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DOES LONG TERM PARENTERAL NUTRITION IN CHILDREN HAVE AN IMPACT ON MALOCCLUSION? PRELIMINARY REPORT

CZY DŁUGOTRWAŁE ŻYWIENIE PARENTERALNE U DZIECI MA WPŁYW NA POWSTAWANIE WAD ZGRYZU? DONIESIENIE WSTĘPNE

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Abstract

Aim: To evaluate the impact of long-term partial parenteral nutrition and its complications on malocclusion in children and adolescents.

Material and methods: The assessment involved 61 patients (2.25 to 16 years of age) without a masticatory parafunction – i.e. 31 subjects receiving parenteral nutrition for a mean period of 5.71 ± 2.87 years, and 30 healthy control subjects. The medical records provided information on the delivery (full-term, preterm), birth body mass, Apgar score, weight deficiency at the age of 1 year; the patient assessment included the current body mass, the number of enteral meals per day and parenteral meals per week, occlusion (acc.to Orlik-Grzybowska's parameters). The statistical analysis was performed by using the chi-square test, Spearman's correlation analysis; the statistical significance was $p < 0.05$.

Results: Premature infants with low birth body mass (38.7%), Apgar score below 7 (25.8%), underweight in the first year of life (74.2%) and on examination day (58.1%) were only part of the test group. Mean number of eaten meals: 4.63 ± 1.88 in parenteral nutrition patients, 6.26 ± 1.39 in healthy individuals in the control group. Malocclusions were significantly more frequent in the children receiving parenteral nutrition (38.71%: the most frequent defects included crossbite (19.31%), open bite malocclusion (12.9%), crowding of teeth (9.67%), than in the control group (13.3%: crossbite (3.3%), open bite malocclusion (3.3), crowding of teeth (3.3%). A correlation was statistically proved between the malocclusion and parenteral nutrition, the number of parenteral feeding sessions per week, the current low body mass.

Conclusion: Long-term parenteral nutrition, a decreased number of oral meals and a coexistent low body mass at the developmental age may contribute to the development of malocclusion.

Key words: eating habits, perinatal factors, low body mass, occlusion

Streszczenie

Cel: Ocena wpływu przewlekłego, częściowego żywienia pozajelitowego i jego powikłań na występowanie wad zgryzu u dzieci i młodzieży.

Materiał i metody: Zbadano 61 pacjentów (wiek 2,25-16 lat), bez parafunkcji narządu żucia (grupa badana – 31 żywionych pozajelitowo średnio $5,71 \pm 2,87$ lat, grupa kontrolna – 30 ogólnie zdrowych). Z dokumentacji medycznej uzyskano informacje dotyczące porodu (o czasie, przedwczesny), masy

urodzeniowej, punktacji Apgar, niedoboru masy ciała w 1. roku życia; oceniono: aktualną masę ciała, liczbę posiłków doustnych w ciągu dnia i pozajelitowych w ciągu tygodnia, warunki zgryzowe (wg Orlik-Grzybowskiej). Analiza statystyczna: test chi-kwadrat, analiza korelacji Spearmana; istotność statystyczna $p < 0,05$.

Wyniki: Tylko w grupie badanej znalazły się dzieci urodzone przedwcześnie z małą masą urodzeniową (38,7%), z < 7 punktów Apgar (25,8%), niedoborem masy ciała w pierwszym roku życia (74,2%) i w dniu badania (58,1%). Średnie liczby posiłków doustnych: $4,63 \pm 1,88$ u żywionych pozajelitowo, $6,26 \pm 1,39$ zdrowych grupie kontrolnej. Wady zgryzu występowały istotnie częściej u żywionych pozajelitowo (38,71%: najczęściej zgryz krzyżowy – 19,31%, otwarty – 12,9%, stłoczenia – 9,67%) niż w grupie kontrolnej (13,3%: zgryz krzyżowy – 3,3%, otwarty – 3,3, stłoczenia – 3,3%). Potwierdzono statystycznie korelację wad zgryzu z żywieniem pozajelitowym, liczbą wlewów pozajelitowych w tygodniu, aktualnym niedoborem masy ciała.

Wniosek: Przewlekłe stosowane żywienie pozajelitowego, zmniejszenie liczby posiłków doustnych i towarzyszący niedobór masy ciała w okresie rozwojowym może sprzyjać wystąpieniu wady zgryzu.

Słowa kluczowe: nawyki żywieniowe, czynniki okołoporodowe, niedobór masy ciała, zgryz

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INTRODUCTION

Parenteral nutrition, or intravenous alimentation, is the treatment administered in the conditions in which full oral nutrition is not possible or does not supply the full calorie intake and requirement for particular nutrients (1-4). It may be the only route of alimentation (the so-called total parenteral nutrition – TPN), or it may cover less than 50% of the daily requirements (the so-called partial parenteral nutrition – PPN). It is introduced in early childhood, including newborn infants; in some patients it is provided for several years. The treatment is frequently indicated in children with short bowel syndrome (SBS) defined as an anatomical or functional loss of over 50% of the small intestine (5). The SBS aetiology may include congenital defects of the digestive tract, and intestinal resection in the course of necrotising inflammation or congenital evisceration (2, 4, 5).

Parenteral nutrition involves the risk of multiple complications – i.e. infections, resulting from central venous catheter, and requiring antibiotic therapy, e.g. venous thrombosis, liver function disorders, and metabolic complications, including metabolic bone disease. The children receiving long-term parenteral nutrition are

frequently prone to inadequate weight and height and a delayed bone age (4, 6, 7). The complications, and an inadequate masticatory function associated with elimination or less frequent oral alimentation, may result in an increased risk of malocclusion than in the general population (8).

The aim of the present study was to determine a correlation between long-term parenteral nutrition and its complications in malocclusion in children and adolescents.

MATERIAL AND METHODS

Sixty one patients aged 2.25-16 years, were enrolled in the study – i.e. 31 subjects receiving parenteral nutrition (the study group; mean age: 6.12 ± 3.2 years) and 30 healthy subjects (the control group; mean age: 6.76 ± 3.15 years). In 27 patients parenteral nutrition was started under one year old, in other four between one and three years old. Mean parenteral nutrition duration was – 5.71 ± 2.87 years. Figure 1 presents dentition type in both groups.

The exclusion criteria in the study group were the duration of parenteral nutrition for less than 12 months, and the patient's age on its introduction – i.e. over the age

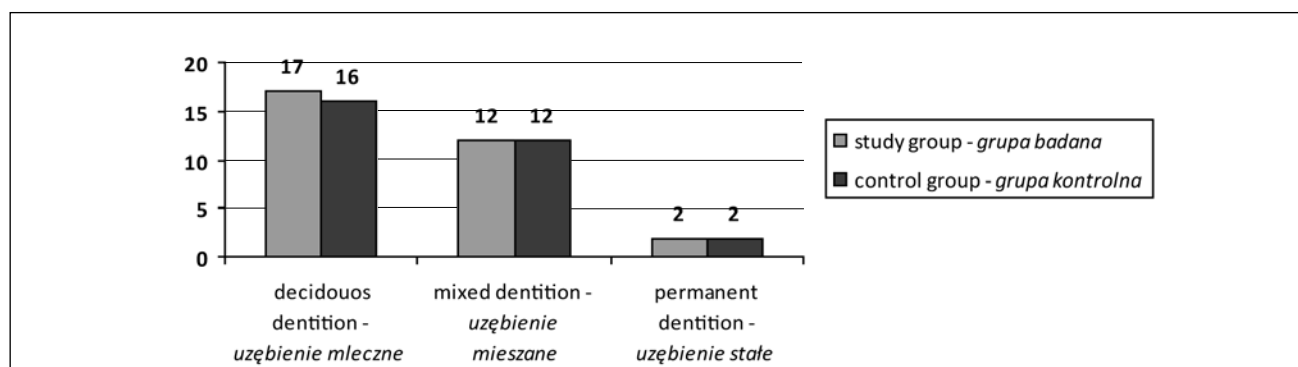


Fig. 1. The type of dentition in study and control group.

Ryc. 1. Rodzaj uzębienia w badanej grupie i grupie kontrolnej.

of three years. The exclusion criteria for the control subjects were chronic diseases, long-term drug administration, incomplete eruption of teeth, present parafunctions, and an early loss of deciduous teeth were.

The major reasons for long-term parenteral nutrition included: short bowel syndrome (27 children), ulcerative colitis (1 child), pseudo-obstruction of the alimentary tract (1 child), protein-losing enteropathy (1 child) and chronic secretory diarrhoea (1 child).

METHODS

The study included:

- **assessment of medical records:** delivery (full-term/preterm) and selected perinatal aspects – i.e. low birth body mass (<2500 g), Apgar score, low body mass (<3 percentile) at the age of one year;
- **body mass assessment on examination:** low body mass was recorded as <3 percentile;
- **dietary history:** oral meals/day, parenteral feeding sessions/week; duration of nutritional treatment;
- **orthodontic clinical assessment** (based on clinical examination according to *Orlik-Grzybowska*);
- **of the positional relationship between the upper and the lower dental arches in the three planes** (the occlusion) in relation to three spatial planes (anteroposterior plane: posterocclusion and anterior occlusion), vertical plane: open bite and deep bite, transverse plane: lingual crossbite and buccal crossbite);

- **of the space conditions** (spacing and crowding of the teeth) (9);
- **statistical analysis**, was conducted using chi-square test for comparison of proportions. Spearman's rank correlation coefficient and Cramer's V were used for correlation analysis. Dichotomous variables for correlation analysis were coded as 0 and 1. Statistical significance was set at $p < 0.05$.

RESULTS

The medical records showed that 38.7% of the patients receiving parenteral nutrition had been delivered before term (the same children had also been assessed with a low birth body mass (<2500 g); in 25.8% of the subjects the Apgar score had been below 7 points (moderate or severe asphyxia), 74.2% of the children had been low body mass at the age of one year. All control subjects had been born at full term, with the body mass >2500 g, and the Apgar score of 9 or 10 points. 58.1% of the patients receiving parenteral nutrition were diagnosed as underweight on the assessment day. The mean number of enteral meals in the subjects receiving parenteral nutrition was lower than that in the control group, and the duration of the dietary treatment ranged from 1.16 to 12.16 years (mean duration of the parenteral nutrition 5.71 ± 2.87 yrs) (tab. I).

Malocclusions were found in 38.71% of the patients receiving parenteral nutrition: (the most frequent

Table I. General parameters recorded on the assessment day, and until the end of the first year of age in the patients receiving parenteral nutrition vs the control group.

Tabela I. Parametry ogólne w dniu badania i do ukończenia 1. roku życia w grupie żywionej pozajelitowo i kontrolnej.

General conditio <i>Stan ogólny</i>	Parenteral nutrition <i>Żywienie pozajelitowe</i>	Control group <i>Grupa kontrolna</i>
	N / %	
Age: 1 yr <i>Pierwszy rok życia</i>		
Apgar score <7 <i><7 punktów w skali Apgar</i>	8/25.8	0
Preterm delivery/low body mass <i>Poród przedwczesny/niska waga urodzeniowa</i>	12/38.7	0
Low body mass at age of 1 yr <i>Niedobór masy ciała w pierwszym roku życia</i>	23/74.2	0
Assessment day <i>W dniu badania</i>		
Low body mass <i>Niedobór masy ciała</i>	18/58.1	0
Nutrition <i>Sposób odżywiania</i>	Mean N	
enteral meals/d <i>posiłki enteralne w ciągu dnia</i>	4.63±1.88	6.26±1.39
parenteral meals/wk <i>posiłki pareneralne w ciągu tygodnia</i>	4.97±2.04	0
parenteral nutrition (yrs) <i>czas trwania żywienia pozajelitowego w latach</i>	5.71±2.87	0

Table II. Spearman's rank of correlation coefficients or Cramer's V (for dichotomous variables) between malocclusion and other parameters.

Tabela II. Współczynniki korelacji rang Spearmana lub V Cramera (dla zmiennych zero-jedynkowych) między wadami zgryzu a innymi cechami.

	Malocclusion Wada zgryzu	Open bite Zgryz otwarty	Crossbite Zgryz krzyżowy	Posteroclusi-on Tyłozgryz	Crowding of teeth Stłoczenia
Parenteral nutrition Żywienie pozajelitowe	0.257*	0.174	0.251	-0.003	0.072
Age on introduction of parenteral nutrition ^a Wiek rozpoczęcia żywienia pozajelitowego ^a	-0.027	-0.349	0.046	0.166	-0.007
Duration of parenteral nutrition ^a Czas trwania żywienia pozajelitowego ^a	0.271	-0.043	0.329	0.041	0.250
Low body mass on assessment day Niedobór masy ciała w dniu badania	0.294*	0.329*	0.102	0.081	0.184
Apgar scale <7 pts <7 punktów w skali Apgar	0.224	0.057	0.161	0.199	-0.092
Preterm delivery/low body mass Poród przedwczesny/niska waga urodzeniowa	0.192	0.151	0.208	0.139	-0.093
Low body mass at 1 yr Niedobór masy ciała w pierwszym roku życia	0.239	0.251	0.128	0.038	0.126
Mean number of enteral meals/d Średnia liczba posiłków enteralnych w ciągu dnia	-0.274*	-0.196	-0.312*	0.249	-0.137
Mean number of parenteral meals/wk Średnia liczba posiłków parenteralnych w tygodniu	0.310*	0.207	0.313*	-0.045	0.104

*statistically significant correlation coefficients (P<0.05)

a – dotyczy tylko dzieci żywionych pozajelitowo

a – only for children with parenteral nutrition

anomalies included crossbite (19.31%) and open bite malocclusion (12.9%), the less frequent defects were crowding of teeth (9.67%) and posteroclusions (6.45%); in two subjects, crossbite was coexistent with open bite malocclusion, and in 13.3% of the control patients (including crossbite – 3.3%, open bite malocclusion – 3.3, posteroclusions – 3.3%, crowding of teeth (3.3%) (a significant difference $p=0.045$ on the chi-square test). In the patients receiving parenteral nutrition, malocclusions were present in 17.64% of the subjects assessed for their deciduous dentition, and in 75.00% of those with mixed dentition. In the control group, the respective figures were 6.25% and 25%. Statistical analysis did not show any significant correlation with the age at which the parenteral nutrition had been commenced, its duration and perinatal factors - i.e. a preterm birth, a low birth weight, a low Apgar score, and a low body mass at the age of one year. There was, however, a positive correlation between malocclusions and parenteral nutrition, malocclusions and crossbite and a mean number of parenteral meals per week, a concurrent malocclusion and an open bite malocclusion and a concurrent low body mass (tab. II). A negative correlation was also noted between malocclusion and crossbite and the number of enteral meals, which indicates that, with an increased number of meals, the risk of crossbite.

DISCUSSION

The results of the present study showed that the percentage of malocclusions in the patients receiving partial parenteral nutrition (38.71%) was higher than that in the control subjects (13.3%). In both groups it was increasing with the patients' age. The finding is consistent with a generally noted rising incidence of malocclusions and dental abnormalities with age (11). The prevalence of malocclusions in the Polish children of three to five years ranges from 42% to 60%, and from 29.2% to 65.6% in the population of six year olds (11, 12). The main causes of the acquired anomalies in preschool children are dysfunctions and parafunctions (13). The incidence of malocclusion in children at the school age increases, which is due to an early extraction of deciduous teeth (13). Malocclusions were found in approximately 63.7% of 12-year olds, and in 66.0% of the 18-year old population (11). According to Karłowska, the incidence of malocclusion ranges between 50% and 70%, and, considering dental anomalies, it affects 80% of the population (14). Considerable differences in the statistical figures result not only from different study criteria but are also due to the age of the study subjects, their residence area, the health education level, personal oral hygiene, preventive dental, orthodontic, and other measures.

A lower prevalence of malocclusions and dental anomalies in the group of patients receiving parenteral nutrition might have been due to the age aspect (17 children with deciduous dentition, 12 subjects with a mixed type dentition, and only two subjects with permanent dentition), and exclusion of patients with parafunctions of the masticatory system and an early loss of deciduous dentition, which are crucial aetiological factors contributing to the anomalies of the masticatory system. The malocclusions were found in as many as 75% of the children with mixed dentition receiving parenteral nutrition, which seems to emphasize the negative effect of the parenteral nutrition. In the control group, the malocclusions were diagnosed merely in 13.3% of the subjects; this, however, might have been due to the exclusion of children with harmful habits and an early loss of deciduous teeth.

In toddlers and preschool children, the masticatory system and its function are dependent on food consistency and the mode of its intake (14). With a long-term parenteral nutrition, an insufficient functional load of the masticatory system may lead to a lack of physiological attrition of the deciduous teeth and result in jaw narrowing, crowding of teeth and crossbite or posterioclusions. As found in the present study, the negative correlation between malocclusion and the number of oral meals and, a simultaneously positive correlation with the number of parenteral feeding sessions confirms a negative impact of an absent functional load of the masticatory system upon the course of developmental processes of the stomatognathic system.

An interesting correlation was also noted between malocclusion and a low body mass found in over half the number of the children receiving parenteral nutrition. As it is generally known, body mass is one of the nutritional indicators of the body. According to Świąder et al. children with short bowel syndrome (SBS), who receive parenteral nutrition, achieve statistically significantly lower values of their antropometric features, BMI index and percentage of the proper body mass (15).

An insufficient body mass may indicate an inadequate supply to satisfy the patient's nutrient requirements, including protein and vitamins essential for the normal growth and bone mineralization. Studies of animal models suggest that protein calorie malnutrition results in an abnormal development and growth of the face (16, 17). The significance of malnutrition in the aetiology of malocclusion has been evidenced by studies in preschool children (18). However, in their study of 2060 children at the age of 12-15 years, Thomaz et al did not find any direct correlation between malnutrition and crowding of teeth. Nevertheless, the correlation was found in children with habitual mouth breathing (19).

The findings suggest that malnutrition may result in a higher susceptibility of the bone matrix to harmful factors. In our study group, malnutrition in children was correlated with a smaller number of meals than in the subjects receiving only oral nutrition. It should, however, be stressed that diagnosing a low body mass on examination does not provide evidence of long-term malnutrition over a number of years. In our study group of

children receiving parenteral nutrition, malnourishment was found both on the assessment day as well as in their first year of age. Additionally, a frequent complication of parenteral nutrition is metabolic bone disease, which, in the case of our study group, might have been an additional factor predisposing to malocclusion.

CONCLUSIONS

A small number of the subjects and age differences of the study group members do not allow the authors to formulate the final conclusions. Nevertheless, the results presented indicate a necessity to continue the research, since its analysis suggests that a long-term parenteral nutrition, a decreased number of oral meals, and an accompanying low body mass are contributory factors in malocclusion.

REFERENCES

1. *Laskowska J.*: Żywnienie pozajelitowe u dzieci. *Farm. Pol.*, 2009, 65(7), 499-504.
2. *Shulman R.J., Phillip S.*: Parenteral Nutrition in Infants and Children. *J. Pediatr. Gastroenterol. Nutr.*, 2003, 36 (5), 587-607.
3. *Jakubczyk M., Czerwionka-Szaflarska M., Matczuk M., Świątek K., Kusza K.*: Leczenie żywieniowe w praktyce pediatrycznej. *Ped. Pol.*, 2008, 83(4), 390-440.
4. *Pittiruti M., Hamilton H., Biffi R., MacFie J., Pertkiewicz M.*: ESPEN Guidelines on Parenteral Nutrition: central venous catheters (access, care, diagnosis and therapy of complications) *Clin. Nutr.*, 2009, 28(4), 365-377.
5. *Sigalet D.L.*: Short bowel syndrome in infants and children: an overview. *Semi Pediatr. Surg.*, 2001, 10(2), 49-55.
6. *Mahgoub L.O.E., Puntis J.W.L.*: Long-term parenteral nutrition. *Current Pediatrics* 2006, 16, 298-304.
7. *Colomb V., Dabbas-Tyan M., Taupin P., Talbotec C., Revillon Y., Jan D., De Potter S., Gorski-Colin A.M., Lamor M., Herreman K., Corriol O., Landais P., Ricour C., Goulet O.*: Long-term outcome of children receiving home parenteral nutrition. A 20-year single center experience in 302 patients. *J. Pediatr. Gastroenterol. Nutr.*, 2007, 44(3), 347-353.
8. *English J.D., Buschang P.H., Throckmorton G.S.*: Does Malocclusion Affect Masticatory Performance? *Angle Orthod.*, 2002, 72, 21-27.
9. *Piekarczyk B., Zadurska M.*: Etiologia wad narządu żucia. W: *Zarys współczesnej ortodontcji* (red. Karłowska I.), Wydawnictwo Lekarskie PZWL, Warszawa 2008.
10. *Karłowska I.*: Diagnostyka wad zgryzu. W: *Zarys współczesnej ortodontcji* (red. Karłowska I.), Wydawnictwo Lekarskie PZWL, Warszawa 2008.
11. *Kawala B., Szumielewicz M., Kozanecka A.*: Czy ortodonta są jeszcze potrzebni? *Epidemiologia wad zgryzowo-zębowych u dzieci i młodzieży w Polsce w ostatnich 15 latach.* *Dent. Med. Probl.*, 2009, 46, 3, 273-327.
12. *Raftowicz-Wójcik K., Matthew-Brzozowska T., Kawala B.*: Częstość występowania wad zębowo-zgryzowych u dzieci w wieku 3-5 lat. *Dent. Med. Probl.*, 2010, 47, 339-342.
13. *Zadurska M., Piekarczyk B.*: Epidemiologia zaburzeń w rozwoju narządu żucia. W: *Stomatologia wieku rozwojowego* (red. Szpringer-Nodzack M, Wochna-Sobańska M), Wydawnictwo Lekarskie PZWL, Warszawa 2003.

14. *Piekarczyk B., Zadurska M.*: Etiologia wad narządu żucia. W: *Zarys współczesnej ortodoncji* (red. Karłowska I), Wydawnictwo Lekarskie PZWL, Warszawa 2008.
 15. *Świąder A., Rózdżyńska A., Popińska K., Arasimowicz E., Książyk J.B.*: Ocena rozwoju fizycznego dzieci z zespołem krótkiego jelita na podstawie wybranych parametrów antropometrycznych. *Pediatric Endocrinology, Diabetes and Metabolism*, 2010, 16, 4, 284-288.
 16. *Luke D.A., Tonge C.H., Reid D.J.*: Metrical analysis of growth changes in the jaws and teeth of normal, protein deficient and calorie deficient pigs. *J. Anat.*, 1979, 129, 449-457.
 17. *Tonge C.H., McCance R.A.*: Normal development of the jaws and teeth in pigs, and the delay and malocclusion produced by calorie deficiencies. *J. Anat.* 1973, 115, 1-22.
 18. *Thomaz E.B.A.F., Valença A.M.G.*: Relationship between childhood underweight and dental crowding in deciduous teething. *J. Pediatr.*, 2009, 85, 110-116.
 19. *Thomaz E.B.A.F., Cangussu M.C., da Silva A.A.M., Assis A.M.*: Is Malnutrition Associated with Crowding in Permanent Dentition? *Int. J. Environ. Res. Public Health*, 2010, 7(9), 3531-3544.
 20. *Babiak M., Babiak J., Marcinkowski J.T.*: Częstość występowania wad zgryzu u 4, 5, i 6-letnich dzieci z parafunkcjami narządu żucia. *Probl. Hig. Epidemiol.*, 2012, 93(2), 319-326.
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