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EVALUATION OF EFFECTIVENESS OF MARCO ROSA APPLIANCE IN ORTHODONTIC TREATMENT OF CHILDREN WITH DENTAL CROWDING

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Patients with dental crowding have varying degrees of aesthetic, morphological and functional disorders that on the whole worsen their general somatic health. Despite the fact that the etiology of crowding is multifactorial, most researchers believe that the cause of its occurrence and development is primarily a lack of space in the dentition. The purpose of this study was to evaluate the effectiveness of Marco Rosa appliance in orthodontic treatment of children with crowding based on the results of a questionnaire. The obtained data show that the advantages of Marco Rosa appliance are the absence of changes in angulation of upper first permanent molars, a rapid and stable effect of skeletal expansion and 90.5 % satisfaction with treatment. Taking into account the results of the study will allow for the improvement of the effectiveness of orthodontic treatment for children with dental crowding.

Key words: children, upper jaw, malocclusion, dental crowding, orthodontic treatment, Marco Rosa appliance.

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ОЦІНКА ЕФЕКТИВНОСТІ ВИКОРИСТАННЯ АПАРАТУ МАРКО РОСА В ОРТОДОНТИЧНОМУ ЛІКУВАННІ ДІТЕЙ ЗІ СКУПЧЕНІСТЮ ЗУБІВ

Пацієнтам зі скупченістю зубів властивий різний ступінь естетичних, морфологічних і функціональних порушень, які загалом погіршують стан їх загальносоматичного здоров'я. Незважаючи на те, що етіологія скупченості зубів мультифакторна, більшість дослідників вважають, що причиною її виникнення і розвитку, передусім, є недостатня кількість місця в зубному ряду. Метою даного дослідження була оцінка ефективності використання апарату Марко Роса в ортодонтичному лікуванні дітей із скупченістю зубів на підставі результатів анкетування. Отримані дані свідчать, що перевагами апарату Марко Роса є відсутність зміни ангуляції верхніх перших постійних молярів, швидкий і стабільний ефект скелетного розширення та 90,5 % задоволеності лікуванням. Врахування результатів проведеного дослідження дозволить підвищити ефективність ортодонтичного лікування дітей зі скупченістю зубів.

Ключові слова: діти, верхня щелепа, зубощелепні аномалії, скупченість зубів, ортодонтичне лікування, апарат Марко Роса.

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The efficacy of complex orthodontic treatment of patients with dental crowding largely depends on the application of an interdisciplinary approach, more thorough, detailed identification of etiological factors and differentiated implementation of the latest methods and appliances with determination of the potential of youth growth and taking into account individual norms of cranium structure [11].

The phylogenetic reduction of the masticatory apparatus is the most significant among many factors that contribute to massive crowding. One of the determining factors of the process that leads to the reduction of dentoalveolar area is a change in the composition of food. In the course of evolution, individual elements of dentition must change simultaneously. However, under the influence of reduced chewing loads, the alveolar processes of the jaws are reduced more intensively compared to the teeth, creating a lack of space for the correct position of the teeth [6]. Also, the success of complex orthodontic treatment for dental crowding is significantly enhanced by an interdisciplinary approach that takes into consideration individual growth potential and cranial structure. At the same time, such an approach should recognize the impact of evolutionary changes in diet on the masticatory apparatus. Also, addressing the phylogenetic reduction of the dentoalveolar area is crucial for effective orthodontic interventions.

The most common is dental crowding, which is a prevalent orthodontic issue that can arise in children, leading to misalignment, potential oral health problems, and aesthetic concerns. This condition occurs due to the narrowing of dentition, which may be due to the reduced jaw size [10]. Since the development of the upper jaw is guiding, and the lower jaw usually adapts, it is necessary to notice the clinical manifestations of the anomaly in time and create conditions for the correct restructuring of the upper dentition [1]. For this purpose, fixed appliances with support on teeth only (Hyrax), on teeth and mucous membranes (Haas, Derichsweiler), and on mini-implants (MARPE) have been developed [4]. The Haas and Hyrax appliances based on the first permanent molars have shown high efficacy during the period of mixed dentition [9].

Most modern researchers prefer a Marco Rosa appliance (Haas appliance modification) among fixed devices for expansion of the upper jaw during the mixed dentition period. It consists of a base in the form of

two mini-plates, a screw, metal wires fixed on temporary canines and crowns on second temporary molars [5]. This orthodontic appliance, designed to minimise invasiveness while maximizing efficacy, harnesses biomechanical principles to facilitate dental alignment. Through its construction and application, the appliance produces controlled forces. The treatment with the Marco Rosa appliance is desired to stimulate upper jaw growth. Such a bone-remodelling process takes time and patience of patients, who are children [5].

It is important to mention the impact of parents on treatment results, which can also be determined as a key factor in achieving them. Parents hope that orthodontic treatment improves their children's quality of life. As parents who seek orthodontic treatment for their children, derive from different socioeconomic situations, and cultures, their influence on children may vary differently. Children may estimate all parental decisions positively, so even when communication and relationship levels differ, they should allow a real dialogue between child and parent, sharing every benefit and difficulty, and receiving consistent support for the desired effectiveness of treatment. The importance of open communication between parents and children during the treatment process cannot be overestimated, as it promotes understanding and cooperation, which ultimately leads to a more successful treatment experience [5].

Therefore, rapid achievement of a high level of satisfaction with aesthetic, morphological and functional results is an urgent task for an orthodontist.

The purpose of the study was to analyse the efficacy of the Marco Rosa appliance in the orthodontic treatment of children with crowding based on questionnaire results.

Materials and methods. An anonymous questionnaire was developed in Google Forms and was conducted on the basis of Poltava State Medical University from September to January 2023. Parents of 21 children (girls – 12 (57.1 %), boys – 9 (42.9 %)) undergoing orthodontic treatment with Marco Rosa appliance (Fig.1) were also interviewed.



Fig.1. Marco Rosa appliance.

Inclusion criteria were the age of children 6–12 years old at the beginning of treatment, dental crowding present at the beginning of treatment, treatment with Marco Rosa appliance, no other appliances used during the treatment period, and agreement to participate in the questionnaire. 378 responses to 18 questions were statistically analysed with the help of Microsoft Office Excel software. A literature search was conducted for modern domestic and foreign studies from 2015 to the present related to the treatment of crowding in the period of mixed dentition using the Marco Rosa appliance. The articles were searched using PubMed, Google Scholar, and Research Gate databases in English and Ukrainian using

the following search terms: “treatment of crowding”, “mixed dentition”, “Haas appliance on deciduous molars”, “Marco Rosa appliance”, “treatment of crowding in mixed dentition”, “appliance for maxillary expansion”, “Marco Rosa appliance”. Found research papers were selected according to the following inclusion criteria: patients aged 6–12 years with erupted first permanent molars, upper jaw narrowing of more than 5 mm, moderate to severe crowding, high level of patient cooperation, and publication of research in the period 2015–2024. Literature reviews, articles, and abstracts describing the treatment of crowding in periods of permanent dentition, the use of surgical methods, and the use of mini-implants as supports were excluded.

Results of the study and their discussion. According to our survey results, the following age distribution was obtained: 6 years – 9.5 %, 7 years – 14.3 %, 8 years – 28. %, 9 years – 9.5 %, 10 years – 38.1 %. The majority of parents (61.9 %) noticed the dentoalveolar anomaly in their children on their own. The other 38.1 % paid attention to it during paediatric dentist examinations.

76.2 % of parents believe that dentoalveolar anomalies will worsen their children's health. Of these, the majority noticed chewing disorders (40 %), 25 % noticed speech disorders in their child, and another 9.1 % noticed respiratory disorders, difficulty in communicating, and aesthetic deficiencies. At the time of the survey, 38.1 % of respondents had already been treated for 4–6 months and more than 10 months, 9.5 % for 2–3 and 7–10 months, and 4.8 % for 1–2 months.

The next question aimed to determine the main causes that made respondents seek orthodontic care. During the first visit to an orthodontist, complaints of malocclusion or aesthetic defects and crowding of teeth were the most common (40.9 % each), oral breathing and lip closure disorders (18.2 %), speech disorders (9.1 %), whereas chewing and swallowing were less common (4.5 %). The most frequent complaints were lip closure, mouth breathing disorders, aesthetic defects, and dental crowding.

The following question block was concerned with children's change of everyday habits after beginning therapy with the Marco Rosa appliance. More than one-third (38.1 %) of children did not change

their diet during orthodontic treatment. However, it is worth noting that 28.6 % of respondents mentioned the need to brush their teeth after each meal, and 23.8 % – a restriction of solid food intake.

When it comes to regularity of tooth hygiene, the majority of children (81 %) brush their teeth 2 times a day, 14.3 % of respondents brush after every meal, and 4.7 % brush once a day. One-third of parents (33.3 %) disagree that orthodontic appliances worsen their child's oral hygiene. 38.1 % of parents control how their child brushes his/her teeth, 47.1 % do it from time to time, and 4.8 % do not control it at all.

Probably the most interesting question block was the one regarding the satisfaction levels of respondents and the causes of their partial or complete dissatisfaction. Full satisfaction with the treatment was present by 90.5 % of respondents, and 9.5 % were not entirely satisfied with the received care (Fig.2).

Despite the situation described, 76.2 % of respondents had complaints during orthodontic treatment (Fig.3). 36.4 % of them reported toothache during orthodontic treatment, while other respondents noted that the appliance interfered with eating solid food (31.8 %), interfered with communication and caused frequent inflammation of the mucous membrane (13.6 % each). According to the majority of parents' opinion (95.2 %), fixed orthodontic appliances are suggested to be more useful for children with mixed dentition than removable ones.

Is your child satisfied with the treatment?

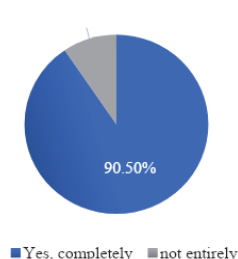


Fig. 2. Is your child satisfied with the treatment? This pie chart shows answers from respondents concerning their satisfaction with treatment. The majority of respondents selected the option "yes".

Reasons for dissatisfaction with the stages of treatment

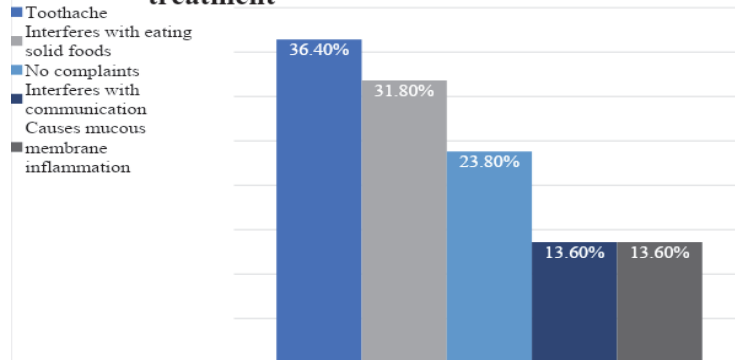


Fig. 3. Reasons for dissatisfaction with the stages of treatment. The bar graph shows factors contributing to therapy dissatisfaction listed in order from "most" to "least" relevant: toothache, interference in solid food eating, absence of complaints, interference in communication, and mucous membrane inflammation.

Age of 6–10 years with erupted first permanent molars with more than $\frac{2}{3}$ of the roots of temporary canines and second deciduous molars preserved is the optimal indication for use of Marco Rosa appliance. Ugolini considered the Marco Rosa appliance an effective device when roots of upper second temporary molars have the bare minimum of length as the size of their crowns on the orthopantomogram [15].

An important advantage of the Marco Rosa appliance over other fixed appliances for maxillary expansion is the support on the second temporary molars and less distal rotation of the first permanent molars due to the absence of rings, allowing free adaptation to changes in the occlusal plane. Another benefit is avoiding undesired effects such as root resorption and periodontal damage that have already been described for permanent teeth when used as anchored teeth [4]. The more anterior position of the screw in the Marco Rosa appliance also plays a positive role and provides the necessary expansion between canines [15].

Most authors are of the opinion that the lowest recurrence rate of crowding is observed in patients who were treated during tooth changes, i.e., during the period of active jaw growth. Marco Rosa appliance helps to reduce spontaneously the degree of crowding in 48 % of patients [2]. The palatal expansion may contribute to an increased arch perimeter, which can further enhance the alignment of the incisors [4]. This appliance is most effective in horizontal jaw growth, as the Little index value of the upper teeth decreases by 6.2 ± 1.4 mm during treatment, while in neutral and vertical growth types, the Little index decreases by 5.8 ± 1.5 mm and 4.2 ± 1.3 mm, respectively. Changes in Little Index for the lower teeth also correlate with the type of jaw growth: in the horizontal type of growth, the most significant decrease is observed by 5.1 ± 0.7 mm, in the neutral type – by 4.3 ± 0.5 mm, and in the vertical type – by 3.4 ± 0.3 mm [1].

Even though the Marco Rosa appliance helps to obtain a significant expansion of the upper jaw and rise of arch length, the study of Mutinelli shows relapse of intercanine and intermolar width after treatment. However, after 2 years and 4 months after the end of the therapy, the remaining expansion values still significantly increased [9]. Another study suggests significant differences in inter-first premolar, inter-second premolar intermolar arch width, and arch perimeter after the Marco Rosa appliance treatment. However, arch length increases throughout and decreases after expansion was found to be not significant [8].

The use of the Marco Rosa appliance may result in the expansion of the lower dental arch due to indirect impact. However, Cozzani found significant increases in lower jaw dimensions only in intercanine width, whereas permanent intermolar width remained unchanged. Those changes can also be explained by spontaneous increase of transverse intercanine width, which happens to occur during mandibular lateral incisors eruption phase [4].

It was also found that use of Marco Rosa appliance in early mixed dentition simultaneously with skeletal expansion leads to self-regulation of frontal crossbite. In Rosa's research, 84 % of patients experienced a spontaneous correction of anterior crossbite. Such early treatment eliminates the need for a bite-plane. It is crucial to mention that direct forces were not applied on permanent teeth. Another result considered greater and more expected self-regulation of lateral incisors than central ones [15].

Based on the above-mentioned findings of different researchers, the mechanism of action of the Marco Rosa appliance gives significant clinical results with high success rates of various conditions.

However, the stability of these treatment results is of high importance in orthodontics. Mutinelli showed that early dental age, crossbite, and gender were of the most significant factors in achieving and maintaining stable expansion in the retention period. At the same time vertical dimension did not affect the stability of orthodontic therapy results.

Since the Marco Rosa appliance causes a skeletal effect of upper jaw expansion, during which bone remodelling occurs in the suture area, the logical consequence of treatment is the remodelling of the floor of the nasal cavity [14]. According to Si, after treatment with the Marco Rosa appliance, the width of the nasal cavity and its volume increased by 2.25 ± 0.77 mm and 2236.15 mm³, respectively. The increase in facial depth is associated with an increase in maxillary sinus volume. Si found the following pattern: for every 1000 mm³ increase in maxillary sinus volume, the facial depth in hard tissues increased by 0.477–0.683 mm, and the facial depth in soft tissues increased by 0.455–0.629 mm [14].

Among the complications that can occur when using the Marco Rosa appliance, the most common are loosening of temporary teeth as a result of resorption of their roots and mucosal damage. They were detected in 17 % and 12 % of patients in the study by MałgorzataKuc-Michalska [3]. According to MałgorzataKuc-Michalska, caries of abutment teeth and periodontal disease were detected in patients with the same frequency – 9 %: extremely rare were a pallor of nasal mucosa, nosebleeds that disappear after a two-day period without activating the device [3].

Conclusions

The high efficacy of using the Marco Rosa appliance in cases of crowding of teeth with a decrease in transverse dimensions of the upper jaw has been proven. The advantages of the appliance are the absence of changes in angulation of the upper first permanent molars, the rapid effect of skeletal expansion and the stability of positive treatment results. According to the results of the questionnaire, it was found that despite the complete satisfaction with the treatment of 90.5 % of respondents, 76.2 % had complaints during orthodontic treatment. Taking into account the results of this study will improve the effectiveness of orthodontic treatment of children with dental crowding.

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ANALYSIS OF THE BACKGROUND LEVEL OF M1 AND M2 MACROPHAGE CYTOKINES IN PATIENTS WITH REVISION RHINOPLASTY

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The purpose of the study was to evaluate the background level of cytokines M1 and M2 of the macrophage phenotype in patients with revision rhinoplasty. The search for effective diagnostic methods will improve treatment and prevention of negative consequences of reconstructive rhinoplasty. 63 patients (18–45 years old) who underwent revision rhinoplasty using a rib graft were under supervision. Patients were divided into two groups based on fibrinogen levels for further studies. The levels of TNF- α , TGF- β 1 cytokines (DRG Diagnostic Inc., Germany), IL-6, IL-10, IL-13 (IBL International, Germany), IL-12, IL-18 (ElabScience, USA) were evaluated in all patients. In patients after rhinoplasty who have postoperative complications in the form of nasal deformity, there was an increase in the synthesis of cytokines characteristic of macrophages of the M1 phenotype and a decrease in the level of cytokines of the M2 phenotype of macrophages. The identified differences require further research to study their pathogenetic role in developing complications in rhinoplasty patients.

Key words: revision rhinoplasty, rib implant, fibrosis, fibrinogen, cytokines.

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АНАЛІЗ ФОНОВОГО РІВНЯ ЦИТОКІНІВ М1 ТА М2 ФЕНОТИПУ МАКРОФАГІВ У ПАЦІЄНТІВ З РЕВІЗІЙНОЮ РИНОПЛАСТИКОЮ

Метою роботи було оцінити фоновий рівень цитокінів М1 та М2 фенотипу макрофагів у пацієнтів з ревізійною ринопластикою. Пошук ефективних способів діагностики дозволить покращити лікування та профілактики негативних наслідків реконструктивної ринопластики. Під наглядом знаходилося 63 пацієнти (18–45 років), яким було проведено ревізійну ринопластику з використанням реберного трансплантату. Для подальших досліджень пацієнти були розділені на дві групи за рівнем фібриногену. Усім пацієнтам проводили оцінку рівня цитокінів TNF- α , TGF- β 1 (DRG Diagnostic Inc., Німеччина), IL-6, IL-10, IL-13 (IBL International, Німеччина), IL-12, IL-18 (ElabScience, США). У пацієнтів після ринопластики у яких виявлено післяопераційні ускладнення у вигляді деформації носу спостерігаються посилення синтезу цитокінів, які характерні для макрофагів М1 фенотипу та зниження рівня цитокінів М2 фенотипу макрофагів. Виявлені відмінності потребують подальших досліджень для вивчення їх патогенетичної ролі в розвитку ускладнень у пацієнтів з ринопластикою.

Ключові слова: ревізійна ринопластика, реберний імплант, фіброз, фібриноген, цитокіни.

The work is a fragment of the research project “The latest technologies in plastic and reconstructive surgery”, state registration No. 0119U000700.

Rhinoplasty is considered one of the most complex procedures in the field of facial plastic surgery. Various types of grafts are widely used in reconstructive rhinoplasty, but special attention is paid to grafts of human origin. Among them, transplants from the nasal septum, ear, and costal cartilage are the most popular. However, the main disadvantage of using autografts is their tendency to resorption. Despite the proven advantages of using costal cartilage compared to quadrangular cartilage of the nose and ear, graft resorption has a significant risk, which can lead to undesirable results in rhinoplasty [1, 2, 3, 4].