed blend metal crown (PBMC). It is a vestibular esthetically coated preformed metal crown [34]. In order to provide the required thickness of the construction, counteracting the mechanical and occlusal loading, it is necessary to remove a minimum of 1.5 mm from the occlusal surface of the tooth [34]. Other prerequisites for the PBMC preparation include circumferential grinding of the tooth with a preparation step, located 1 mm below the gingival margin. Possible disadvantages of this type of crowns are the risks of fracturing or separating the esthetic coating from the metal base [52].

The open preformed metal crown is a modified PMC. After the final fixation, a part of the crown construction and the adhering cement is removed, corresponding to the visible part of the tooth, while retaining the marginal edges. The exposed tooth surfaces are treated with acid, and an appropriately looking vestibular surface [34, 53, 54] is modeled on them by using a composite material.

In frontal teeth with extensive caries lesions, fractures, discoloration or malformations, in nursing bottle caries or after endodontic treatment, there are indications for the use of polycarbonate preformed crowns (PPC) [32, 54]. They were first presented by Miller in 1973 as highly esthetic and inexpensive frontal teeth restorations. A disadvantage in their application is their low resistance to abrasive forces, which is why they are not recommended in the case of bruxism, deep bite and dental crowding [32].

In 2007, the first preformed zirconium crowns (ZC) for children were fabricated [34]. Indications for their use include cases of severely damaged and/or carious deciduous teeth, discolorations, malformations of dental struc-

tures, etc. Due to the risk of excessive teeth grinding and in order to provide material resistance to masticatory forces, the use of ZC is limited in the case of dental crowding [55, 56].

Because of their high rigidity, ZC cannot be adapted and/or modified like other types of crowns. This requires specific preparation and use of special aids such as try-in mock-up crowns for checking the size and occlusion [5, 32]. The treated teeth are circumferentially grinded by 1.5 mm and occlusally (or incisally) by about 1.5-2 mm, following the natural contours of the tooth. The marginal preparation finish line is 1-2 mm subgingivally [54].

The ZC should lie down passively without any friction and tension [34], as any additional pressure can lead to fracture. If necessary, minimal corrections can be made in the area of marginal edges with a diamond bur in a high-speed water cooling dental handpiece. Interproximal and occlusal adaptation is undesirable, as the removal of glaze in these areas significantly reduces the resistance of ceramics [55].

For permanent fixation of ZC, the authors recommend the use of polymer-modified glass ionomer cements, composites and calcium-aluminum cements [56].

#### DISCUSSION:

The presented literature analysis allows the following generalizations:

- Implant-supported prosthesis in children should be performed after detailed and in-depth cephalometric and orthodontic analysis.

- Implant insertion should be performed after completion of the final bone growth, to overcome the risk of traumatizing the dental follicles, impairing the eruption of teeth and the development of facial bones. The minimum age for an implant-supported prosthesis is 14-15 years for girls and 17-18 years for boys. It is possible to implant before the final skeletal maturation, but only in the lower frontal area due to fewer growth centers in this zone.

- Mistakes in the planning of implant-supported prosthesis are usually associated with impaired esthetics, function, and prophylaxis. Removal of implants, due to improper planning, is usually also associated with psycho-

emotional impairment in young patients.

- The use of mini-implants with the aim to improve retention or to restore with fixed constructions the missing teeth is considered an easy and effective approach with a rapid healing process.

- Fixed crown prosthesis in children is considered a successful and secure method in the restoration of carious teeth, fractured teeth, dental malformations and erosions, etc.

- The crowns used in children include preformed metal crowns, blend crowns, open preformed metal crowns, polycarbonate crowns and zirconium crowns. They have a high prophylactic value with regard to secondary caries and successfully restore the masticatory and speech function even in cases, where conservative dentistry methods fail.

#### CONCLUSION:

Fixed prosthesis in childhood influences the normal growth and development of orofacial structures, the psycho-emotional, social and physical development of children. The restoration of occlusion-articular balance and normal masticatory function creates favorable conditions for the processes of intake and absorption of the vital nutrients.

In the case of fractured and missing structures in the frontal sections of dentition, prosthetic restorations allow the correct realization of sound articulation and favor the proper development of speech function in accordance with age, with an impact on communication, personal and social development skills.

The advantages of the fixed prosthesis in terms of the esthetic medical-biological indicator are taken into account after three years of age when the formation of the individual self-esteem and the perception of how they are perceived by others starts to develop in children.

All this determines the relevance and significance of the knowledge, proper planning and application of the various modern methods of the fixed prosthesis in childhood in order to achieve an intraoral esthetic, functional and prophylactic optimum with an impact on the overall physical and psycho-emotional development of children.

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