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OCCLUSION AND NUTRITION AFTER PEADIATRIC PROSTHETIC TREATMENT

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Abstract

Nutritional and well-balanced food intake is of utmost importance for children's proper physical development and growth. Changes in masticatory structures are likely to cause significant change in both children's and adult's diet. The aim of this study is to examine the occlusion and the intake of macronutrients in children who have undergone dental treatment and restoration of the teeth affected by caries and its complications with different types of aesthetic crowns.

The study included 103 children, which are prosthetically treated with crown structures and divided into four age groups. The restoration of the occlusal balance after the completion of the prosthetic treatment was established by means of a new generation of digital recording system (OccluSense by Bausch, Germany). A 24-hour diary on consumed foods and liquids was taken from children and their parents. Data is analyzed and processed statistically.

The obtained results in all studied diagrams showed an increase in the occlusal forces bilaterally in the distal areas of the dentition in the anterior-posterior direction. Protein and carbohydrate intake by the tested children corresponded to the recommended range of 15.2 ± 3.7 E% and 46.6 ± 7.8 E%. Increased fat intake of 38.1 ± 7.5 E%, as well as fibre consumption below the recommended values (13.6 g to 18.6 g) have also been observed.

Dental restoration of heavily damaged children's teeth using prosthetic dentistry methods provides the opportunity for a normal intake of the main macronutrients.

Key words: nutrition, children age, macronutrients, crown

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Introduction. Complete nutrition is crucial for the proper growth and development processes in childhood [1]. Scientific studies [2–4] discuss the link between nutrition and oral health. It is well known [5] that dental disorders, partial or total lack of teeth disrupt the chewing efficiency. This leads to restriction of dietary intake, to incomplete initial processing of the nutrients, to digestive system diseases, etc. The use of different types of prosthetic structures in children and adults can also affect the import of the nutrients [6]. Inappropriately adapted constructions can lead to pain, reduced chewing efficiency, oral mucosal infections and taste changes. All of this affects the overall well-being of the body – changes in weight and psychological conditions. There is a tendency for patients to receive mushy high-carbohydrate food low in vitamins and minerals.

Contemporary scientific studies [7–10] analyze the connection between chronic caries and its complications and children's inadequate nutrition. According to Sheiham [11] the untreated carious lesions cause pain and discomfort during meals, which is the main reason for deviations in the quality and quantity of the ingested nutrients. The affected patients limit their consumption to several types of foods that do not usually meet the physiological needs of the body at this age.

A study by Daly et al. [12] shows that almost 25% of the patients with disorders in dental structures have changed their diet after the disease onset and 36% reported that at least once an occurrence of pain and/or discomfort had prevented them from food consumption.

In their study Clarke et al. [13] proved that all children under research who have early childhood caries also have signs of malnutrition, i.e. they were underweight considering their age. Their statement has been supported by Abolfotouh et al. [7] whose study has found that young underweight patients had higher incidence of dental caries in deciduous dentition than those with normal weight.

Of scientific interest is the study by Acs et al. [8], the purpose of which is to track weight changes in young patients before and after treating of early childhood caries. The results show that the affected children weigh less than 80% of the recommended age weight. Within a period of an average of 1.4 ± 0.4 years, after the defect's restorations, a "catch-up" phenomenon was reported for the treated children. Other scientific studies [14–16] also testify to improved indicators of growth and development processes in children after recovering the damaged teeth. Positive change in body weight within normal weight ranges for this age was also reported. According to Sheiham [11], conducting treatment and restoring the shape and size of the teeth, positively affects the chewing function and creates appropriate conditions for normal, quantitative and qualitative intake of nutrients.

In the thorough literary references, we made, we, however, failed to find any scientific data on the changes in the main macronutrients intake after crown restorations of deciduous teeth, affected by caries. This calls for a more detailed analysis of the way prosthetic treatment with aesthetic crowns can affect proteins, carbohydrates, fats and fibre intake.

The purpose of the study is to examine the occlusion and the intake of macronutrients in children who have undergone dental treatment and restoration of the teeth affected by caries and its complications with different types of aesthetic crowns.

Material and methods. The objects of this study are 103 patients (39 boys, 64 girls), aged between 3 and 17 years (average age 10 ± 4 years); 38.8% of children are with permanent dentition, 37.9% are with mixed dentition, and the other 23.3% are with deciduous dentition. Study objects have been divided into the following groups: 1st group – 3 to 7 years old (24 children in total – 11 boys, 13 girls); 2nd group – 7 to 10 years old (21 children in total – 8 boys, 13 girls); 3rd group – 10 to 14 years old (26 children in total – 10 boys, 16 girls); 4th group – 14 to 17 years old (32 children in total – 10 boys, 22 girls).

Out of all subjects studied, on 11 children (10.7%) 44 crowns made by composite material using CAD-CAM system are placed. In 23 children (22.3%) – 36 zirconium crowns are placed. Ceramic crowns were placed on 27 (26.2%) children. Thirty-two of the children (31.1%) underwent prosthetic treatment with 52 metal-ceramic crowns. The remaining ten children (9.7%) have 21 resin crowns.

The restoration of the occlusal balance after the completion of the prosthetic treatment was established by means of a new generation of digital recording system (OccluSense by Bausch, Germany) (Fig. 1).

For the purpose of the study, two months after the end of the prosthetic treatment, data on the food and fluids intake within 24 h were collected. Food diaries were set out, containing the food and beverages consumption information, divided into hours in three main and two intermediate meals. To measure the dietary intake, were used measurement units as: teaspoon, tablespoon, tea cup, water cup, bowl, dish (portion).



Fig. 1. Registration of the occlusion with digital system OccluSense

The obtained data on the intake of food and fluids were analyzed using a software program for processing of the nutritional intake by the population of Bulgaria at the National Center for Public Health and Analyses, developed at the Ministry of Health, Bulgaria. Daily protein (E%), carbohydrate (E%), fat (E%), fibre (g) intake average standard values with standard deviation were derived as well.

The obtained data were subjected to statistical analysis with SPSS v. 20.0 using the following analyses: descriptive statistics, χ^2-criterion, Fisher's exact test, t-test, variance analysis, and correlation analysis. MS Excel 2010 was used for tabular and graphical representation of the results.

Results and discussion. Prosthetic treatment performed to restore severely damaged teeth in children achieved a harmonious distribution of occlusal parameters in terms of force distribution, both on individual teeth and in terms of quartered force distribution. In 2D view the recorded data show the masticatory pressure by two dimensional coloured shapes (Fig. 2).

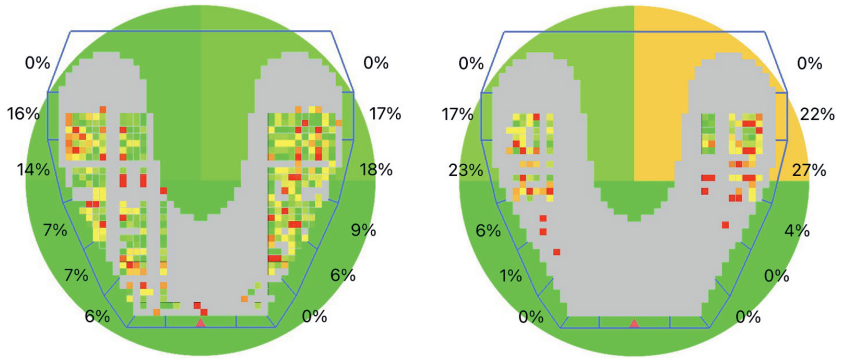


Fig. 2. Distribution of occlusal forces in central occlusion in 2D view

3D view allowed analyses of the data in bar diagram. The different heights in the columns visualized occlusal pressure – the higher the column, the higher the pressure of occlusal contact. The ability to calculate the masticatory pressure distribution allowed us to fully track the ratio of individual contact points with the surrounding areas as well as all contact points of the entire dental arch from the moment of the realization of the first occlusal contact to the maximum bite force in centric occlusion (Fig. 3).

The obtained results in all studied diagrams showed an increase in the occlusal forces bilaterally in the distal areas of the dentition in the anterior-posterior direction. Unlike the force-loaded lateral areas, the frontal area is characterized by weak contacts in 71.84% of the cases (74 of the children) or lack of such in 28.16 % of cases (29 of the children). The articulation analysis confirmed the clinical data for the absence of articulation blockages in protrusion, left and right laterotrusion.

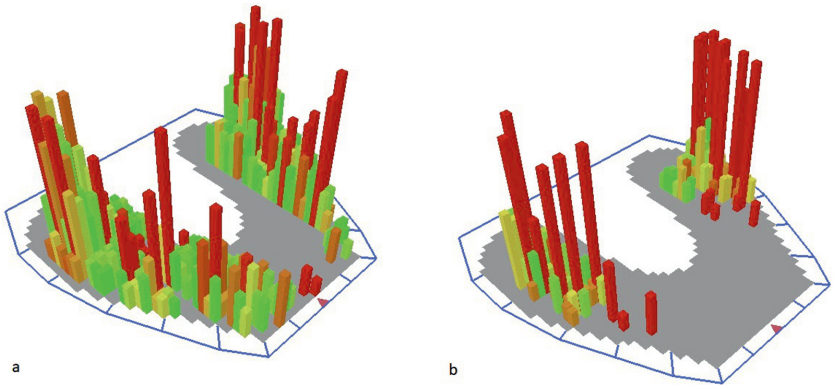


Fig. 3. Distribution of occlusal forces in central occlusion in 3D view – in patients with weak contacts in the frontal area (a) and in patients with no contacts in the frontal area (b)

The average protein intake by all children values were estimated at 15.2 ± 3.7 E%. When comparing the values obtained with the recommended values [17] of 10–20 E% it was found that in 86% of the children the consumption of proteins corresponds to the reference value. At 6%, protein intake is lowered and at 8% exceeds the needs. When examining criteria by age, we found the following daily average intakes with standard deviation: from 3 to 7 years – 16.3 ± 3.4 E%, minimum – 10.9 E%, maximum – 22.9 E%; from 7 to 10 years – 16.1 ± 4.5 E%, minimum – 7.5 E%, maximum – 28.2 E%; from 10 to 14 years – 13.8 ± 2.3 E%, minimum – 9.3 E%, maximum – 18.0 E%; from 14 to 18 years – 15.0 ± 4.0 E%, minimum – 7.8 E%, maximum – 26.0 E%.

The average daily fat intake with standard deviation by all children was reported to be 38.1 ± 7.5 E%, with the lowest value being 20.2 E% and the highest – 58.7%. After a comparative analysis with the recommended values of nutrition of the Republic of Bulgaria (25–35%) [17], an average of 3.1 E% increase in fat intake was found. The resulting deviation is of statistical significance ($P = 0.031$).

From all of the studied children it is found that in 66% of them the fat intake is increased. In 30% of children, normal fat consumption was reported, and in 4% the intake was below the recommended for the age range.

When examining criteria by the age group, we found that for children aged 3 to 7, daily fat intake with standard deviation was 32.8 ± 7.2 E%.

Children aged 7–10 years received an average of 38.0 ± 6.0 E% (average value with standard deviation) fat. A statistically significant difference ($P = 0.032$) was found when compared to reference values. The consumption by this group was 3 E% above the upper limit of recommended values intake.

A statistically significant difference ($P = 0.000$) was also reported in the 10–14 age group of children. The average consumption with standard deviation was 41.4 ± 7.0 E%, which is 6.4 E% above the upper recommended limit. This group

had the highest fat intake compared to others. The highest estimated value was 58.7 E%.

For the teenage group (14–17 years) the intake of fatty substances with standard deviation was 39.6 ± 7.1 E%. The difference of 4.6 E% over the upper limit of the recommended for this age range is statistically significant ($P = 0.001$).

There is a statistically significant relationship between fat intake and carbohydrate intake ($\chi^2 = 0.000$, Fisher's exact test = 0.000).

All of the children (100%) who had fat intake below the reference values had consumed carbohydrates within the recommended limits. In children receiving recommended fat values – 96.8% – the carbohydrates intake was within the references as well. As for subjects consuming fats above recommended limits, 62.7% were reported to take carbohydrates below the age requirement.

Average carbohydrate intake values with standard deviation of 46.6 ± 7.8 E% were reported for all the children. In comparing it with the physiological norms (45–60 E%) we found that 58% of the studied children have an intake corresponding to the body's energy demands. In 42% of children, carbohydrates intake was lower than required. In none of our children did we find carbohydrate intake above the recommended values.

When considering the average consumption with standard deviation of carbohydrates for each age group it was found that children aged between 3 and 7 took 50.9 ± 7.0 E%, between 7 and 10 years – 45.9 ± 6.6 E%, between 10 and 14 years – 44.8 ± 7.7 E%, between 14 and 18 years – 45.4 ± 8.3 E%. Lower values relative to the recommended ones were reported only in the 10–14 age group. The difference was not statistically significant. For the other groups, carbohydrate intake was within the recommended range.

When examined, the fibres intake by the studied children it was found that 61% did not take a sufficient amount according to the reference values of balanced nutrition. In 22% of the subjects studied intake is more than the recommended values, and only 17% had fibre consumption according to references for their age. The lowest reported values were 2.1 g per day and the highest – 35.6 g per day.

After examining the age criterion it was found that the youngest children (3–7 years) had an average daily intake with standard deviation of 13.6 ± 5.7 g, at a limit of 14 g per day, the second group of children (7–10 years) consumed 14.3 ± 3.7 g, at a limit of 16 g per day, the third group (10–14 years) – 16.3 ± 5.8 g, at a limit of 19 g per day and teenagers received 18.6 ± 7.8 g, at a limit of 21 g per day.

In a comparative analysis of the average values and recommended values, it was found that all groups had consumed less than the amount of fibre required for the age (Fig. 4).

A statistically significant difference ($P = 0.045$) was found in the 7–10-year-old group. The average intake was 1.7 g below the recommended age-appropriate amount. A statistically significant difference ($P = 0.029$) was also found in the

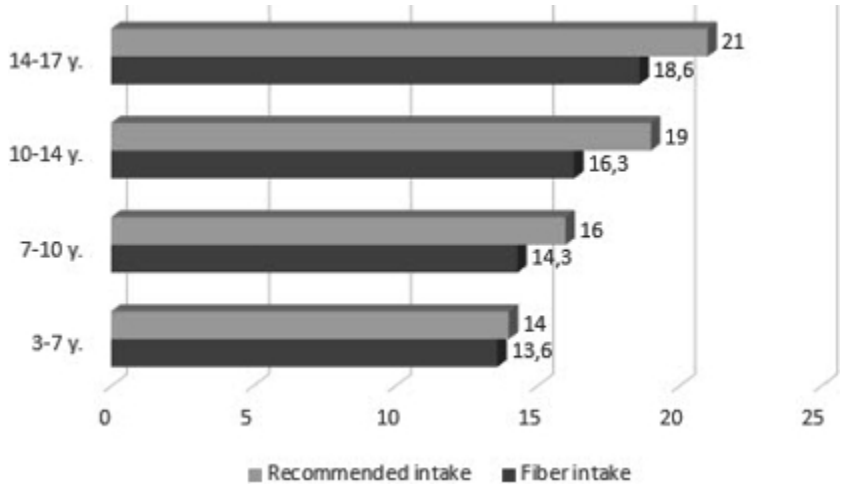


Fig. 4. Average daily fibre intake by age group compared with recommended values

intake by children aged 10–14 years. For this group, the average intake was 2.7 g below the recommended.

There are no statistically significant differences in fibre intake and reference values in groups of children aged 3–7 and 14–17 years.

A statistically significant correlation between carbohydrate intake and fibre intake ($\chi^2 = 0.015$, Fisher's exact test $= 0.018$) was identified.

Of the group of the children with reduced (according to the recommended values) carbohydrate intake – 76.7% had a reduced fibre intake as well. From those whose carbohydrate intake was within referent limits – 49.2% had also reduced consumption of foods rich in fibre.

Discussion. Timely prosthetic treatment in children allows the restoration of normal occlusal-articulation relations. The balanced distribution of occlusal forces is crucial for the comfort in mechanical processing of food and for providing conditions for the action of the bio-chemical agents.

According to the physiological norms of nutrition of the Bulgarian population [17], the established levels of protein consumption for the children we studied are within the recommended range of 10–20%. The data we have obtained are confirmed by previous studies [18–20] in the country and in Europe, which indicate that protein intake in this age ranges between 11 and 17%.

About fat intake the findings are in line with the global trend of increased consumption of foods containing high amounts of hidden fat [20]. Children often mention foods such as crisps, processed foods and other foods high in harmful fatty substances as favourite and preferred.

The values we established for carbohydrate intake (46.6%) of all tested children are in support of the results so far [18–20] for the country, as well as globally, i.e. carbohydrate intake in boys and girls of this age range between 39 and 61.6 E%.

Fibres are complex oligo- and polysaccharides and are part of carbohydrate intake. In children with carbohydrate intake according to the recommended values, fibre intake was reduced in almost half of the children (49.2%). Therefore, the energy obtained from the consumed carbohydrates at this age is at the expense of higher intake of simple sugars (monosaccharides and disaccharides), which have a low nutritional value and increase the risk of overweight. According to the recommendations [17], two-thirds of carbohydrate intake should be from complex polysaccharides. Children of this age have increased consumption of chocolate, confectionery and other foods rich in simple sugars and reduced intake of whole grains and nuts, which are major sources of fibre, proving the aberrations reported.

Conclusion. According to the recommendations of the World Health Organization, dental diseases are part of the group of non-infectious diseases. The results obtained show that prosthetic treatment with crown constructions in childhood provides prerequisites for intake of basic macronutrients, according to the recommendations for balanced nutrition.

The study and assessment of dietary intake of children who have undergone dental treatment, conducted for the first time in Bulgaria, should be part of the diagnostic protocol of dental practitioners because it emphasizes the importance of the functional chewing apparatus as part of the whole digestive system and provides preconditions for prophylaxis of malnutrition as a result of disturbed dental structures.

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