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Prevalence of Periodontal Diseases in Functional Models of Occlusion in Natural Dentition

Występowanie schorzeń przyzębia w modelach funkcjonalnych zgryzu w uzębieniu naturalnym

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Abstract

Background. There are still many controversies on selecting the occlusal concept for prosthetic rehabilitation of patients with partially missing teeth. Some authors have recommended the canine protected occlusion claiming that the pattern is the most suitable for protecting the periodontium from excessive occlusal load. However, other authors have stated that the group-function occlusion is more appropriate due to even distribution of occlusal forces on both working sides. It seems that the studies on the prevalence of periodontal diseases in the above occlusal relationships in natural dentition may be very helpful in solving the controversies.

Objectives of the study is to determine the dependence between prevalence of periodontal diseases and functional models of occlusion in natural dentition.

Material and Methods. Among 1500 subjects examined in Wrocław Medical Diagnostic Center „Dolmed” the group of 834 patients was selected with complete or almost complete natural dentition. The patients underwent a routine dental examination and clinical analysis of the stomatognathic system to recognize the functional models of occlusion and the presence of periodontal disease according to WHO index.

Results. The whole of incidence of periodontal diseases was found to increase from 20 to 50 years of age and it diminished afterwards. The incidence of gingivitis in the group with cuspid protected, unilateral cuspid guidance and nontypical models of occlusion was higher than in the subjects with group-function occlusion and balanced occlusion. However, the differences between them were not statistically significant. On the contrary, the incidence of periodontitis showed the significant differences in dependence on the occlusions and age.

Conclusions. 1. Superficial periodontal diseases are not dependent on type of occlusion in natural dentition. 2. Taking into account the relatively low frequency of periodontitis in subjects with group-function occlusion and increasing the prevalence of the occlusion with age it may be assumed that the occlusion may, better than others stimulate the periodontal tissues and thus prevent the premature lack of teeth (**Dent. Med. Probl. 2003, 40, 2, 239–245**).

Key words: periodontal diseases, functional models of occlusion.

Streszczenie

Wprowadzenie. W piśmiennictwie ciągle jeszcze istnieją kontrowersje odnośnie do wyboru najlepszej koncepcji okluzji w rehabilitacji protetycznej pacjentów z częściowymi brakami zębów. Niektórzy autorzy rekomendują okluzję zabezpieczoną kłami twierdząc, że najlepiej zabezpiecza przyzębie przed nadmiernymi obciążeniami, podczas gdy inni podkreślają, że okluzja z grupową funkcją zębów zapewnia równomierne obciążenie przyzębia po obu stronach pracujących. Wydaje się, że analiza stanu przyzębia w wymienionych modelach okluzji w uzębieniu naturalnym może przyczynić się do rozwiązania tych kontrowersji.

Cel pracy. Celem badań było określenie zależności między występowaniem schorzeń przyzębia a rodzajem modelu funkcjonalnego okluzji w uzębieniu naturalnym.

Materiał i metody. Spośród 1500 osób zbadanych w Dolnośląskim Centrum Diagnostyki Medycznej „Dolmed” wybrano grupę 834 pacjentów z całkowicie lub niemal całkowicie zachowanym uzębieniem naturalnym. U pacjentów tych przeprowadzono rutynowe badanie stomatologiczne uzupełnione analizą funkcjonalną układu stomatognatycznego, która pozwalała na rozpoznanie poszczególnych postaci okluzji. Schorzenia przyzębia określano według wskaźnika WHO.

Wyniki. Stwierdzono, że ogólna częstość periodontopatii wzrastała u osób w wieku 20–50 lat, a potem się zmniejszała. Rozpowszechnienie zapaleń dziąseł w grupie osób ze zgryzem zabezpieczonym kłęb dwustronnie i jednostronnie oraz w atypowych postaciach zgryzu było wyższe aniżeli u osób z grupową funkcją i zgryzem zbalansowanym, ale stwierdzone różnice nie były istotne statystycznie. Występowanie zapaleń przyzębia wykazywało natomiast znaczące różnice w zależności od okluzji i wieku.

Wnioski. 1. Zapalenia dziąseł nie zależą od typu okluzji i wieku. 2) Biorąc pod uwagę stosunkowo niską częstość zapaleń przyzębia u badanych z grupową funkcją zębów bocznych oraz wzrastanie tego modelu zgryzu z wiekiem, można przyjąć, że ten typ okluzji może lepiej niż inne modele zgryzu stymulować tkanki przyzębia i tym samym przeciwdziałać przedwczesnej utracie zębów z powodu chorób przyzębia (**Dent. Med. Probl.** 2003, 40, 2, 239–245).

Słowa kluczowe: schorzenia przyzębia, modele funkcjonalne okluzji.

The present paper is a contribution to the evaluation of concepts of occlusion recommended in prosthetic rehabilitation of patients with partial missing teeth. There have been still great controversies concerning this problem. Some authors [1–8] have stated that the most appropriate occlusion, for prosthetic rehabilitation is the cuspid protected occlusion, because in such an occlusion, the posterior teeth are protected from the horizontal occlusal forces, which are considered to be the most traumatogenic for the periodontal tissues. However, the other authors [9–29] have stressed the group function occlusion is more suitable for prosthetic purposes, because in such circumstances the occlusal loadings are distributed among all the working side posterior teeth providing the even stimulation for periodontal ligaments, and thus strengthening the periodontium. Moreover, there is also a group of researchers [30–35] claiming that the simulation of individual model of occlusion in prosthetic rehabilitation is the only solution to protect the periodontium. It seems that the analysis of periodontal state in relationship to occlusion forms performed in a great population of patients with complete natural dentition should allow to explain that different opinions on choosing the occlusal pattern for prosthetic rehabilitation.

The purpose of the study is to determine the dependence between prevalence of periodontal diseases and functional models of occlusion in natural dentition.

Material and Methods

Material of the study consisted of 834 patients with complete natural dentition or singular missing teeth without any prosthetic replacements. The patients were selected from 1500 Wrocław workers population examined during the prophylactic examination in the Lower Silesia Medical Diagnostic Center in Wrocław. Among them there were 325 female and 509 male. Age of the subjects ranged from 20 to 63 years old (Tab. 1).

All selected patients were examined in a routine manner. The state of periodontium was determined according to the index recommended by WHO for screening the periodontium in prophylaxis examinations performed on the great populations:

0 – no signs and symptoms of periodontal diseases,

1 – signs and symptoms of gingivitis,

2 – signs and symptoms of advanced destruction of periodontium (periodontitis) [21, 41].

Moreover, in all the subjects, the clinical functional analysis of the stomatognathic system was performed to recognize the functional models of occlusion (20, 36). The functional models of occlusion were recognized while evaluating the occlusal contacts of opposing teeth in the centric and eccentric occlusal positions of the mandible, i.e., in the centric position, lateral working and balancing sides, and in the anterior excursion of the mandible to the edge-edge position of anterior teeth. The following models of occlusion were diagnosed:

I – bilateral cuspid-protected occlusion,

II – unilateral cuspid-protected occlusion,

III – group-function occlusion,

IV – balanced occlusion,

V – “other” occlusion.

The characteristics of particular models of occlusion are as follows. The bilateral cuspid-protected occlusion (Model I) is diagnosed, if there

Table 1. Number of examined patients in dependence on sex and age

Tabela 1. Liczba badanych pacjentów w zależności od płci i wieku

Sex (Płeć)	Age – years (Wiek – lata)				
	20–29 n	30–39 n	40–49 n	50–63 n	Total (Razem)
Female (Kobiety)	149	116	44	16	325
Male (Mężczyźni)	203	177	89	40	509
Total (Razem)	352	293	133	56	834

are no posterior teeth contacts during lateral or combined lateral and protrusive excursions of the mandible. The only occlusal contact on the working sides is usually seen between the opposing cuspids, while the contacts of opposing central incisors and, sometimes, the lateral incisors are noted in the protrusive position of the mandible.

The unilateral cuspid-protected occlusion (Model II) is recognized, when there are contacts of opposing cuspids and posterior teeth on one working side, while on the other working side – only between the opposing cuspids. The other features of Model II are similar to those mentioned above for Model I.

The group-function occlusion (Model III) occurs, if during the lateral occlusal excursions of the mandible the contacts of opposing cuspids, premolars and, sometimes, first molars are observed on both working sides. Such contacts of the teeth are absent on both balancing sides. In the protrusive excursion of the mandible the opposing central and lateral incisors are in contact.

The balanced occlusion (Model IV) may be characterized as the multiple contacts of all posterior and anterior teeth occurring in all excursive positions of the mandible.

Moreover, in the studied subjects there were recognized the “other” models of occlusion

(Model V), which were different from the above defined models of occlusion.

For statistical estimating the obtained results of the studies, Fisher's test was used with p -value ≤ 0.05 .

Results

The prevalence of periodontal diseases (periodontal index = 1 + 2) in the studied population is presented in Table 2. It was found that 36.7% of examined persons revealed the periodontal diseases. The diseases were more frequent in female than in male. The appropriate data were 30.5% and 40.7%. The observed difference in frequencies of the periodontal diseases in dependence on sex was statistically significant ($p < 0.05$).

Table 3 summarizes the results of studies on prevalences of particular models of occlusion in the whole population. The studies revealed that in natural dentition all above mentioned models of occlusion may be shown. The most typical models of occlusion were group-function occlusion (Model III) and bilateral cuspid-protected occlusion (Model I). The appropriate percentages were 41.5% and 26.4%. The frequency of other models of occlusion were lower. The unilateral cuspid-

Table 2. Prevalence of periodontal diseases (index = 1 + 2) in studied population in relationship to sex

Tabela 2. Występowanie schorzeń przyzębia (indeks = 1 + 2) w badanej populacji w zależności od płci

Periodontal diseases (Schorzenia przyzębia) Index = 1 + 2	Female (Kobiety)		Male (Mężczyźni)		Total (Razem)	
	n	%	n	%	n	%
Present (Obecne)	99	30.5	207	40.7	306	36.7
Absent (Brak)	226	69.5	302	59.3	528	63.3
Total (Razem)	325	100.0	509	100.0	834	100.0

Statistically sufficient difference between female and male ($p < 0.05$); różnica statystycznie istotna między kobietami i mężczyznami ($p < 0.05$).

Table 3. Prevalence of functional models of occlusion in studied population in relationship to sex

Tabela 3. Występowanie modeli funkcjonalnych zgryzu w badanej populacji w zależności od płci

Model of occlusion (Model zgryzu)	Female (Kobiety)		Male (Mężczyźni)		Total (Razem)	
	n	%	n	%	n	%
I	93	28.6	127	25.0	220	26.4
II	60	18.5	91	17.9	151	18.1
III	131	40.3	215	42.2	346	41.5
IV	27	8.3	47	9.2	74	8.9
V	14	4.3	29	5.7	43	5.1
Total (Razem)	325	100.0	509	100.0	834	100.0

Statistical analysis of differences between:

I_F-I_M ($p = 0.12077$); II_F-II_M ($p = 0.41552$); III_F-III_M ($p = 0.29039$); IV_F-IV_M ($p = 0.15709$); V_F-V_M ($p = 0.18805$).

-protected occlusion (Model II) was found in 18.1% subjects, while the balanced occlusion (Model IV) – in 8.9% subjects. The lowest percentage, 5.1%, was found for “other” models of occlusion (Model V). Moreover, the study revealed that the occlusal models are not dependent on sex. The little differences in frequencies of particular models of occlusion between male and female were not statistically significant ($p > 0,05$).

Taking into account the significantly higher frequency of periodontal diseases in female than in male, and no significant differences of models of occlusion in dependence on sex, it was assumed that the influence of sex on periodontal diseases may be distributed evenly in particular groups of occlusion, and thus, in the further studies the patients were not divided into sex subgroups. The frequency of perio-

dontal diseases in particular models of occlusion are presented in Table 4. The frequency of total periodontal diseases (index = 1 + 2) was lowest in Models III and IV, and was subsequently 31.2% and 33.7%. In Models I and II the total periodontal diseases were more frequently seen, and the appropriate data were 42.7% and 41.7%. The differences in the periodontal disease prevalences between Models I and III, and between Models II and III, were statistically significant ($p = 0,002$, $p = 0,01$).

The prevalence of gingivitis (index = 1) ranged from 17.5% to 27.1% among particular models of occlusion, however, the statistical analysis revealed no significant differences between the mentioned groups. The frequencies of periodontitis (index = 2) in particular models of occlusion were lower than frequencies of gingivitis, and varied from 11.0% in

Table 4. Prevalence of particular kinds of periodontal diseases in dependence on models of occlusion

Tabela 4. Występowanie poszczególnych postaci schorzeń przyzębia w modelach funkcjonalnych zgryzu

Model of occlusion (Model zgryzu)	With gingivitis (Z zapaleniem dziąseł) (index = 1)		With periodontitis (Z zapaleniem przyzębia) (index = 2)		Total (Razem) index = 1 + 2	
	n	%	n	%	n	%
I	53	24.1	41	18.6	94	42.7
II	41	27.1	22	14.6	63	41.7
III	70	20.2	38	11.0	108	31.2
IV	13	17.5	12	16.2	25	33.7
V	9	20.9	7	16.3	16	37.2
Total (Razem)	186	22.3	120	14.4	306	36.7

Statistical analysis of differences between:

I_1-III_1 ($p = 1.085316$); II_1-III_1 ($p = 1.70382$); IV_1-III_1 ($p = 0.09846$);

I_2-II_2 ($p = 0.15269$); I_2-III_2 ($p = 0.0052$); II_2-III_2 ($p = 0.12949$); III_2-V_2 ($p = 0.15289$);

$I_{1+2}-II_{1+2}$ ($p = 0.42364$); $II_{1+2}-III_{1+2}$ ($p = 0.01166$); $I_{1+2}-III_{1+2}$ ($p = 0.00266$); $III_{1+2}-IV_{1+2}$ ($p = 0.33310$); $III_{1+2}-V_{1+2}$ ($p = 0.21311$); $I_{1+2}-V_{1+2}$ ($p = 0.06998$).

Table 5. Prevalence of gingivitis (index = 1) in particular models of occlusion in dependence of age

Tabela 5. Występowanie zapalenia dziąseł (indeks = 1) w modelach funkcjonalnych zgryzu w zależności od wieku

Age (Wiek)	20–29			30–39			40–49			≥ 50		
Occlusion (Model zgryzu)	n*	%	n**	n*	%	n**	n*	%	n**	n*	%	n**
I	26	25.2	103	17	21.8	78	10	28.6	35	–	–	4
II	19	27.9	68	19	31.1	61	2	12.5	16	1	16.6	6
III	26	20.8	125	25	21.2	118	14	21.5	65	5	13.1	38
IV	4	12.1	33	8	29.6	27	1	12.5	8	–	–	6
V	6	26.1	23	–	–	9	3	33.3	9	–	–	2
Total (Razem)	81	23.0	352	69	23.5	293	30	22.5	133	6	10.7	56

n* – number of subjects with gingivitis and determined model of occlusion in a specified group of age; n** – number of subjects with determined model of occlusion in a specified group of age.

Statistical analyses of differences between:

$I_{20-29}-III_{20-29}$ ($p = 0.21311$); $III_{20-29}-IV_{20-29}$ ($p = 0.1291$);

$II_{30-39}-III_{30-39}$ ($p = 0.07118$); $III_{30-39}-IV_{30-39}$ ($p = 0.17259$);

$I_{40-49}-III_{40-49}$ ($p = 0.21609$).

Model III, through 14.6% in Model II, to 18.6% in Model I. The difference in frequencies of periodontitis between Model I and III was statistically significant ($p = 0.05$).

In further studies the prevalence of gingivitis (index = 1) was analysed in dependence on age in particular models of occlusion. The results of the studies are presented in Table 5. It was found that this kind of periodontal diseases revealed no significant increase with age. There was no significant differences in prevalence of the periodontal diseases when comparing the disorders in the most typical models of occlusion (See legend in the bottom of Table 5).

In table 6 there were gathered the results of studies on dependence of the periodontitis (index = 2) on age were collected. Significant increase of the diseases in the whole material; from 4.0% in group of 20–29 years, through 15.7% in group of 30–39 years, to 33.8% in group 40–49 years old subjects was observed. (P-value for the differences in the two first age groups were $p < 0.001$). Moreover, a similar tendency with age was noted for the periodontal diseases related to Model I ($p < 0.001$), and Model II ($p < 0.05$). Also, the prevalence of the periodontitis in particular groups of age were higher in Models I and II, than in Model III. However, in the first group of age (e.i. in 20–29 years), the differences in the preva-

lence of the periodontal diseases between Models I and III, and between Models II and III, were not statistically significant ($p = 0.158$, $p = 0.410$), nevertheless, the differences in frequency of the diseases noted between Model I and III were significant in the further groups of age, that means in age of 30–39 years ($p = 0.003$), 40–49 years ($p = 0.04$), and 50 and more years ($p = 0.04$).

Discussion

The interesting result of the studies was the observation of almost constant frequency of gingivitis in particular models of occlusion, and no dependence of the diseases on age. This fact seems to support the opinion of many authors, who relate an etiology of the gingivitis to the dental plaque and its metabolism products [20, 24, 37–38, 40]. However, the study revealed the increase of destructive periodontal diseases with age, and also the differentiated prevalence of the diseases in particular models of occlusion. Taking into account that the present studies were performed on the selected group of patients with almost complete natural dentition, that is in a group of patients, in whom the increase of morphological and functional disturbances of the masticatory system due to loss of teeth was eliminated to a mini-

Table 6. Prevalence of destructive periodontal diseases (index = 2) in particular models of occlusion in dependence of age
Tabela 6. Występowanie zapaleń przyzębia (indeks = 2) w modelach funkcjonalnych zgryzu w zależności od wieku

Age (Wiek)	20–29			30–39			40–49			≥ 50		
Occlusion (Model zgryzu)	n*	%	n**	n*	%	n**	n*	%	n**	n*	%	n**
I	5	4.8	103	19	24.3	78	15	42.8	35	2	50.0	4
II	2	2.9	68	10	16.4	61	6	37.5	16	4	66.7	6
III	3	2.4	125	12	10.2	118	17	26.2	65	6	15.8	38
IV	2	6.0	33	4	14.8	27	4	50.0	8	2	33.3	6
V	2	8.7	22	1	11.1	9	3	33.3	9	1	50.0	2
Total (Razem)	14	4.0	352	46	15.7	293	45	33.8	133	15	26.7	56

n* – number of subjects with periodontitis and determined model of occlusion in a specified group of age; n** – number of subjects with determined model of occlusion in a specified group of age.

Statistical analyses of differences between:

Total_{20–29}–Total_{30–39} ($p = 0.000002$); Total_{30–39}–Total_{40–49} ($p = 0.000011$); Total_{40–49}–Total_{≥50} ($p = 0.17090$).

I_{20–29}–I_{30–39} ($p = 0.00006$); I_{30–39}–I_{40–49} ($p = 0.02371$); I_{40–49}–I_{≥50} ($p = 0.39245$);

II_{20–29}–II_{30–39} ($p = 0.04317$); II_{30–39}–II_{40–49} ($p = 0.03200$); II_{40–49}–II_{≥50} ($p = 0.052823$);

I_{20–29}–II_{20–29} ($p = 0.26830$); I_{20–29}–III_{20–29} ($p = 0.15808$); II_{20–29}–III_{20–29} ($p = 0.41056$); II_{20–29}–IV_{20–29} ($p = 0.39245$);

III_{20–29}–V_{20–29} ($p = 0.14265$);

I_{30–39}–II_{30–39} ($p = 0.12570$); I_{30–39}–III_{30–39} ($p = 0.00385$); II_{30–39}–III_{30–39} ($p = 0.11466$); II_{30–39}–IV_{30–39} ($p = 0.42594$); IV_{30–39}–V_{30–39} ($p = 0.390041$);

I_{40–49}–II_{40–49} ($p = 0.35916$); I_{40–49}–III_{40–49} ($p = 0.04382$); II_{40–49}–III_{40–49} ($p = 0.18362$); II_{40–49}–IV_{40–49} ($p = 0.27909$); III_{40–49}–V_{40–49} ($p = 0.32471$); IV_{40–49}–V_{40–49} ($p = 0.24292$);

I_{≥50}–II_{≥50} ($p = 0.29908$); I_{≥50}–III_{≥50} ($p = 0.04872$); II_{≥50}–III_{≥50} ($p = 0.00285$); II_{≥50}–IV_{≥50} ($p = 0.124106$); II_{≥50}–V_{≥50} ($p = 0.33664$); III_{≥50}–V_{≥50} ($p = 0.107293$); IV_{≥50}–V_{≥50} ($p = 0.33664$).

mum, it may be suggested that such local factors as a loss of teeth should not compromise the health of periodontium. On the other hand, it may be assumed that the constant frequency of gingivitis is a result of transformation of some cases of gingivitis into profound periodontal diseases with simultaneously growing the new cases of gingivitis. Such an explanation may be very probable due to increasing with age some general diseases. Moreover, a stress of life and damaging conditions in the environment of work may also diminish the periodontium resistance with age. The contribution of these medical and social factors usually increases with age and time of employment. If such an assumption were true, then the increase of the destructive periodontal diseases should be similar in particular models of occlusion. However, it was observed the higher frequency of the periodontitis in bilateral cuspid-protected occlusion than in the group-function occlusion. Thus, the above results may indicate that in those most typical natural models of occlusion some different local factors may occur and be related to a various extent of occlusal contacts of teeth in eccentric excursions of the mandible. If so, in the bilateral cuspid-protected occlusion the eccentric excursions of the mandible are limited by contact of the opposing cuspids. The cuspids, according to the concept by D'Amico [1], Stuart and Stallard [7], and Lucia [4], prevent the posterior teeth from making any contacts on either the working and the nonworking sides. The cuspids protect the posterior teeth from wear both during the functional and parafunctional activity of the masticatory system. In this type of occlusion Goldstein [15] found less periodontal diseases than in the group-function

occlusion. Also, some experimental studies with using excessive occlusal forces or disturbances revealed no damage to periodontal ligaments nor the mobility of teeth [39–42]. However, in cuspid-protected occlusion all the load in any excursive position of the mandible is born by the anterior teeth. The studies performed by Beyron [9], Moozeh et al. [19], and Rieder [25] revealed that the patients with cuspid-protected occlusion showed the higher incidence of tooth mobility. Moreover, some other authors [12, 16, 20, 28] stressed that in the group-function occlusion with all posterior teeth in contact on the working sides, the occlusal loads are distributed evenly in the lateral excursions of the mandible. Similar opinion was expressed by Okeson [20], Beyron [9], Glickman [13] and Geiger [31]. In the group-function occlusion the obliquely directed forces are generated on all posterior teeth, however the forces are not excessive or long lasting, and thus they may even strengthen the periodontium, especially in young people with healthy periodontium.

Conclusions

1. Gingivitis are not dependent on type of occlusion in natural dentition.
2. Taking into account the relatively low frequency of periodontitis in subjects with group-function occlusion and increasing the prevalence of the occlusion with age it may be supposed that the occlusion may better than other models of occlusion stimulate the periodontal tissues and thus prevent the premature lack of teeth due to periodontal diseases.

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