

Research in the effectiveness of oral hygiene training methods for children with Down syndrome

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Abstract. Introduction. The number of children diagnosed with genetic diseases that manifest by disorders of various severity degrees and complicate the child's social adaptation, steadily increases with each passing year. Limited communication abilities make it difficult to provide high-quality medical care using invasive treatment methods for dental pathology in these children. Therefore, the properly organized primary prevention of dental diseases in children with Down syndrome (DS) will reduce the patients' need for treatment. However, the specificity of cognitive activity, motor functions, and emotional development in children with DS determine the search for new techniques of training hygienic skills as the main method of preventing dental diseases starting from an early age. **Aim:** To analyze the effectiveness of training methods for children with Down syndrome in mastering the standard tooth-brushing technique. **Materials and Methods:** Oral hygiene training methods were approbated in 2 groups of children with Down syndrome, 10 children in each, under the control of the Green-Vermillion index. The course included 9 sessions of 30 minutes each. Training involved two forms, specifically, business "interpersonal" game and multimedia training. **Results and Discussion.** In the first group of Down syndrome patients, the sequence of movements completely matched the standard on the seventh day of training for 7 out of 10 patients. By the ninth day of training, 9 out of 10 patients could repeat the sequence independently, with minimal errors. The hygiene level, on average, in the first group of children corresponded to a satisfactory value already on the seventh day of training. On the ninth day of training, a satisfactory average value of the Green-Vermillion Index was maintained in the first group. In the second group of Down syndrome patients, the sequence of movements matched the standard for 3 out of 10 patients on the seventh day of training. By the ninth day of training, the sequence of movements by the standard tooth-brushing method corresponded to the standard for 5 out of 10 children, the Green-Vermillion Index being characterized as satisfactory only in 3 out of 10 patients; on average the second group demonstrated a poor hygiene level. **Conclusions.** Based on the results of training in the standard tooth-brushing method to patients with DS, the most effective appeared to be the "interpersonal" business game with repeated practice of hand-to-hand movements and actions comments in combination with the praise to the imitating child. To create a dynamic stereotype, the training course should include at least nine sessions.

Keywords: children, Down syndrome, hygiene, oral cavity.

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Исследование эффективности методов обучения гигиене полости рта детей с синдромом Дауна

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Реферат. Введение. Количество детей с генетическими заболеваниями различной степени тяжести и выраженности нарушений, осложняющие адаптацию ребенка в обществе, неуклонно растет с каждым годом. Ограниченные возможности общения затрудняют оказание качественной медицинской помощи с использованием инвазивных методов лечения стоматологической патологии у таких детей. Таким образом, правильно организованная первичная профилактика стоматологических заболеваний у детей с синдромом Дауна позволит снизить потребность пациентов в лечении. Однако специфика познавательной деятельности, двигательных функций и эмоционального развития детей с синдромом Дауна определяет поиск новых методов обучения гигиеническим навыкам, как основному методу профилактики стоматологических заболеваний, начиная с раннего возраста. **Цель исследования:** проанализировать эффективность методов обучения детей с синдромом Дауна стандартной технике чистки зубов. **Материалы и методы исследования:** апробация методов обучения гигиене полости рта проводилась в 2-х группах детей с синдромом Дауна по 10 человек под контролем индекса Грина-Вермиллиона. Курс включал в себя 9 занятий по 30 минут. Обучение проводилось в двух формах: деловая «межличностная» игра и мультимедийное обучение. **Результаты и их обсуждение.** В первой группе пациентов с синдромом Дауна последовательность движений полностью соответствовала стандартной на седьмой день обучения у 7 из 10 пациентов. К девятому дню обучения 9 из 10 пациентов могли самостоятельно повторять последовательность с минимальными ошибками. Уровень гигиены в среднем в первой группе детей соответствовал удовлетворительному значению уже на седьмой день обучения. На девятый день обучения в первой группе сохранялось удовлетворительное среднее значение индекса Грина-Вермиллиона. Во второй группе пациентов

с синдромом Дауна на седьмой день тренировок последовательность движений соответствовала стандартной у 3 из 10 пациентов. К девятому дню обучения последовательность движений при выполнении стандартного метода чистки зубов соответствовала норме у 5 из 10 детей, индекс Грина-Вермиллиона характеризовался как удовлетворительный только у 3 из 10 пациентов; в среднем во второй группе отмечался неудовлетворительный уровень гигиены. **Выводы.** По результатам обучения пациентов с синдромом Дауна стандартному методу чистки зубов наиболее эффективной оказалась деловая «межличностная» игра с повторной отработкой движений рук и комментариями к действиям в сочетании с похвалой в адрес подражающего ребенка. Для формирования динамического стереотипа учебный курс должен включать не менее девяти занятий.

Ключевые слова: дети, синдром Дауна, гигиена полости рта.

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Introduction. The relevance of the study is determined by the difficulty of providing dental care to children diagnosed with Down syndrome (Q90) [1]. Delayed intellectual and speech development combined with slowed physical development create for these children additional health issues and significant difficulties in acquiring self-care skills, including oral hygiene [2].

According to statistics, 80% of children with Down syndrome (DS) have mild to moderate degree of intellectual disability (intelligence quotient 25-70), and in rare cases, a severe degree (intelligence quotient <25). Regardless of the level of intellectual disability, the maxillofacial region of children with DS has characteristic morpho-functional features. Predictors of poor oral hygiene in these children include bone tissue hypoplasia, arched palate, reduced muscle tone, hypertrophy of the palatine and pharyngeal tonsils contributing to the formation of mouth breathing, leading to dryness of the oral mucosa and impaired self-cleaning processes. In these conditions, the lack of quality oral hygiene care contributes to the development of pathology in the hard tissues of the teeth and periodontal tissues. The application of an effective methodology for teaching oral hygiene to children in this category will help reduce the likelihood of developing mucous membrane diseases, tooth decay, and improve their overall quality of life.

Aim: To assess the quality of teaching the standard tooth-brushing method to children with Down syndrome using advanced case technologies.

Materials and methods: Patients diagnosed with Down syndrome (Q90) with moderate intellectual disability (based on the results of the Wechsler test in medical records) were divided into two groups of 10 individuals each, aged 11-14 years. The initial examination included a survey and examination as the main methods, and the use of the Greene-Vermillion hygiene index as an additional research method. When practicing the skills of the standard tooth brushing technique in both groups of children with Down syndrome, controlled teeth cleaning was conducted to observe the degree of assimilation of step-by-step actions. The results of the training were monitored using the hygiene index. The training course lasted 9 days, each session lasting 30 minutes.

Considering the psychophysiological characteristics of the children, hygiene skills were formed in these patients in two case scenarios: A business-like “interpersonal” game and a multimedia format.

In the first group, the business-like “interpersonal” game took place during the initial appointment involving the patient, one parent, and a dental hygienist. The steps of the standard tooth-brushing method were practiced repeatedly “hand in hand” with the hygienist in one session, maximizing the patient’s attention and coordination. The parent actively participated in the process, encouraging the child. To automate the acquired skills at home, parents of children in the first group were instructed to practice the learned techniques twice a day after meals on the second, fourth, sixth, and eighth days.

In the second group, multimedia equipment was used for visual clarity during the acquisition of standard tooth-brushing skills, creating conditions that allowed combining visual and logical methods of mastering information. A dental hygienist-led video lesson with a well-developed sequence of actions for the standard tooth-brushing method was presented. After the initial appointment at home, parents of children in the second group were also assigned to practice the skills according to the proposed method once a day on the second, fourth, sixth, and eighth days.

The effectiveness of teaching children in both groups was assessed on the third, fifth, seventh, and ninth days in the clinic during controlled tooth brushing, with mandatory visualization of the hygiene status. Passive correction of errors in reproduced movements was employed, emphasizing parents’ attention to the mistakes. Subsequently, all movements of the standard tooth-brushing method were repeated in both groups with the participation of the dental hygienist.

The reproduced algorithm of the standard tooth-brushing method was evaluated using our newly developed methodology, involving the sequential summation of points:

1 point: Sequential, segmental (segment-2-3-adjacent teeth) cleaning of the vestibular surface of the upper and lower dental arches.

2 points: Sequential, segmental cleaning of the oral surface of the upper and lower dental arches.

3 points: Proper cleaning of the occlusal surfaces of the upper and lower dental arches.

4 points: Correct execution (with gum involvement) of the final group of circular movements with closed dental arches.

5 points: Use of correctly performed sweeping movements when cleaning the vestibular and oral surfaces of the upper and lower dental arches.

The evaluation of the correct algorithm in conducting the standard tooth-brushing method implies a maximum score of 5 points.

Results and discussion: During our research, the following was observed. In the first group of Down syndrome patients, the sequence of movements completely matched the standard on the seventh day of training for 7 out of 10 patients. By the ninth day of training, 9 out of 10 patients could repeat the sequence independently, with minimal errors.

In the second group of Down syndrome patients, the sequence of movements matched the standard for 3 out of 10 patients on the seventh day of training. By the ninth day of training, the sequence of movements with the standard tooth-brushing method corresponded to the standard for 5 out of 10 children (Fig. 1).

The development of dynamic stereotypes requires significant effort from individuals with Down syndrome (DS) due to cognitive development characteristics [3]. Children with DS exhibit reduced memory, slower information perception rates, difficulties in action planning, low material generalization levels, and delayed response formation, even when learning simple daily life skills (tying shoelaces, fastening buttons and locks). They require a large number of repetitions to internalize the material. Individual oral hygiene, unlike the aforementioned skills, involves even more steps in the motor chain and greater complexity, associated with the need to control the force and accuracy of movements and one's position in space. Children with DS find it challenging to transfer learned oral hygiene skills from clinical appointments to home conditions [4,5]. Due to their low ability to operate multiple concepts simultaneously (e.g., the correct sequence of movements and the accuracy of the movements during tooth brushing), they need to create patterns instead of flexible behavior that takes circumstances into account. All these characteristics determine the volume of acquired skills during active learning and their retention over a long period [6,7].

Presenting information in a different format to the second group of DS-diagnosed children results

in a lower retention of manual skills over the 9-day interval. This is because the peculiarities of object-practical thinking typical for DS individuals require the use of multiple analyzers simultaneously to create a holistic image, i. e., vision, hearing, tactile sensitivity, and proprioception. Visual-kinesthetic analysis yields the best results. The close connection between cognitive development and the development of other spheres, such as motor, speech, and socioemotional development, may determine the effectiveness or lack thereof (in the case of disturbances in one of the spheres). Multimedia presentation of information does not consider the individual inertia of mental processes and the long latent period between the presented information and the responsive reaction of individuals in this category.

Regarding the dynamics of acquiring manual skills in the conducted study, it was identified that in neither group was there an absolute adherence to the action algorithm when reproducing the standard tooth-brushing method during the first and second clinical appointments (on days 1 and 3 of the study) (Fig. 2).

Despite the lower "chaotic attention" inherent in this age group compared to younger children, 100% survival of manual skills was not observed in any group of DS patients. The choice of the age group in this study is somewhat arbitrary since even within one age group, age norms cannot be used due to the different levels of development in children with DS. This fact justified our chosen form of hygiene education: an individual one. Each child received an individual approach during clinical appointments. Considering it impractical to use large time intervals between repetitions of the developed movement chain, habit formation for daily tooth brushing was essentially conducted twice a day: on the second, fourth, sixth, and eighth days - exclusively at home, on the first, third, fifth, seventh, and ninth days - in clinical and home conditions.

We found that both groups of children faced the greatest difficulty in reproducing sweeping movements of the standard tooth-brushing method. The standard tooth-brushing method, as a whole, and its integral

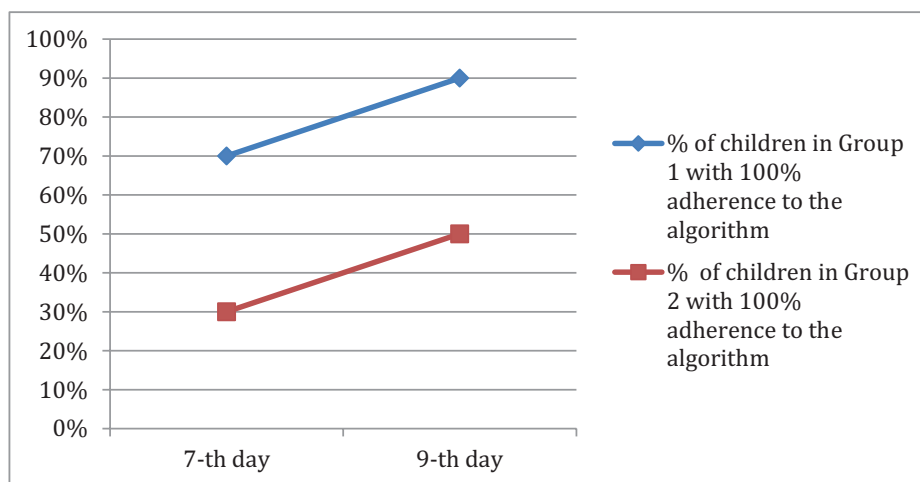


Fig. 1. Dynamics of Action Sequence Acquisition

(Legend: blue line – percentage of children in Group 1 with 100% adherence to the algorithm, red line – percentage of children in Group 2 with 100% adherence to the algorithm; X-axis: 7th day / 9th day, Y-axis: %)

Рис.1. Динамика освоения последовательности действий

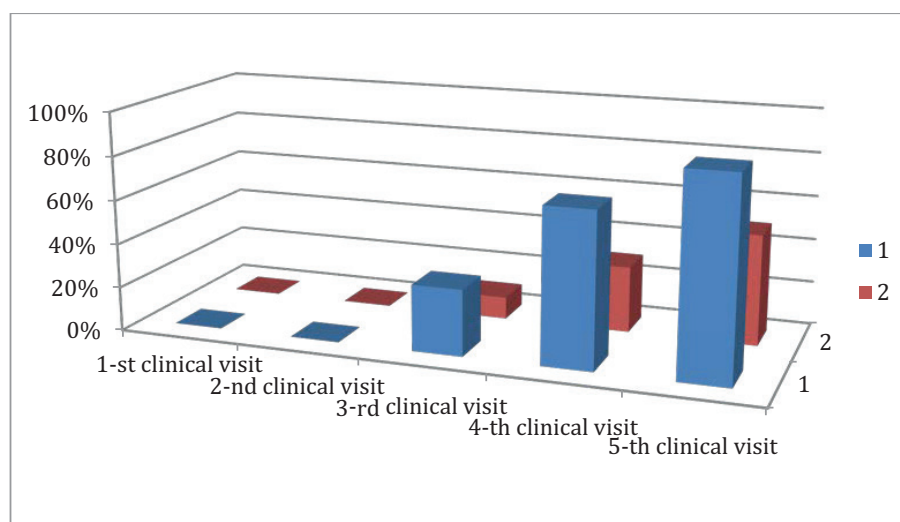


Fig. 2. Degree of Accumulation of Manual Skills in Children Groups 1 and 2 over time
(Legend: X-axis: 1st to 5th clinical visits; Y-axis: %; Z-axis: group 1 – blue, group 2 – red)
Рис.2. Степень развития мануальных навыков у детей 1-й и 2-й групп с течением времени

component - sweeping movements during oral care - are vivid examples of fine motor skills, a balanced collaboration of the nervous and muscular systems of the body. It is a result of coordinated tactile sensitivity, a kinesthetic component, and dynamic and reciprocal coordination of movements [8,9]. Considering this, in developing skills for the standard tooth-brushing method, we did not use a staged approach to increase the effectiveness of learning. To avoid the perception by these groups of children of various stages of tooth brushing as separate, unrelated locomotion, we used the holistic exercise learning method [10]. After all, only a complete chain of correctly performed movements will ensure good oral hygiene.

Regarding the level of oral hygiene, we found that the hygiene level, on average, in the first group of children corresponded to a satisfactory value already on the seventh day of training. On the ninth day of training, a satisfactory average value of the Green-Vermillion Index was maintained in the first group.

In the second group of children, the Green-Vermillion Index was characterized as satisfactory only in 3 out of 10 patients on the ninth day of training; on average, a poor level of hygiene was maintained in the second group on the ninth day of training.

Fine motor skill disorders characteristic of patients with this condition (manifesting as difficulties in reproducing sweeping movements when cleaning the vestibular and oral surfaces of dental arches) do not allow achieving good Green-Vermillion Index values, even with adherence to the sequence of actions during the standard tooth-brushing method.

Conclusions: Thus, in training DS patients for the standard tooth-brushing method, the most effective case technology was the business-like “interpersonal” game with repeated practice of “hand in hand” movements and comments on actions combined with praise for the imitating child. To form a stable dynamic stereotype, the training course should consist of at least nine sessions.

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