

Anna Gogola¹, Edward Saulicz^{1,2}, Małgorzata Matyja³, Paweł Linek¹, Andrzej Myśliwiec¹,
Agata Tuczyńska⁴, Dagmara Molicka⁵

ASSESSMENT OF CONNECTION BETWEEN THE BITE PLANE AND BODY POSTURE IN CHILDREN AND TEENAGERS

OCENA ZWIĄZKU POMIĘDZY PŁASZCZYZNĄ ZGRYZU A POSTAWĄ CIAŁA U DZIECI I MŁODZIEŻY

¹Chair of Kinesiotherapy and Special Methods of Physiotherapy,
The Jerzy Kukuczka Academy of Physical Education in Katowice, Poland

²Academy of Business in Dąbrowa Górnicza, Poland, Physiotherapy Department

³Chair of Physiotherapy of Nervous and Locomotor Systems,
The Jerzy Kukuczka Academy of Physical Education in Katowice, Poland

⁴Department of Maxillofacial Orthopaedics and Orthodontics,
Medical University of Poznań. Collegium Stomatologicum

⁵Chair of Basis of Physiotherapy, The Jerzy Kukuczka
Academy of Physical Education in Katowice, Poland

Abstract

Aim: Attempt to compare the occlusion condition in groups of children with different body posture.

Material and methods: 336 children aged from 8 to 14 years were investigated. The subjects were selected in orthodontic clinics (237 children) and at schools (98 children). All participants were divided into groups with different body posture according to Kasperczyk's point method. The comparison of the occlusion quality was performed with the use of a scale developed by Emmerich-Popłatek.

Results: The studied group comprised following number of persons: 12 (3.56%) with no malocclusion, 37 (10.98%) with mild, 162 (48.37%) with moderate and 124 (37.09%) with severe malocclusion. In relation to the body posture, 52.67% of the participants had correct posture, 45.53 % had a faulty posture of mild degree and 1.78% of severe degree. A considerable differentiation of the occlusion condition was discovered within the three groups. In view of a small number of participants with a faulty posture of considerable degree (n=6) the comparative analysis of the occlusion condition was performed between the group with a correct body posture and group with faulty posture (created by combining group 2 and 3). The result of the analysis suggests a significant differentiation of the occlusion condition between the groups mentioned above ($p < 0.01$).

Conclusion: Children with faulty postures present more intense malocclusions than children with a correct body posture. Results of this type suggest the need for interdisciplinary look at people with malocclusions whose therapy should involve body posture correction.

Key words: body posture, faulty posture, occlusion, malocclusion

Streszczenie

Cel: Próba porównania stanu zgryzu w grupach dzieci o różnej postawie ciała.

Materiał i metody: Do obserwacji zakwalifikowano 336 dzieci w wieku od 8 do 14 lat. Badanych pozyskano w poradniach ortodontycznych (237 dzieci) oraz w szkołach (98 dzieci). Spośród wszystkich badanych wydzielono grupy o różnej postawie ciała, przy użyciu metody punktowej Kasperczyka. W poszczególnych grupach wykonano porównanie jakości zgryzu z wykorzystaniem skali opracowanej przez Emmerich-Popłatek.

Wyniki: W badanej grupie wyodrębniono 12 osób (3,56%) bez wady zgryzu, 37 osób (10,98%) z lekką wadą, 162 osoby (48,37%) ze średnią wadą oraz 124 osoby (37,09%) z ciężką wadą zgryzu. W odniesieniu do postawy ciała 52,67% osób miało postawę prawidłową, 45,53% wadę postawy ciała nieznacznego stopnia, 1,78% wadę postawy znacznego stopnia. Analiza porównawcza stanu zgryzu pomiędzy grupami z postawą prawidłową i z wadą postawy (powstała z połączenia dwóch grup) ujawniała istotną różnicę ($p < 0,01$).

Połączenia dwóch grup z wadą średnio ciężką i ciężką dokonano ze względu na bardzo małą liczbę dzieci (6-cioro z wadą ciężką postawy).

Wnioski: Dzieci z wadami postawy ciała przejawiają bardziej nasilone wady zgryzu niż dzieci z prawidłową postawą ciała.

Słowa kluczowe: postawa ciała, wada postawy, zgryz, wady zgryzu

DEV. PERIOD MED., 2014, XVIII, 4, 453-458

INTRODUCTION

The literature review shows that there is a number of evidence signifying the connection between the bite plane and body posture (1, 2). It was proven that there is a relationship between the mandible position and dynamic postural parameters – balance or posture stability (1-3). The occurrence of interaction between occlusal relationship and selected body posture elements has also been discovered. The evidence has been presented which implies that there is a close connection between the occlusion condition and head position and neck muscles activity (4, 6). A connection between the facial morphology and body parts located in a certain distance from the head, like the thorax, lumbar section or pelvis, was also observed (7, 8). It was proven that there is a link between the malocclusions and scoliosis (9, 10). A few reports also confirm the correlation between the bite plane and foot architecture (11, 12, 13).

It is difficult to correspond to such numerous pieces of evidence proving the correlation between the bite plane and postural parameters. However, the measurement equipment, which was used by the authors referred to above, is not available in the clinical conditions. Daily practice of people dealing with the postural evaluation of children makes it possible to use only simple, inexpensive and uncomplicated research methods. Their task is the initial verification of the body posture parameters, qualifying for further examination with the use of more specialist measuring tools. On that account, the authors of this project made an attempt to compare the occlusion condition in groups of children with different body posture with the use of methods widely applied in the clinical environment.

MATERIAL AND METHODS

336 children, including 173 girls and 163 boys, qualified for the research. The volunteers were examined in orthodontic clinics (237 children) and at schools (98 children). The examinations were carried out basing on the two specified aspects, as it was necessary to find children with different occlusion condition and body

posture. There were two selection criteria during the qualification process: 1) the participants had to be in the 8 to 14 age bracket, 2) no evident causes of malocclusion could occur, like: congenital spinal defects, nervous system diseases, genetic syndromes, endocrine glands disorders, neuromuscular dystrophies. The research procedures were carried out in accordance with the binding Declaration of Helsinki from 1979, modified in 1983, and the 8/2008 resolution of the Academy Bioethics Committee for Scientific Research.

The body posture in the studied groups was assessed by means of the Kasperczyk's point method (14). The position of head, shoulders, scapulae, the formation of thoracic kyphosis and lumbar lordosis, thorax, abdomen, knees and feet were taken into consideration. The occurrence of scoliosis was also investigated. Each of the parameters was assessed according to the following scale: 0 points – correct position, 1 point – a slight deviation from the correct condition, 2-3 points – a significant deviation from the correct condition, 4-5 points – deformation of a great degree. The total of the obtained points was the basis for qualification to the specific groups: 0-5 points group with correct body posture, 6-12 points group with a faulty posture of mild degree, 13-28 points group with a faulty posture of considerable degree. A modified division of the faulty postures categories, which is available in the specialist literature, was used (15).

The next stage involved determining the quality of occlusal relationship by means of a scale developed by Emmerich-Poplatek (16). The functional tests (17) were carried out adapting the following scale: 0 points – no defect, 1 point – a minor defect (a discrete disorder proceeding with no harm for the development, functioning and patient's esthetics, without the need for treatment), 2 points – moderate defect of a functional nature requiring orthodontic treatment, 3 points – severe defect of morphological nature proceeding with chewing and speech disorders (absolutely requiring treatment). In case of children, who had already been in the process of orthodontic treatment, the degree of intensification of the treated defect was taken into consideration (18). As result of that, four categories defining the occlusal

quality were distinguished: 0 – no defect, 1 – minor defect, 2 – moderate defect, 3 – severe malocclusion.

All of the measurements were performed by two specialists, the physiotherapist (body posture assessment) and orthodontist (occlusal condition assessment).

A double classification variance analysis was used in the statistical analysis of the results to determine the dependences between the body posture as well as malocclusion and the sex and age. The ANOVA variance analysis was applied to compare the basic parameters of the studied groups (age, height, weight and Rohrer's index). The chi-squared test was used to define the global dependencies between the analyzed variables. Kruskal-Wallis nonparametric ANOVA test and a multiple comparison of mean ranks of all the samples were used to compare the occlusion condition in the three groups with different body posture. The comparison between the two groups was performed by means of Mann-Whitney U test. The use of nonparametric tests is justified by lack of normal distribution in Shapiro-Wilk's test and homogeneity of variance in Levene's test. The adopted statistically significant value was $p < 0.05$.

RESULTS

The analysis of connection between the occlusion condition and sex and age of the investigated people did not demonstrate significant dependencies (sex $p = 0.35$; age $p = 0.38$). Significant differences were however observed in case of dependence between the body posture and sex ($p = 0.01$) as well as age ($p = 0.01$). However, no significant

interactions were discovered which means that the posture changeability with age is similar for both sexes. The comparison of mean values of the body posture assessment between the group of children recruited at clinics (mean value = 4.70) and at schools (mean value = 6.14) was performed and a significant differentiation was obtained ($p < 0.01$). In relation to the main objective, which is the comparative analysis of the occlusion condition in groups with different quality of body posture, the calculations were made for all the subjects collectively. The volunteers were divided into three groups in regard to the quality of body posture: 1. group with correct body posture, 2. group with a faulty posture of minor degree, 3. group with a faulty posture of considerable degree. The comparative analysis of the biometrical data (age, height, weight and Rohrer's index) of the analyzed group did not show any significant differences (Table I). Dependence was however found between the analyzed variables – body posture and occlusion condition ($p = 0.03$). Table II includes the detailed description of the analysis together with the subjects' percentage participation in the specific categories of body posture and occlusion.

The comparative analysis of the occlusion condition and the body posture proves a significant differentiation between the group with correct body posture and the group with faulty posture of mild degree ($p = 0.01$). The remaining groups did not manifest any significant differences (Table III).

In view of a small number of participants with a faulty posture of considerable degree ($n = 6$) the comparative analysis of the occlusion condition was performed between

Table I. Mean value, standard deviation of age, weight, height and Rohrer's index and the result of variance analysis (F) as well as the significance level of differences (p) of the analyzed groups.

Tabela I. Wartość średnia, odchylenie standardowe wieku, masy ciała, wysokości, wskaźnik Rohrera oraz wynik analizy wariancji (F) i poziom istotności różnic (p) badanych grup.

	Body posture according to Kasperczyk <i>Postawa ciała wg Kasperczyka</i>			Variance analysis <i>Analiza wariancji</i>	
	(1) (n=177)	(2) (n=153)	(3) (n=6)	F	p
Age (years) <i>Wiek (lat),</i> \bar{x} sd min-max	10.95±1.83 8-14	10,86±1.74 8-14	10,8±0.83 10-12	0.11	0.88
Weight (kg) <i>Masa ciała (kg),</i> \bar{x} sd min-max	38.8±10.13 20-66	39.7±11.06 22-80	48±13.92 34-70	2.00	0.14
Height (cm) <i>Wysokość ciała (cm),</i> \bar{x} sd min-max	147.9±11.98 123-182	147.2±14.61 136-179	152.4±7.63 148-166	0.45	0.64
Rohrer's index <i>Wskaźnik Rohrera,</i> \bar{x} sd min-max	1.17±0.16 0.79-1.66	1.21±0.20 0.88-2.23	1.33±0.23 1.02-1.60	0.69	0.50

(1) group with correct body posture, (2) group with a faulty posture of minor degree, (3) group with a faulty posture of considerable degree

(1) grupa z postawą prawidłową, (2) grupa z wadą postawy ciała nieznacznej stopnia, (3) grupa z wadą postawy ciała znacznego stopnia

Table II. The subjects' percentage participation in specific categories of body posture and occlusion.

Tabela II. Procentowy udział badanych w poszczególnych kategoriach postawy ciała i zgryzu.

Occlusion condition Stan zgryzu	Total % Ogółem %	Body posture according to Kasperczyk % Postawa ciała wg Kasperczyka %		
		(1) (n=177)	(2) (n=153)	(3) (n=6)
(0)	3.56	4.60	2.63	0
(1)	10.98	15.52	5.92	0
(2)	48.37	50.00	46.71	50.00
(3)	37.09	29.88	44.73	50.00
Pearson's Chi ²	chi-2	df	p	
	13.93	6	0.03*	

*Statistically significant difference

Occlusion condition: (0) – group with no defect, (1) group with minor defect, (2) group with moderate defect, (3) group with a severe defect.

Body posture: (1) group with a correct posture, (2) group with a faulty posture of mild degree, (3) group with a faulty posture of considerable degree.

*Różnica istotna statystycznie

Stan zgryzu: (0) – grupa bez wady, (1) grupa z lekką wadą, (2) grupa ze średnią wadą, (3) grupa z ciężką wadą.

Postawa ciała: (1) grupa z postawą prawidłową, (2) grupa z wadą postawy ciała nieznacznego stopnia, (3) grupa z wadą postawy ciała znacznego stopnia.

Table III. Mean values of the malocclusion, mean ranks of a four-degree scale of the malocclusion in three body posture groups and the results of mean ranks comparison (Z) and significance level (p).

Tabela III. Średnie wartości wad zgryzu, średnia rang 4-stopniowej skali wad zgryzu w trzech grupach postawy ciała oraz wynik porównania średnich rang (Z) i poziom istotności (p).

Maloccl. index Indeks wad zgryzu	Body posture according to Kasperczyk Postawa ciała wg Kasperczyka			Kruskal-Wallis test Test Kruskala-Wallis					
	(1) (n=177)	(2) (n=153)	(3) (n=6)	1/2		1/3		2/3	
				Z	p	Z	P	Z	p
\bar{x} , sd min-max	2.05±0.79 0-3	2.33±0.70 0-3	2.50±0.54 2-3	2.89	0.01*	1.21	0.68	0.44	0.98

*Statistically significant difference.

(1) group with correct posture, (2) group with a faulty posture of mild degree, (3) group with a faulty posture of considerable degree.

*Różnica istotna statystycznie.

(1) grupa z postawą prawidłową, (2) grupa z nieznaczną wadą postawy, (3) grupa ze znaczną wadą postawy.

the group with a correct body posture and group with faulty posture (created by combining group 2 and 3). The result of the analysis suggests a significant differentiation of the occlusion condition between the groups mentioned above ($p < 0.01$) (Table IV).

DISCUSSION

The performed analysis proves that there is a connection between body posture and bite plane. This claim is

particularly supported by the result of analysis comparing the occlusion condition between two groups – one with the correct posture and the other, which included participants from both groups with faulty posture. The analysis of three groups showed significant differentiation only between group 1 (correct posture) and group 2 (faulty posture of mild degree). Lack of differences, in relation to the group with a faulty posture of considerable degree, results probably from a little number of subjects in this group (only 6 studied people).

Table IV. Sum of ranks and levels of significance (p) comparing the state of occlusion in two groups of posture.

Tabela IV. Suma rang oraz poziom istotności (p) porównania stanu zgryzu w dwóch grupach postawy ciała.

Sum of ranks <i>Suma rang</i>		Manna-Whitney U Test <i>Test U Manna-Whitneya</i>	
		(1)	(2)
(1) (n=177)	(2) (n=159)	U	p
26190.5	29087.5	10965.5	p<0.01*

*Statistically significant difference.

(1) group with a correct body posture, (2) group with faulty posture.

*Różnica istotna statystycznie.

(1) grupa z postawą prawidłową, (2) grupa z wadą postawy.

Proving the connection between the posture and occlusion encourages a more thorough assessment of the occlusion condition in children with faulty body postures. Silvestrini-Biavati et al (19) add that the presence of defects in one of the studied areas in a child, involves conducting screening tests in the other area. Numerous authors claim, that the pathological conditions in one area may influence other since the body systems are connected with each other and form an integral, structural unit (7, 8, 20, 21). This type of dependencies was also confirmed in this research, in which the connection between the occlusion quality and body posture was proven by means of more subjective research tools. These observations have logical reasons since the incorrect muscular tone in one of the chain links (temporomandibular articulations, spine, pelvis, extremities) may be directly transferred to the remaining body parts. Consequently, the organism loses the state of equilibrium, triggering a series of compensatory mechanisms consisting in tensing the muscles in other antagonistic body parts (22).

The extensively substantiated connections between specific body parts as well as the research results, also those presented in this study, encourage employing a routine orthodontic control in children with faulty body postures. Hypothetically, correction of global postural disorders in children with faulty postures may decrease the risk of malocclusion. It has to be however taken into consideration, that a lot of issues will remain in the conjecture sphere as this subject matter is very complex. Both, the body posture and the occlusion are the resultants of influence of a lot of factors, which are difficult to eliminate during scientific observation (23, 24).

The basic research problem is the difficulty in reduction of the disturbing factors, choice of relevant diagnostic tests and forming homogeneous control groups (25, 26, 27). For the ethical reasons it is also not possible to carry out a longitudinal observation of the influence of incorrect muscle activity on the quality of posture and occlusion. For that reason the main guidelines to adopt the adequate strategy, are still the theoretical basics supported by research results and specialists experience.

LIMITATIONS

The limitation of this project is a little number of participants in the group with faulty posture of considerable degree, mixed character of the group (clinic and school) as well as wide age range of the participants.

Conclusions

Children with faulty postures present more intense malocclusions than children with a correct body posture. Results of this type suggest the need for interdisciplinary look at people with malocclusions whose therapy should involve body posture correction.

REFERENCES

1. Cuccia A., Caradonna C.: The relationship between the stomatognathic system and body posture. Clinics. 2009, 64, 61-66.
2. Korbmacher H., Eggers-Stroeder G., Koch L., Kahl-Nieke B.: Corelations between anomalie of the dentition and pathologies of the locomotor system – a literature review. J. Orofac. Orthop. 2004, 65, 190-203.
3. Bracco P., Deregibus A., Piscetta R.: Effects of different jaw relations on postural stability in human subjects. Neurosci. Lett. 2004, 356, 228-230.
4. Kondo E., Aoba T.J.: Case report of malocclusion with abnormal head posture and TMJ symptoms. Am. J. Orthod. Dentofacial. Orthop. 1999, 116, 481-493.
5. Leiva M., Miralles R., Palazzi C., Marulanda H., Ormeño G., Valenzuela S., Santander H.: Effects of laterotrusive occlusal scheme and body position on bilateral sternocleidomastoid EMG activity. Cranio. 2003, 21, 99-109.
6. Solow B., Sonnesen L.: Head posture and malocclusions. Eur. J. Orthod. 1998, 20, 685-93.
7. Lippold C., Danesh G., Schilgen M., Drerup B., Hackenberg L.: Relationship between thoracic, lordotic, and pelvic inclination and craniofacial morphology in adults. Angle Orthod. 2006, 76, 779-785.
8. Lippold C., Danesh G., Hoppe G., Drerup B., Hackenberg L.: Trunk inclination, pelvic tilt and pelvic rotation in relation to the craniofacial morphology in adults. Angle Orthod. 2007, 77, 29-35.
9. Ben-Bassat Y., Yitschaky M., Kaplan L., Brin I.: Occlusal patterns in patients with idiopathic scoliosis. Am. J. Orthod. Dentofacial. Orthop. 2006, 130, 629-633.
10. Huggare J., Pirttiniemi P., Serlo W.: Head posture and dentofacial morphology in subjects treated for scoliosis. Proc. Finn. Dent. Soc. 1991, 87, 151-158.
11. Valentino B., Fabozzo A., Melito F.: The functional relationship between the occlusal plane and the plantar arches. An electromyography study. Surg. Radiol. Anat. 1991, 13, 171-174.

12. *Valentino B., Melito F., Aldi B., Valentino T.*: Correlation between interdental occlusal plane and plantar arches. An EMG study. *Bull. Group Int. Rech. Sci. Stomatol. Odontol.* 2002, 44, 10-13.
13. *Valentino B., Melito F.*: Functional relationship between the muscles of mastication and the muscles of the leg. An electromyographic study. *Surg. Radiol. Anat.* 1991, 13, 33-37.
14. *Kasperczyk T., Walaszek R.*: Przydatność metod punktowania w ocenie wady postawy ciała. (W): Wady postawy ciała u dzieci i młodzieży. Red. J. Nowotny. Bielsko-Biała: Wydawnictwo Wyższej Szkoły Administracji, 2009, 57-63.
15. *Nowotny J., Saulicz E.*: Niektóre zaburzenia statyki ciała i ich korekcja. AWF, Katowice, 1998.
16. *Emmerich-Popłatek K.*: Epidemiologiczne badania porównawcze stanu układu stomatognatycznego i potrzeb leczniczych populacji w wieku rozwojowym z województwa gdańskiego. Rozprawa doktorska. AMG, Gdańsk, 1998.
17. *Łabiszewska-Jaruzelska F. (red.)*: Ortopedia szczękowa. Zasady i praktyka. PZWL, Warszawa, 1997.
18. *Emmerich-Popłatek K.*: Epidemiologiczne badania porównawcze stanu układu stomatognatycznego i potrzeb leczniczych populacji w wieku rozwojowym z województwa gdańskiego. Rozprawa doktorska. AMG, Gdańsk, 1998.
19. *Silvestrini-Biavati A., Migliorati M., Demarziani E., Tecco S., Silvestrini-Biavati P., Polimeni A., Matteo M.*: Clinical association between teeth malocclusions, wrong posture and ocular convergence disorders: an epidemiological investigation on primary school children. *Pediatrics.* 2013, 13, 12.
20. *Zepa I., Hurmerinta K., Kovero O., Nissinen M., Kononen M., Huggare J.*: Associations between thoracic kyphosis, head posture, and craniofacial morphology in young adults. *Acta Odontol. Scand.* 2000, 58, 237-242.
21. *Lippold C., Van Den B.L., Danesh G., Ehmer U.*: Interdisciplinary study of orthopedic and orthodontic findings in pre-school infants. *J. Orofac. Orthop.* 2003, 64, 330-340.
22. *Andrade A.S., Gavião M.B., Gameiro G.H., De Rossi M.*: Characteristics of masticatory muscles in children with unilateral posterior crossbite. *Braz. Oral. Res.* 2010, 24, 204-210.
23. *Sakaguchi K., Mehta N.R., Abdallah E.F., Forgione A.G., Hirayama H., Kawasaki T., Yokoyama A.*: Examination of the relationship between mandibular position and body posture. *Cranio.* 2007, 25, 237-249.
24. *Milani R.S.*: Relationship between dental occlusion and posture. *Cranio,* 2000, 18, 127-134.
25. *Perinetti G., Contardo L., Biasati A.S., Perdoni L., Castaldo A.*: Dental malocclusion and body posture in young subjects: a multiple regression study. *Clinics.* 2010, 65, 689-695.
26. *Manfredini D., Castrolfiorio T., Perinetti G., Guarda-Nardini L.*: Dental occlusion, body posture and temporomandibular disorders: where we are now and where we are heading for. *Journal of Oral Rehabilitation.* 2012, 39, 463-471.
27. *Michelotti A., Buonocore G., Manzo P., Pellegrino G., Farella M.*: Dental occlusion and posture: an overview. *Prog. Orthod.* 2011, 12, 53-58.

Author's contributions/Wkład Autorów

According to the order of the Authorship/Według kolejności

Conflicts of interest/Konflikt interesu

The Authors declare no conflict of interest.

Autorzy pracy nie zgłaszają konfliktu interesów.

Received/Nadesłano: 06.05.2014 r.

Accepted/Zaaceptowano: 16.07.2014 r.

Published online/Dostępne online

Address for correspondence:

Anna Gogola

ul. Moździerzowców 1, 43-602 Jaworzno

tel. 603-112-533

e-mail: aniagogola@op.pl