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Analysis of occlusal characteristics of identical homozygous twins

Analiza okluzalnih karakteristika jednojajčanih blizanaca

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Abstract

Background/Aim. Functionally stable occlusion is characterized by optimal and orthopedic stable position of the condyle, harmonious contact ratio of upper and lower teeth in the final occlusal position of the mandible, optimal relationship of dental arches at the eccentric movement of the lower jaw and stable interocclusal space in physiological position. As there are no ideal order of teeth and absolute intermaxilar harmony nor individually acceptable standards or prototype of functionally optimal occlusion, the aim of this study was to analyze occlusal characteristics of identical twins. **Methods**. This clinical-epidemiological and functional study involved 30 pairs of identical twins, both males and females, aged 20 to 40 years. The main criterion for the selection of participants was preserved function of orofacial system, as a precondition for application of the Peer Assessment Rating (PAR) index, which is the most reliable tool for diagnosing malocclusion and evaluating occlusal parameters: the distance between the contact points of agonists of front segments of the dental arches, side occlusion of the sagittal, vertical and transversal position, overjet, anterior crossbite, deep and open bite, overbite of incisors and relationship of middle dental arches. **Results**. Using *t*-test for independent samples, no significant difference in the values of PAR index, according to gender, was established. The average difference of 0.833 between the twin groups (for male twins: $\bar{x}$ = 7.97, SD = 6.625; for female twins: $\bar{x}$ = 7.13, SD = 5.606) was not statistically significant [t (58) = 0.526; p = 0.601; 95% confidence interval: -2.339–4.005]. **Conclusion**. The lack of significant differences in occlusal PAR index analysis in both the same and different twin groups, implies the dominance of hereditary factors.

Key words:
twins; sex factors; denal occlusion; malocclusion.

Apstrakt

Uvod/Cilj. Funkcionalno stabilnu okluziju karakterišu optimalan i ortopedski stabilan položaj kondila, harmoničan kontaktni odnos gornjih i donjih zuba u završnom okluzionom položaju mandibule, optimalna relacija pri ekscentričnim kretnjama donje vilice i stabilan interokluzioni prostor u položaju fiziološkog mirovanja. Pošto ne postoje idealni poredak zuba i apsolutni međuvilični sklad, kao ni individualno prihvatljivi standardi optimalne okluzije, cilj rada bio je analiza okluzalnih obeležja jednojajčanih blizanaca. **Metode**. Kliničko-epidemiološkim i funkcionalnim ispitivanjem obuhvaćeno je 30 parova jednojajčanih blizanaca, podjednake polne zastupljenosti, starosti od 20 do 40 godina. Osnovni kriterijum za izbor ispitanika bila je očuvana funkcija orofacijalnog sistema, kao preduslov primene *Peer Assessment Rating* (PAR) indeksa kojim se najpouzdanije dijagnostikuju malokluzije i ocenjuju okluzalni parametri: rastojanje između kontaktnih tačaka agonista prednjih segmenata zubnih nizova, bočna okluzija u sagitalnom, vertikalnom i transverzalnom položaju, incizalni stepenik, prednji ukršten zagrižaj, dubok i otvoren zagrižaj, vertikalni preklop sekutića i odnos sredina zubnih nizova. **Rezultati**. Primenom *t*-testa za nezavisne uzorke nije utvrđena statistički značajna razlika u vrednostima PAR indeksa u zavisnosti od pola. Prosečna razlika od 0,833 između blizanačkih grupa (za blizance muškog pola: $\bar{x}$ = 7,97, SD = 6,625; za blizance ženskog pola: $\bar{x}$ = 7,13, SD = 5,606) nije bila statistički značajna [t (58) = 0,526, p = 0,601; 95% interval poverenja -2,339–4,005]. **Zaključak**. Izostanak značajnih razlika pri okluzalnoj analizi PAR indeksa, kod istih i različitih blizanačkih grupa, tumači se dominacijom naslednih faktora.

Ključne reči:
blizanci; pol, faktor; zubi, okluzija; malokluzija.

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Introduction

Occlusion is the direct contact of the upper and lower dental arch at rest and during the various functions of the orofacial system. It indicates the anatomical order of teeth in rows, their relationships to other structures of orofacial system and jaw relationships in the sagittal and frontal plane [1–4]. In the contemporary interpretations there is a prevalent physiological concept of efficient basic functions of the orofacial system, without sensation, pain or discomfort and without damage of the temporomandibular joint, orofacial muscles and the occlusal complex [3, 4].

Evaluation of the occlusal complex is an integral part of every functional analysis of the orofacial system. Despite the extreme variability, not only regarding the shape and position of individual teeth, but also their relationships, the category "physiological occlusion" refers more to the harmonious function, than to the ideal anatomical relationships in the orofacial system [5]. In these cases, if the condyles are in their physiologically optimal and most stable position, the teeth of upper and lower jaws should be in the most stable position, and providing a greater number of simultaneous contacts with the forces directed and transmitted along the axial axis of the tooth, which have a stimulating effect, unlike the compression force that results in bone resorption and the inclination of the teeth. This means that the horizontal forces in the protrusion and laterotrusion are harmful to the lateral teeth, while the intercanine sector is more distant from areas in which vectors of muscles' forces operate [6].

However, the ideal order of teeth and absolute intermaxillar harmony do not exist, nor individually acceptable standards or prototype of functionally optimal occlusion.

Monozygotic (MZ) twins are defined as the miracle of foetal biology, a medical reproductive challenge, the closest and most enduring biological connection [5]. Also, twins are the epilogue of the most complex, most diverse and the most challenging natural phenomenon during phylogenetic-ontogenetic processes that transform one cell, zygote with initial weight of 0.005 mg, into a multicellular adult, with about 12.5 trillion cells [7, 8].

Occlusal characteristics are the basis of any functional analysis of the orofacial system.

In this study we individually analyzed members of the same pair (intrapaired) and members of different pairs (interpaired) in order to evaluate the stability of the temporomandibular joints, the contact relationship of the upper and lower teeth in the final occlusal position of the mandible, optimal relations with eccentric movements of the lower jaw and stability of interocclusal space in physiological position of the mandible. Thus, the aim of this study was to analyse and evaluate the occlusal characteristics of MZ twins.

Methods

Clinical-epidemiological and functional testing was conducted in a sample of 30 pairs of twins, both males and females, aged 20 to 40 years. The main criteria for the selection of subjects were preserved function of the orofacial system (mainly intact dental arch); preserved comfortable relationship and harmony of dental arches, regardless of the third molars; anatomically correct position and arrangement of the teeth in the jaw, adapted to receive a compression force; mainly preserved number of natural antagonists; stable contact ratio in intercuspal position (ICP) of mandible; absence of deflective contacts, occlusal trauma and periodontal disease on the retruded contact position (RCP)–ICP way; presence of interocclusal free space between the upper and lower dental arches in physiological position; difference between mandibular central position and ICP equal to or less than 2 mm (disocclusion of posterior teeth in protrusion of the mandible, disocclusion of teeth on the nonworking side, the mandible laterotrusion, presence of maximum of three fillings, physiologic function of the masticatory muscles, examinees without previous orthodontic or prosthetic treatment; domination of the first class of Angle's occlusion.

These criteria were the indications for functional analysis and a prerequisite for the application of the Peer Assessment Rating (PAR) index, as most reliable tool for diagnosing malocclusion and evaluating occlusal parameters: the distance between the contact points of anterior segment of the dental arches agonists, lateral occlusion of the sagittal, vertical and transversal projections, overjet, anterior crossbite, deep and open bite, vertical overlap of incisors and relationship between the middle of the dental series [9].

The distance between the agonists' contact points

The distance between agonists' contact points, in frontal segments of the dental series was determined by compass. The defined measurements were expressed in millimetres of the ruler, and the obtained data, depending on the numerical amount of 0–1; 1.1–2; 2.1–4; 4.1–8, and more than 8 mm, were quantitatively evaluated with 0, 1, 2, 3, 4 and 5 points.

After scoring, occlusal anomalies from the group of irregular spacing of an individual or a group of teeth and impacted teeth were multiplied by a corresponding intraclass correlation coefficient of 1 (Table 1).

Table1

Evaluation of the distance between the contact point agonists of frontal segments of the dental arches, by the Peer Assessment Rating (PAR) index

Extent of expression (mm)	Points	Coefficient
0–1	0	
1.1–2	1	
2.1–4	2	1
4.1–8	3	
> 8	4	
Impacted teeth	5	

Lateral occlusion of the sagittal, vertical and transversal planes

In this grading system of occlusal characteristics in systematization of the PAR index, the accepted rule of scoring *in situ* and *in loco* was, to measure expression of 0, 1, 2, 3 and 4. The resulting points were multiplied with intraclass correlation coefficient of 1 (Table 2).

Table 2

Evaluation of lateral occlusions in the sagittal, vertical and transversal position by the Peer Assessment Rating (PAR) index

Position	Extent of expression	Points	Coefficient
Sagittal	Good intercuspation	0	
	Less than1/2 class to full intercuspation	1	1
	½ classes on any tooth	2	
Vertical	No open bite	0	1
	Open bite at least two teeth larger than 2 mm	1	
Transversal	No cross bite	0	
	The tendency to bite crossed	1	
	One tooth in crossed bite	2	1
	More teeth crossed bite	3	
	More teeth in the buccal misses	4	

Overjet

The overjet was valorised depending on the overjet expression – horizontal steps or sagittal spacing of incisal edge of the maxillary central incisors from the buccal surfaces of the lower namesakes. The resulting scores were multiplied by the intraclass coefficient of correlation of 6 (Table 3).

Anterior cross-bite (negative incisal overjet)

Anteriorly positioned crossbite is the occlusal characteristic which was validated in 5 variables and categories of the PAR index, for which, respecting prominency, the score range of 0-4 was applied, and then multiplied with intraclass coefficient of correlation of 6 (Table 3).

Overbite

Overbite in indexed PAR system has 4 gradations which were validated in the range from 0 to 3 points, and then multiplied by intraclass coefficient of correlation of 2 (Table 3).

Open bite

This occlusal characteristic in the vertical position, was classified in 5 variables, ranging from 0 to 4 points. It was multiplied than by infraclass coefficient of correlation of 2 (Table 3).

The relationship of the midlines of the dental arches

For this occlusal variable, which is defined by the contact point between central incisors, corresponding to the sur-

Table 3

Evaluation of overjet, anterior crossbite, overbite, open bite and midlines of dental arches relations by the Peer Assessment Rating (PAR) index

Occlusal characteristics	Extent of expression	Points	Coefficient
Overjet (mm)	0–3	0	
	3.1–5	1	6
	5.1–7	2	
	7.1–9	3	
	> 9	4	
Anterior crossbite	No anterior cross bite	0	
	Contact lenses edges of one or more incisors	1	
	One incisor in reverse occlusion	2	6
	Two incisors in reverse occlusion	3	
	More than two incisors in reverse occlusion	4	
Over bite	Coverage of the lower incisorsis less than1/3	0	
	Coverage of the lower incisors from1/3 to 2/3	1	2
	Coverage of the lower incisorsis greater than 2/3	2	
	Complete coverage of the lower incisors	3	
Open bite, (mm)	Does it	0	
	< = 1	1	
	1.1–2	2	2
	2.1–4	3	
	> 4	4	
Relationship of the jaw midlines	Midline series coincide	0	
	Differ between ¼ and ½ of the width of the lower incisors	1	4
	Deviate more than half of the width of the lower incisors	2	

faces of medial raphe in the upper jaw and mental spine for the lower jaw, the specific rule was applied. This rule determines all of the cases where midlines of dental arches are shifted, in which the numerical value must be added to contralateral side of measured disposition, and reduced from correspondent value on the side measured.

For example: if the participant of this study had shift of the middle part of dental arches of 2 mm towards the right side, than this measured numerical value was deducted of the value which was measured for lateral movement on the right side, and additionally this amount was added to measured lateral movement to the left side.

Numerical scores in the PAR system were accompanied by the measure of expression as shown in Table 3.

Score was multiplied by intraclass coefficient of correlation of 4.

All of the examinations were performed in the dental office, in the physiological chair, with artificial lighting. We used a standard accessories, mandatory for specialist's dental examination with obligatory wearing polyethylene gloves.

Instruments for visual inspection, palpation of muscles, determining potential anomalies of temporomandibular joint (TMJ) and dental relationships consisted of distracter, probe and the dental mirror.

Statistics

All results were statistically analyzed in the program Statistical Package for Social Sciences (SPSS), version 11.5 (Chicago, IL). The reliability of the PAR index, whose data were of continuous type, was expressed as the root square of mean error. In that way, the potential risks of accidental errors (measurement error) were eliminated as well as the subjectivity in the evaluation. Statistically significant differences in the evaluation of the two measurements, the differences between the sexes, as well as deviations from the standard values were tested by t-test or non-parametric alternative the Mann-Whitney test. Value of $p < 0.05$ was considered to be statistically significant.

Results

Occlusal characteristics and possible discrepancies of selected MZ twins were diagnosed using the PAR index.

Tables 4–6 show distribution of participants by variables involved in calculation of the PAR occlusal index in twin samples, for which the distance between the contact points of agonist of front segments of the dental arches (a measure of expresiveness), were evaluated, as well as occlusal relationship in sagittal, vertical and transversal reference planes, measures of overjet expression, the modalities of expression of the crossbite and variations in overbite, open bite and modalities of dental arche midlines.

By evaluating modalities of sagittal measure of occlusal relationships expressiveness, in the anteroposterior direction, following results were obtained: good intercuspation in 27 (45%) of twins, half of the class on any tooth in 20 (33.3%), and less than ½ of class II to the full intercuspation were observed in 10 (16.7%) participants.

By analyzing the distribution of identical twins, according to the modalities of vertical dimension expressiveness, in both groups were 58 (96.7%) subjects, with no open bite,

Table 4

Distribution of the respondents according to the modalities of expression of the distance between the contact point agonists of frontal segments of the dental arches

Distance* (mm)	Identical tweens, n (%)
0–1	46 (76.7)
1.1–2	13 (21.7)
2.1–4	1 (1.7)
Total	60 (100.0)

***The distance between the contact points agonists of frontal segments of the dentition (a measure of expression).**

Table 5

Interpairs comparison of the Peer Assessment Rating (PAR) index, for both twin groups

Gender	Number of respondents	Mean value	Standard deviation	Standard error difference
Male	30	7.97	6.34	6.625
Female	30	7.13	5.89	5.606

Table 6

Comparison of the results of the Peer Assessment Rating (PAR) index for the male and for female twins pairs

Gender	Number of respondents	Mean value	Standard deviation
Male	15	6.33	5.58
Male	15	9.61	7.34
Female	15	7.63	7.15
Female	15	6.67	3.65

while testing the occlusal relationship in transversal position revealed no crossbite in 55 (91.7%) respondents. By assessing the distribution of respondents according to the expression of overjet, in 47 twins sagittal amount of 0–3 mm (78.3%) was prevailing. Also, evaluating the distribution of participants, according to the expression of frontal crossbite among identical twins, no anterior crossbite or negative overjet were found in 58 (96.7%) patients.

By analysing overbite, it was found that in 44 (73.3%) of MZ twins coverage of the lower incisors was less than 1/3, while the jaw midlines deviated from ¼ to ½ of the width of the lower incisors, in more than a half of twins [32 (53,3%)].

Using *t*-test there were no significant differences between the values of twins PAR indices, with respect to the gender.

The averaged difference of 0.833 between the two groups of twins (for a group of male twins: arithmetic mean ($\bar{x}$) = 7.97, standard deviation (SD) = 6.625; for a group of female twins: $\bar{x}$ = 7.13, SD = 5.606) indicated that there were no statistically significant differences at the level α = 5%, [t (58) = 0.526, p = 0.601. 95% confidence interval -2.339–4.005].

Also, intrapaired evaluation and analysis of the PAR index, by using paired *t*-test of dependent samples between pairs of male twins revealed that there was no statistically significant difference within this subgroup.

The average difference in the PAR index of -3.267 between pairs of male twins (for the first pair: $\bar{x}$ = 6.33; SD = 5.589; for the second one: $\bar{x}$ = 9.61; SD = 7.347) was not statistically significant at the level α = 5 % [t (14) = -1.55, p = 0.143; 0.95% interval of confidence -7.787–1.254].

Also, neither intrapaired evaluation, nor the analysis of the PAR index (*t*-test of paired samples) revealed any statistically significant differences within sample of female twins.

The average difference in the PAR index of 0.933 between these two groups of twins (the first group: $\bar{x}$ = 7.6; SD = 7.159; the second group: $\bar{x}$ = 6.67; SD = 3.658) was not statistically significant at the level α = 5% [t (14) = 0.753, p = 0.464 (two-sided); 0.95% interval of confidence -1.726–3.593].

Discussion

In this study we evaluated the occlusal characteristics of the PAR index, and registered occlusion in the sagittal, vertical and transversal position in MZ twins. There were determined overjet, deep (overbite) or open bite and positioned midlines of the dental arches.

Among the variables, the PAR index was evaluated not only by the most critical malocclusion factors, but optimal occlusion factors which determine the diagnostic status and priority of therapeutic treatment. It is important because there is a need to check and verify the validity and reliability of the index [10, 11] and determine the relations between normative and subjective need for treatment [12, 13]. Because of that, this index in contemporary practice is widely used to compare the results and determine their accordance [14–16].

By testing, evaluating and analysing the distance between the contact points of agonists of front segments of the tooth lines, the lowest limit of their expressions of 0–1 mm was obtained in 46 (76.7%) twins. By evaluating modalities of sagittal measure of expressiveness of occlusal relationships similar results were obtained: a good intercuspation in 45% partcipants, half of the class on any tooth in 20 (33.3%) participants, corresponding to the results from the literature on interjaw-maxillo-mandibular relationship [17] in which discussing on dysfunctional disorders, it has been stressed that the occlusal interference causes an excitation of the masticatory muscles, as opposed to the physiological occlusal contacts that have an inhibitory influence [18].

Also, with regards to the role and importance of a deep bite, there is no agreement. Sonnesen et al. [19] claimed that the temporomandibular joint disorders are more common in subjects with a deep bite and significant psychological score. On the contrary Gesch [20] believes that the distal occlusion and deep bite equally contribute to the protection of occlusal disharmony.

The incidence of the open bite in our twin sample is equivalent to the analogous studies in the general population [21]. The analysis of the distribution of respondents according to the modalities of vertical dimension expression, showed that 3.3% of participants had an open bite, as quantified by the ratio of 2:58 of respondents, faced with the possibility of occlusal discrepancies.

By evaluating occlusal relationships in the transversal plane, similar results were obtained. As many as 55 of 60 (91.7%) twin respondents had no anterior crossbite or negative overjet, the least frequent malocclusion in a randomized sample from the general population, as a potential etiologic factor of dysfunctional disorders. By analysing the distribution of respondents according to the modalities of overjet expression it was shown prevailing sagittal amount of 0–3 mm was (78.3%), similar to earlier published studies [17, 18, 21]. Their results suggest interaction of only the extreme values of the horizontal and vertical overlaps with occlusal dysfunctions.

In accordance with the literature data, participants of our study did not have front crossbite [58 (96.7%) of MZ twins]. It resembles the analogous studies that favor a unilateral bite as a significant etiological factor of interjaw insufficiency. Most unilateral crossbites are classified as forced bites, which in the intercuspal position generate temporary contacts and forcibly turns the mandible, although some studies deny this role [22].

Empirical differences were confirmed in the vertical relationship. By evaluating the variation of overbite and comparing the results, it was established a domination of coverage of the lower incisors less than ⅓ in 44 twins. Also, by analysing the distribution of respondents according to the modalities of midline series expression, it was found that the jaw midlines deviated from ¼ to ½ of the width of the lower incisors in more than half of respondents [32 (53.3%)], which is in accordance with the results of similar studies [17–19], but without a bimaxillary repercussion. The results of discrepancies in the midline series are equivalent with findings of Pullinger and Seligman [23] as the latest evidence of a statistically insignificant role of this parameter if there is no mandibular dislocation.

However, in the literature, there are disagreements about needs, the role and significance of occlusal characteristics of the PAR index [16, 24]. There are contrasting arguments, emphasizing that the existence of high and medium correlation among the studied parameters does not mean their approval [25, 26].

The results obtained in this study, despite significant association, point to the fact that adherence to stereotypes when registering occlusal contacts is incompatible with the possibility of variations, and that it is practically unacceptable to generalize occlusal modalities with no tolerance of alternatives in occlusal relationships.

Modern aspects imperatively impose similarities and differences of occlusal relationships, but also inflict the nature as the most successful creator of harmonious relations and orofacial harmony.

Conclusion

By statistical analysis of the occlusal characteristics of the PAR index, for the distance between the contact points of agonists in the frontal segments of the dental lines, occlusal relationship in sagittal, vertical and transversal positions, values overjet, variations overbite, midline dental series, modalities of crossbite and open bite no significant differences between couples of the same and different twin groups were found.

The lack of significant difference in occlusal analysis of the PAR index, in the same and different twin groups, implies the dominance of hereditary factors. The few differences are attributed to the influence of environment or lifestyle, trauma, tooth decay, early loss of deciduous and permanent teeth, or bad habits maintaining in tooth hygiene and oral parafunctions.

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