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Research Article

Changes in some indexes of protein homeostasis and pro-oxidant protection in the oral fluid of young people with periodontitis under the influence of the proposed complex therapy

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Abstract

Periodontal diseases comprise an actual problem nowadays due to their high prevalence. Young people in particularly remain susceptible to aggressive periodontal disorders that affect the suspensory apparatus of the teeth. The aim of the study was to establish some indexes of protein peroxidation and total protein content in the oral liquid of young people affected by stage I periodontitis, degree A and B observed before and after the appointed complex therapy. Conducted investigations demonstrate that there are significant changes in protein homeostasis and pro-oxidant protection in the oral liquid of young people in case of stage I periodontitis, degree A and B. The latter indicates an increase of the total protein content as well as a rise of oxidative protein modifications of both aldehyde and ketone derivatives, which are neutral and basic in nature. The recorded dynamic of the gained results of protein metabolism and pro-oxidant protection in the oral liquid of young people in case stage I periodontitis, degree A and B obtained at different terms after administered treatment suggests that the introduced management provides a pronounced positive effect on the regulation of these indexes. Moreover, herbal remedies as a part of the proposed agents for local and general administration show a good antioxidant effect and contribute to long-term maintenance of gained results. They also prevent recurrence of periodontitis and contribute to prolonged remission.

Keywords

periodontitis, oral liquid, protein homeostasis, pro-oxidant protection, complex periodontal therapy

Introduction

Periodontal diseases comprise an actual problem nowadays in modern society due to their high prevalence, especially in young people. The investigation by Trivedi et al. (2017) suggested that periodontal diseases affect 10–15% of the world population and are one of the leading reasons of tooth loss. Periodontitis is basically a non-specific inflammatory disease, which is initiated by the subgingival biofilm and is modified by the individual's aberrant inflammatory/immune response. Chronic periodontitis if left untreated in young age invariably causes irreversible

loss of periodontal tissues which emphasizes the importance of prevention, early diagnosis and effective management at early stages of its occurrence (Dimitrova 2015; Kolesnyk 2015). The findings provided by authors (Waddington et al. 2000) demonstrated that the enhancement of free radical oxidation reactions, by which the vital homeostatic physiochemical cell parameters are controlled, is a manifestation of toxic effect of activated oxygen metabolites. Disorganization of protein peroxidation and the total protein content are also substantial in the pathogenesis of periodontitis according to data provided by authors (Zyn 2012; Melnychuk 2013; Semenyuk 2016; Lyckkovska and Melnychuk 2017).

The study of protein peroxidation is based on establishment of oxidative protein modification indexes (OMP), which are reliable markers of oxidative tissue damage. The products of OMP are stable and are not quickly to be metabolized by peroxidases and low-molecular antioxidants (Demkovych et al. 2017). Therefore, the analysis of protein peroxidation (OMP of different pools) and the total protein content in the oral liquid of those affected by periodontitis appears to be interested and actual.

The article demonstrates the results of the study regarding some indexes of protein peroxidation and protein content in the oral liquid of young people affected by stage I periodontitis, degree A and B detected before and after the appointed complex treatment.

Materials and methods

We examined 130 non-smokers, which were divided into three groups: the healthy, group (30 healthy individuals of good dental health or intact oral cavity); group I (48 patients affected by periodontitis of I degree, type A); group II (52 patients affected by periodontitis of I degree, type B). Patients were also separated within each group into main and comparative subgroups. The recommended complex treatment was used in the main subgroups of group I and II (30 and 32 people respectively). Traditional methods, on the other side, were administered in the comparative subgroups of I and II groups (18 and 20 people respectively).

Patients of the main subgroups of groups I and II were appointed by the introduced therapy for treatment of generalized periodontitis. Initial periodontal therapy was followed by oral rinses with a standard solution of St. John's wort tincture twice a day for 5–7 days and the direct insertion of the gel developed by us into the periodontal pockets. Gel impregnated with Echinacea purple tincture – 1 ml; St. John's wort tincture – 1 ml ; Enterosgel – 2 g was selected due to the conducted biopharmaceutical studies (Kimak et al. 2013).

In addition, patients were prescribed with Immuno-ton (manufactured by "Galichpharm", Ukraine; registration number: UA/2179/01/01 from 02.10.2019). 5 ml of syrup contains Eleutherococcus liquid extract (Extractum Eleutherococcii fluidum) (extractant – ethanol 40% v/v) (1:1) – 0.98 g, Echinacea purple tincture (*Echinaceae purpureae* tinctura) (extractant – ethanol 50% v/v) (1:10) – 0.47 g, St. John's wort tincture (Tinctura Hyperici) (extractant – ethanol 40% v/v) (1:5) – 0.49 g. "Imuno-ton" exhibits a combined adaptogenic and immune-stimulating effect. The syrup was administered in the first half of the day for 2 teaspoons (10 ml) 2 times a day for 7 days (in case of periodontitis, stage I, degree A) or 3 teaspoons (15 ml) 2 times a day for 10 days (in case of periodontitis, stage I, degree B). Multivitamins with trace elements Duovit (manufactured by KRKA, d.d., Novo mesto, Slovenia; registration number: UA/4077/01/01 from 11.11.202 were also appointed. One red coated tablet contains: vitamin A (retinol palmitate) 5000 IU; vitamin D_3 (cholecalciferol) 200 IU; vitamin C (ascorbic acid) 60 mg; vitamin PP (nicotinamide) 13 mg; vitamin E (a-tocopherol acetate) 10 mg; calcium pantothenate 5 mg; vitamin B_6 (pyridoxine hydrochloride) 2 mg; vitamin B_2 (riboflavin) 1.2 mg; vitamin B_1 (thiamine nitrate) 1 mg; folic acid 0.4 mg; vitamin B_{12} (cyanocobalamin) 3 mg.

One blue film-coated tablet contains: magnesium (Mg^{2+} in the form of magnesium lactate) 20 mg; calcium (Ca^{2+} in the form of calcium hydrogen phosphate) 15 mg; phosphorus (P^{5+} as calcium hydrogen phosphate) 12 mg; iron (Fe^{2+} as iron fumarate) 10 mg; zinc (Zn^{2+} as zinc sulfate) 3 mg; copper (Cu^{2+} as copper sulfate) 1 mg; manganese (Mn^{2+} as manganese sulfate) 1 mg; molybdenum (Mo^{6+} as sodium molybdate) 0.1 mg. The agent was prescribed to be taken by 1 red tablet with vitamins and 1 blue tablet with minerals once a day, after breakfast, swallowed with water, the course lasted for 3–4 weeks.

Generally traditional treatment was used in the patients of the comparative subgroups in groups I and II. First of all the local initial periodontal therapy was introduced, daily mouth washes and oral rinses with Rekutan solution (manufactured by "Galichpharm", Ukraine; registration number: UA/8838/01/01 from 13.07. 2018) were appointed. The solution contains liquid extract of chamomile flowers (Chamomilla flores extractum liquidum) (extractant 50% (v/v) ethanol) (1:1) – up to 100 ml. The agent was used twice daily for 5–7 days. The locally insertions and instillations of Rekutan solution for 15–20 minutes once a day for 5–7 days in the periodontal pocket were also used. Multivitamins with Duovit were prescribed according to the same scheme as in the main subgroups.

All patients were examined before treatment, immediately after treatment, six months and a year after appointed therapy.

All samples of non-stimulated saliva were collected between 10:00 am. and 12:00 pm. 30 minutes after breakfast in a sterilized centrifuge tubes. The tubes were sealed, kept at 4 °C and conveyed to the laboratory for processing within 1 hour. Prior to analysis, the saliva was centrifuged at 10,000 g for 20 minutes at 4 °C.

Determination of OMP was established by method of E.E. Dubinina (reaction of the interaction of oxidized amino acid residues of proteins with 2,4-dinitrophenylhydrazine (2,4-DNPH) with the formation of 2,4-dinitrophenylhydrazone derivatives) [2]. 1 ml of 2,4-DNPH previously dissolved in 2 M HCl was added to 100 µl of

saliva. Then it was incubated for an hour at room temperature. Then samples were added to 1 ml of 20% $HClO_4$ for protein precipitation and centrifuged for 15–20 minutes. Supernatant liquid was collected. The sediment was washed 3 times with a solution of ethanol: ethyl acetate (1:1) to remove lipids, as well as 2,4-DNFH, which did not react with the carbonyl groups of oxidized proteins. The precipitate was left to dry. 3 ml of 8M urea was added to the obtained precipitate, then it was mixed and placed in a water bath until the precipitate was completely dissolved. The optical density of 2,4-dinitrophenylhydrazones was recorded on a SF-36 spectrophotometer at the following wavelengths: 356 nm, 370 nm, 430 nm, and 530 nm. The content of aldehyde and ketone derivatives of neutral dinitrophenylhydrazones (ADPHn and KDFHn) was determined at a wavelength of 356 nm and 370 nm. The content of aldehyde and ketone derivatives of a basic nature (ADPHo and ADPHo) was established at a wavelength of 430 nm and 530 nm. The concentration of total protein was determined by the biuret method using a set of reagents from the research and production company "Simko LTD" (Lviv, Ukraine).

This study was approved by the Ethical Committee of Ivano-Frankivsk National Medical University and there is a written permission obtained from each individual involved in this study. Investigation was conducted at Pediatric Dentistry Department.

The results of the investigations were processed on a Pentium IBM personal computer in a Windows 7 OC using Microsoft Excel 2007 and Statistica, as well as specially designed programs (Delphi JV).

Results and discussion

It was established that periodontal pathology leads to metabolic disorders of all types, including protein metabolism.

The study of protein homeostasis based on indicators of total protein in the oral liquid of young people affected by stage I periodontitis, degree A revealed a significant increase of its content in both the main and in the compared subgroups in 1.83 and 2.14 times ($p<0.001$) respectively compared to the indicators of healthy people. The data is reflected in Table 1.

Table 1. Dynamics of indicators of protein metabolism in the oral fluid of young people in case of periodontitis, stage I, degree A under the influence of complex therapy.

Subgroups of group I	Group of healthy, n=30	Indicators of total protein in the oral liquid of those affected by periodontitis, stage I, degree A mg/ml			
		Before treatment, n=30; n=18	Immediately after treatment, n=30; n=18	6 months after treatment, n=28; n=17	12 months after treatment, n=28; n=16
Main	2,63±0,19	4,8±0,36#	2,71±0,13*	2,60±0,13	2,76±0,23
Compared		5,64±0,36#	3,58±0,43*	2,66±0,18	2,56±0,24

Note: The probability of the difference is indicated:
1. $p<0.001$ – # – comparison of data obtained from patients with periodontitis with indicators of healthy people.
2. $p1<0.001$ – * – comparison of data obtained immediately after treatment with indicators obtained before treatment.

These data appeared to be consistent with the results of a study conducted by Kejriwal et al. (2014) in which the salivary total protein content in patients with periodontitis was 4.3 mg/ml in contrast to 2.9 mg/ml in healthy people. According to these researchers, the increased total protein amount in saliva can be caused by an inflammatory process that stimulates the sympathetic system to increase the synthesis and secretion of some proteins thereby enhancing the protective potential of saliva. The present data were also in agreement with the findings of Zin Thaw et al. (2021) which indicates the total protein content 1,52 g/dl in the healthy group, whereas in patients affected by chronic periodontitis it was significantly elevated up to 6,30 g/dl. Besides, the present findings are similar with Shayla et al. (2013), which found that the total salivary protein in the healthy individuals and in those affected by gingivitis and periodontitis was 0,86 g/ml, 1,19 g/ml and 1,59 g/ml accordingly. We also agree with conclusions that the elevated protein levels occur most likely due to enhanced synthesis and secretion by the salivary glands of each individual.

Administration of local and general therapy in case of generalized periodontitis, stage I, grade A in young people leads to changes of total salivary protein content.

Analysis suggests that the level of this indicator decreased statistically significantly in both studied subgroup: in the main group by 77.12% and by 57.54% ($p1<0.001$) in the compared group immediately after treatment. However, in the main subgroup, its amount has normalized already at the initial stage of treatment, and in the comparative group, it was still at a higher level comparing to healthy people.

In the long-term follow-up period, the total oral protein of all studied young people with periodontitis, stage I, grade A corresponded to the norm.

The study also suggests that there were more expressive changes of total protein in the oral liquid of young people affected by stage I periodontitis, degree B, in particular: an increase in 2.33 times in the main and in 2.17 times ($p<0.001$) in the comparative subgroups (Table 2).

The introduced therapy in young people of the main subgroup affected by periodontitis, stage I, grade B,

Table 2. Dynamics of indicators of protein metabolism in the oral fluid of young people in case of periodontitis, stage I, degree B under the influence of complex therapy.

Subgroups of II group	Group of healthy, n=30	Indicators of total protein in the oral liquid of those affected by periodontitis, stage I, degree B mg/ml			
		Before treatment, n=32; n=20	Immediately after treatment, n=30; n=19	6 months after treatment, n=29; n=16	12 months after treatment, n=27; n=15
Main	2,63±0,19	6,12±0,25 #	2,89±0,18*	2,76±0,20	2,46±0,18
Compared		5,70±0,35 #	4,21±0,48 **	3,07±0,24 ▲	2,33±0,13 •

Note: The probability of the difference is indicated:
$p<0.001$ – # – comparison of data obtained from patients with periodontitis with indicators of healthy people.
$p1<0.001$ – *, $p1<0.05$ – **,– level of probability of values when comparing data obtained immediately after treatment with indicators obtained before treatment.
$p2<0.05$ – ▲ – level of probability of values when comparing data obtained 6 months after treatment with indicators obtained immediately after treatment.
$p3<0.05$ – • – level of probability of values when comparing data obtained 12 months after treatment with indicators obtained after 6 months.

contributed to a significant decrease of total protein in 2.12 times (p1<0.001) observed immediately after treatment, moreover, the recorded indicator corresponded to that in healthy people. The index of total protein of this subgroup has continued to decline unconvincingly, fluctuating within the normal range detected in the long term after treatment.

There was also a convincing reduction of total protein by 35.39% (p1<0.05) in the oral fluid of young people of the comparative subgroups of the II group immediately after treatment, however, the obtained indicators did not correspond to those in the healthy group, but were significantly in 1.60 times (p<0.01) higher.

There was a further decrease of this index by 37.13% (p2<0.05) recorded 6 months after treatment, but the obtained result was still higher than the norm, albeit unreliable.

However, the compliance of the studied indicator with healthy ones was recorded within 12th month of observation as a noticeable reduce by 31.76% (p3<0.05).

Therefore, the treatment of young people with periodontitis, stage I, grade A and B has led to a noticeable improvement in protein metabolism in terms of total protein content in the oral fluid immediately after treatment in both subgroups.

Comparing the level of total protein in the oral fluid of young people of the main and comparative subgroups at different stages after treatment, it can be assumed that the obtained results did not differ in the first group. However, there were some differences between the subgroups in group II. Thus, the content of total protein before treatment increased significantly in all patients compared to the indicators of healthy people.

Yet, the results obtained immediately after treatment in the main and comparative subgroups differed statistically significantly by 45.67%; p<0.05. The gained difference in the values of the total protein content immediately after the treatment indicates a greater benefit from the therapy of periodontitis, stage I, degree B in the main subgroup.

The concentration of OMP_{356}, OMP_{370}, OMP_{430} in the oral fluid of young people in the main subgroup of the patients with periodontitis, stage I, grade A has elevated significantly by 40.82%, 41.30% and 75.00% (p<0.001) respectively. These data are displayed in Table 3.

Similar statistics were obtained for OMP_{370} and OMP 430: a great decrease of these indicators immediately after treatment in 1.38 and 1.65 times (p1<0.001) respectively, and maintenance at this level over the period of 6 and 12 months after treatment.

The gained findings suggest that there was an improvement of OMP at wavelengths of 356 nm, 370 nm and 430 nm as a result of our proposed complex therapy regarding periodontitis, stage I, degree A in young people immediately after treatment and their significant reduction to the level of healthy ones. The achieved results for all indicators were maintained even in the distant periods after treatment.

The concentration of OMP_{356}, $OMP_{370,}$ OMP_{430} has increased by 38.78%, 39.13% and 62.50% (p<0.001), respectively in the oral fluid of young people of the comparative subgroup diagnosed with periodontitis, stage I, degree A, these data are displayed in Table 4.

Table 3. Dynamics of indicators of OMP in the oral liquid of young people in the main subgroup in case of periodontitis, stage I, degree A, influenced by complex therapy.

Indexes	Group of haelthy, n=30	Before treatment, n=30	Immediately after treatment, n=30	6 months after treatment, n=28	12 months after treatment, n=28
OMP_{356}, c.u.	0,049±0,002	0,069±0,001 #	0,047±0,001 *	0,049±0,002	0,047±0,002
OMP_{370}, c.u.	0,046±0,002	0,065±0,001 #	0,047±0,002 *	0,046±0,001	0,046±0,001
OMO_{430}, c.u.	0,016±0,001	0,028±0,002 #	0,017±0,002 *	0,016±0,001	0,016±0,001

Note: The probability of the difference is indicated:
1. p<0.001 – # – comparison of data obtained from patients with periodontitis with indicators of healthy people.
2. p1<0.001 – * – comparison of data obtained immediately after treatment with indicators obtained before treatment.

Table 4. Dynamics of indicators of OMP in the oral liquid of young people from the compared subgroup in case of periodontitis, stage I, degree A, influenced by complex therapy.

Indexes	Group of healthy, n=30	Before treatment, n=18	Immediately after treatment, n=18	6 months after treatment, n=17	12 months after treatment, n=16
OMP_{356}, c.u.	0,049±0,002	0,068±0,001 #	0,051±0,002 *	0,048±0,002	0,055±0,003
OMP_{370}, c.u.	0,046±0,002	0,064±0,001 #	0,047±0,001 *	0,047±0,001	0,059±0,003 •
OMP_{430}, c.u.	0,016±0,001	0,026±0,001 #	0,016±0,001 *	0,017±0,001	0,019±0,001

Note: The probability of the difference is indicated:
1. p<0.001 – # – comparison of data obtained from patients with periodontitis with indicators of healthy people.
2. p1<0.001 – * – level of probability of values when comparing data obtained immediately after treatment with indicators obtained before treatment.
3. p3<0.01 – • – level of probability of values when comparing data obtained 12 months after treatment with indicators obtained after 6 months.

Traditional periodontal therapy administered in young people diagnosed with periodontitis, stage I, grade A has led to following results: a statistically significant decrease of OMP_{356} in 1.33 times (p1<0.001), which corresponded to the indicator in healthy people.

Moreover, the amount of OMP_{356} continued to fall inconclusively within the normal range 6 months after treatment. However, a year later, there was its incredible growth compared to the previous indicator. The final result obtained was higher than in healthy young adults, although not so notable.

When assessing the reliability of the difference between the OMP_{370} obtained before and immediately after treatment, there were their impressive changes by 36.17% (p1<0.001), the obtained figures were equal to those of healthy young people. This index did not change 6 months after therapy, but there was a deterioration of the results observed 12 months after as OMP_{370} increased again by 25.53% (p3<0.001) in comparison to the index obtained at the previous stage. These data significantly exceeded the indicator of healthy people in 1.28 times (p<0.001).

The OMP_{430} has experienced similar changes such as its noticeable fall by 62.50% (p1<0.001) immediately after therapy as well as its normalization 6 months after treatment. However, 12 months after, `the indicator rose again, albeit

insignificantly compared to the previous one, but it differed from the norm statistically significantly by 18.75% (p<0.05).

The analysis proved that traditional treatment of periodontitis, stage I, degree A contributed to a noticeable improvement of all studied indexes of OMP. However, the gained positive results did not last longer than one year, which may be due to the occurrence of exacerbations 12 months after therapy.

There were also pronounced changes of protein peroxidation in the oral fluid of young people of the main subgroup in the case of periodontitis, stage I, degree B as the concentration of OMP_{356}, OMP_{370}, OMP_{430} in the oral fluid increased in 1.53, 1.54 and 2.00 times (p<0.001) in accordance. These data are shown in Table 5.

Table 5. Dynamics of indicators of OMP in the oral liquid of young people from the main subgroup in case of periodontitis, stage I, degree B, influenced by complex therapy.

Indexes	Group of healthy, n=30	Before treatment, n=32	Immediately after treatment, n=30	6 months after treatment, n=29	12 months after treatment, n=27
OMP_{356}, c.u.	0,049±0,002	0,075±0,001 #	0,048±0,001 *	0,049±0,001	0,05±0,002
OMP_{370}, c.u.	0,046±0,002	0,071±0,002 #	0,044±0,001 *	0,044±0,001	0,044±0,001
OMP_{430}, c.u.	0,016±0,001	0,032±0,002 #	0,023±0,001 *	0,017±0,001▲	0,017±0,001

Note: The probability of the difference is indicated:
1. p<0.001 – # – comparison of data obtained from patients with periodontitis with indicators of healthy people.
2. p1<0.001 – * – level of probability of values when comparing data obtained immediately after treatment with indicators obtained before treatment.
3. p2<0.001 – ▲ – level of probability of values when comparing data gained 6 months after treatment with indexes obtained immediately after treatment.

The recommended treatment of periodontitis, stage I, grade B improved the level of OMP_{356} in the oral fluid of young people immediately, demonstrating a significant decline of its content in 1.56 times (p1<0.001), which was equal to the indicator in healthy people. In the long term of observation, the above-mentioned indicator practically did not change, but only slightly fluctuated within the normal range.

Analysis show that content of OMP_{370} has normalized immediately after the treatment by a convincing 61.36% (p1<0.001) decrease and remained at the achieved level over the period of 6 and 12 months after treatment.

The amount of another indicator of protein peroxidation OMP_{430} in the main subgroup also decreased naturally and significantly by 39.13% (p1<0.001), but did not reach this level in the group of healthy in the near term after treatment of periodontitis, stage I, degree B. There was an improvement towards its normalization with a significant decrease by 35.29% (p2<0.001) 6 months after. The obtained result was maintained throughout the year.

As can be seen from the gained data, the proposed complex therapy of periodontitis, stage I, degree B contributed to a significant improvement of all investigated indicators of protein peroxidation, approaching healthy levels after treatment, except for OMP_{430}, which amount has become normal 6 months after introduced therapy. The reached results were reliably preserved even 12 months afterwards.

Changes in the indicators of protein peroxidation in the oral liquid of young people observed in the comparative subgroup in the case of periodontitis, stage I, degree B were statistically indicative: the concentration of OMP_{356}, OMP_{370}, OMP_{430} in the oral liquid gained in 1.55, 1.52, and 1.88 (p<0.001) times, respectively. These data are shown in Table 6.

Table 6. Dynamics of indicators of OMP in the oral liquid of young people from the compared subgroup in case of periodontitis, stage I, degree B, influenced by complex therapy.

Indexes	Group of healthy, n=30	Before treatment, n=20	Immediately after treatment, n=19	6 months after treatment, n=16	12 months after treatment, n=15
OMP_{356}, c.u.	0,049±0,002	0,076±0,002 #	0,049±0,002 *	0,053±0,002	0,060±0,005
OMP_{370}, c.u.	0,046±0,002	0,070±0,002 #	0,044±0,002 *	0,048±0,002	0,066±0,003 •
OMP_{430}, c.u.	0,016±0,001	0,030±0,001 #	0,023±0,001 *	0,016±0,002▲	0,021±0,001 ••

Note: The probability of the difference is indicated:
1. p<0.001 – # – comparison of data obtained from patients with periodontitis with indicators of healthy people.
2. p1<0.001 – * – level of probability of values when comparing data obtained immediately after treatment with indicators obtained before treatment.
3. p2<0.01 – ▲ – level of probability of values when comparing data obtained 6 months after treatment with indicators obtained immediately after treatment.
4. p3<0.05 – ••, p3<0.001 – • – the level of probability of values when comparing data obtained 12 months after treatment with indicators obtained after 6 months.

Investigation suggests that content of OMP_{356} and OMP_{370} in the oral fluid of young people of the comparative subgroup group II decreased significantly immediately after treatment in 1.55 and 1.59 times (p1<0.001) respectively, and reached the level of that one of healthy people.

They practically did not change 6 months after traditional therapy. However, a year later, there was deterioration in both indicators, namely: an insignificant extend of OMP_{356} and a statistically significant growth of OMP_{370} by 37.50% (p3<0.001) compared to the indicators obtained 6 months after. The detected fluctuations of the above mentioned indicators were higher 12 months after treatment in comparison to the norm, namely: for OMP_{356} in 1.22 times (p<0.05), and for OMP_{370} in 1.43 times (p<0.001).

There were also modifications of OMP_{430} in accordance with the changes in OMP_{356} and OMP_{370}. Thus, traditional therapy had a pronounced effect on this indicator in the oral fluid of young people affected by periodontitis, stage I, degree B lessening it by 30.43% (p1<0.001).

However, its content was still greater than the norm. The level of OMP_{430} continued to decrease to the level of healthy people by 43.75% (p2<0.01) 6 months after treatment.

Nevertheless, a year later, the achieved results were lost – there was again a raise of OMP_{430} by 31.25% (p3<0.05) compared to the figures obtained at the previous stage of the examination. The revealed result was statistically higher than the indicators in healthy people, namely in 1.31 times (p<0.01).

So, as can be assumed from the study, there was an indicative improvement and normalization of all OMP indexes, except that for OMP_{430}, which level had normalized 6 months after therapy. This changes were observed in young people diagnosed with periodontitis,

stage I, degree B of the comparative subgroup, immediately after treatment.

Still, the effect of the treatment did not last long, so the examination of the cured young people conducted a year later revealed a significant worsening in all indicators compared to the healthy ones. The obtained findings may be caused by the re-exacerbation of the pathological process in the periodontium 12 months after traditional treatment.

The achieved statistic of investigated indexes suggests that there was no difference in studied parameters of oral liquid in the main and comparative subgroups for periodontitis, stage I, stage A and B at different stages after treatment and the results did not differ immediately after treatment and 6 months after treatment.

Nevertheless, the follow-up 12 months after demonstrates that there was a notable contrast between all data in the subgroups, except that for OMP_{356} in case of periodontitis, stage I, grade B, namely: in the case of periodontitis, stage I, grade A for OMP_{356} – by 17.02% ($p<0.05$), for OMP_{370} – by 28.26% ($p<0.001$) and for OMP_{430} – by 18.75% ($p<0.05$); and in the case of periodontitis, stage I, degree B for OMP_{370} – by 50.00% ($p<0.001$) and for OMP_{430} – by 23.53% ($p<0.01$).

Conclusion

There are significant changes in oral protein homeostasis and pro-oxidant protection observed in the oral liquid of young people diagnosed with periodontitis, stage I, degree A, especially during its exacerbation. This testifies an increase of the total protein content and an increase of OMP of both aldehyde and ketone derivatives which are of neutral and basic nature and suggests that these parameters might be considered as biomarkers of periodontitis.

The recorded dynamics of the obtained indicators of protein metabolism and pro-oxidant protection in the oral fluid of young people with periodontitis, stage I, degree A and B, obtained before and at different times after periodontal treatment demonstrated that the suggested therapy has a pronounced positive effect on the regulation of these indexes.

The herbal remedies recommended for both local and general treatment proved to have an antioxidant effect, contribute to the long-term maintenance of a positive result after periodontal treatment and prevent the occurrence of repeated exacerbations of periodontal pathology, therefore promoting long-term remission.

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