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Evaluation of the Antioxidant Enzyme and Lipid Peroxidation Product Content in the Cervical Lymph and Jugular Blood during Experimental Apical Periodontitis and Its Treatment.

N. A. Ogrina*, Yu. G. Golinskiy, N. A. Luneva, L. A. Ermolaeva, E. S. Mikhailova, O. V. Khabarova, and S. A. Tumanova

Saint Petersburg State University, 7/9 Universitetskaya nab., St. Petersburg, 199034 Russia.

ABSTRACT

The efficacy of a devised complex endodontic and endoosseous implantation technique in a combination with porous hydroxiapatite ceramics was clinically and experimentally proved on treating retainers with chronic inflammatory processes in the periapical area while making fixed dentures.

Keywords: Lipid peroxidation, conjugated diene, malonic dialdehyde, superoxide dismutase, catalase, apical periodontitis, endodontic endosseous implantation.

Corresponding author

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INTRODUCTION

Studying the periodontal inflammation in the experiment is very important for the dental practice. The works by many authors have described morphological changes in experimental periodontitis [2,3]; an impairment of free radical oxidation and peroxidation of lipids plays an important role in its pathogenesis [4,5,6], however, the conducted studies used the biochemical techniques insufficiently.

Many authors adhere to the viewpoint that the methods of inflammatory periapical chronic process treatment should include factors that can stimulate cells of supporting tissues, enhance their functional activity, thereby providing the directed differentiation for optimization of the processes of reparative regeneration of bone and connective tissue systems [1].

The objective of this study was to experimentally investigate the activity of free radical oxidation and peroxidation of lipids (conjugated diene, malondialdehyde, superoxide dismutase, catalase) in outflowing lymph and blood of dogs from the source of chronic inflammatory periapical process in the comparative aspect during its treatment by traditional and developed comprehensive methodology of endodontic endosseous implantation in combination with porous hydroxyapatite ceramics.

MATERIAL AND METHODS OF THE EXPERIMENTAL STUDY

The models of reproduced chronic apical periodontitis of dogs served as the material for the experimental study following the known method (Magid E.A., Temkin E.S., 1997), being adequate to the corresponding human pathology. The experiment involved 12 mongrel adult dogs of both sexes weighing 10-12 kg, and kept in vivarium. All animals were divided into 3 groups: 1st control group (with intact dental arch), 2nd control group (traditional treatment), and the experimental group (combined treatment). The object of research included free-radical and lipid peroxidation (LPO) in the lymph flowing from the source of inflammation from the jugular lymphatic duct and the blood from the jugular and femoral veins of dogs at baseline, in 45 days after modeling of chronic inflammatory periodontitis and within 30 days after its treatment by experimental combined and traditional methods. The LPO products such as conjugated dienes (CD), malondialdehyde (MDA), superoxide dismutase (SOD) and catalase were determined in plasma and lymph. The animals of the experimental group underwent combined treatment of chronic apical periodontitis with resection of the root apex in combination with endodontic endosseous implantation and filling of bone defect with the porous hydroxyapatite ceramic granules. The animals of the control group underwent treatment of chronic apical periodontitis by traditional method with resection of the root apex and bone defect filling with the “blood” clot. Within 2-3 weeks after the treatment, the non-removable orthopedic structures (artificial crowns), providing maximum contact during occlusion, were made for the experimental animals.

RESULTS OF THE EXPERIMENTAL STUDIES

To compare the amount of lipid and AOP enzymes peroxidation in lymph and blood under investigation, their amount was expressed as a percentage by taking the original amount for 100%. As one can see from the tables below, after 45 days, both the 2nd control and the experimental groups demonstrated 375.3% of CD (conjugated dienes) flowing into jugular lymph at the beginning of the process, while the blood had only 156.2%. The treatment conducted by traditional method demonstrated 186.9% of CD (conjugated dienes) in the jugular lymph, and by combined treatment - 111.3% against 375.3%. In case of traditional treatment, the amount of CD in the jugular blood was 124.6%, and in case of combined treatment - 113.4% against 156.2% (Fig. 1, 2).

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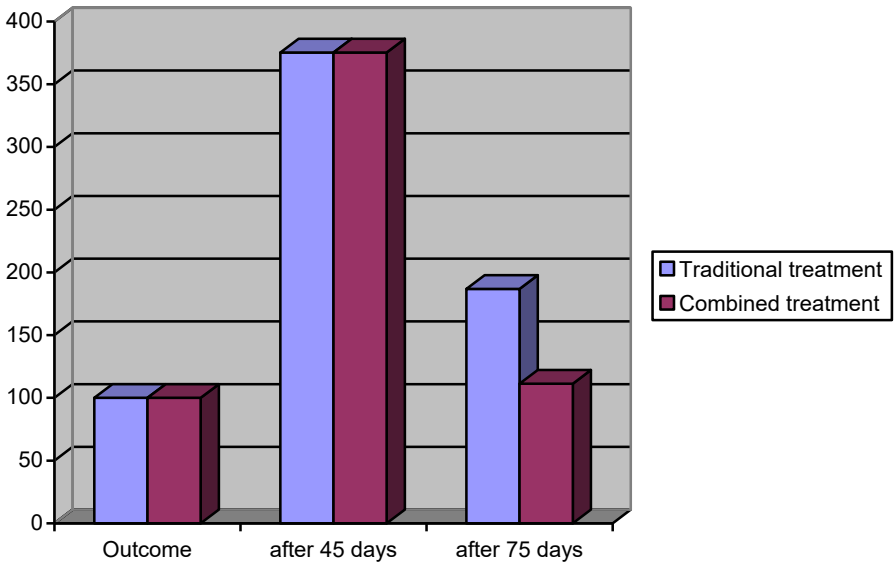

Fig. 1. Conjugated dienes content in the jugular lymph during experiment

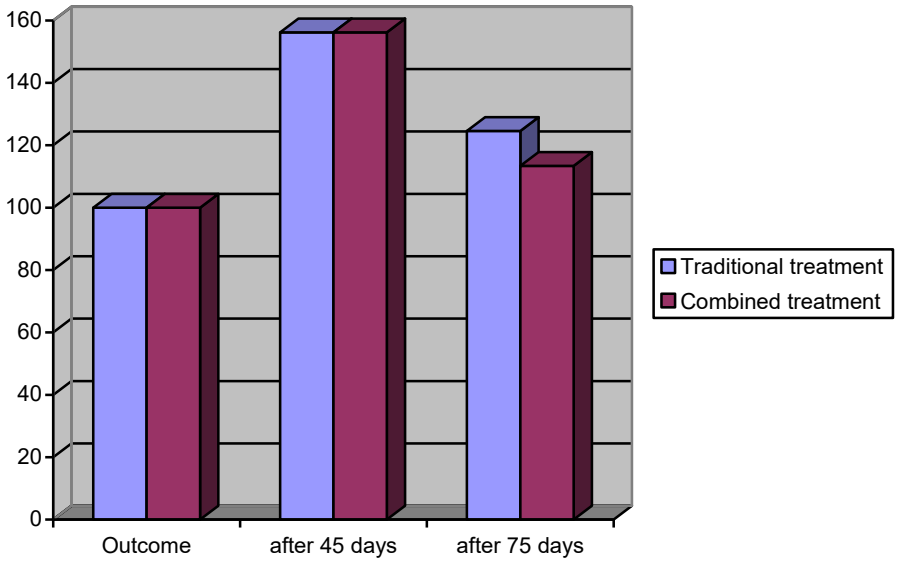

Fig. 2. Conjugated dienes content in the jugular blood during experiment

Table 1. ***DC content in the control group II (traditional treatment)***

Observation period	jugular lymph		jugular blood		femoral blood	
Outcome	13.48±1.18	100%	14.46±1.13	100%	17.45±1.0	100%
45 days (chr. Pt)	50.59±5.19	375.3%	22.6±4.19	156.2%	19.32±3.2	110%
75 days (treatment)	25.2±1.16	186.9%	18.2±1.2	124.6%	18.1±1.4	103.7%

Table 2. CD content in the experimental group (combined treatment)

Observation period	jugular lymph		jugular blood		femoral blood	
Outcome	13.48±1.18	100%	14.46±1.13	100%	17.45±1.0	100%
45 days (chr. Pt)	50.59±5.19	375.3%	22.6±4.19	156.2%	19.32±3.2	110%
75 days (treatment)	15±2	111.3%	16.4±1.4	113.4%	17.2±1.2	98.6%

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Determination of MDA in the jugular lymph and blood in the 2nd control and experimental groups showed that after 45 days from the beginning of the process the jugular lymph received 280% of MDA, while the blood - 158%. In case of treating the experimental animals the MDA content in jugular lymph was 200.0% of DC upon traditional method, and upon combined treatment - 160.0% against 280.0% without any treatment. The MDA content in jugular lymph was 117.0% of DC upon traditional treatment, and upon combined treatment - 100.0% against 158.0% (Fig. 3, 4).

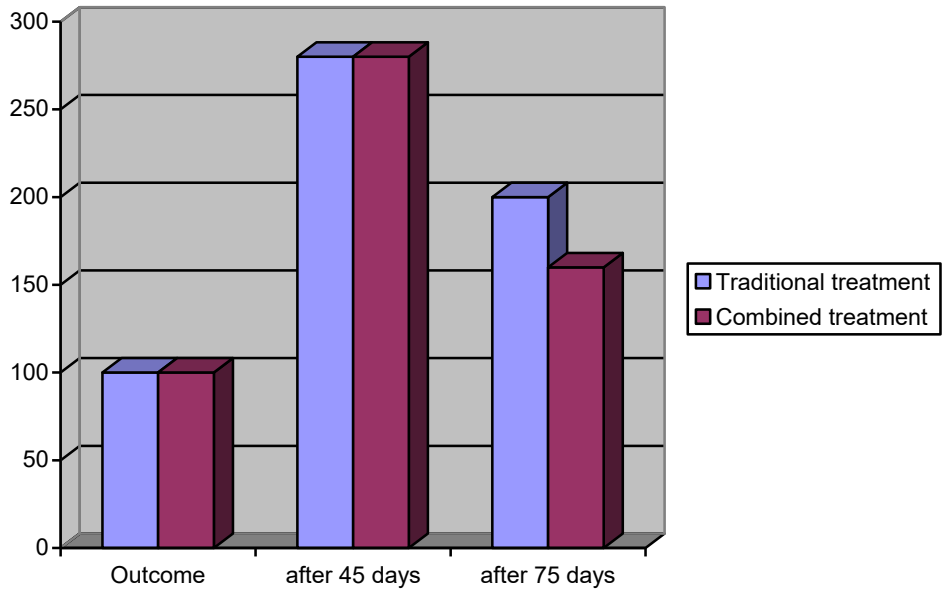

Fig. 3. Malondialdehyde content in the jugular lymph during experiment

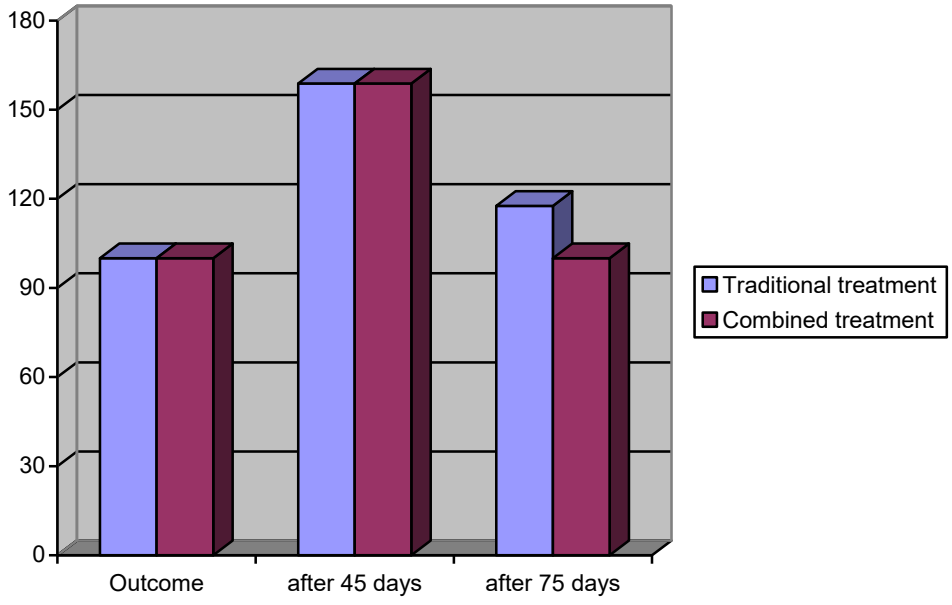

Fig. 4. Malondialdehyde content in the jugular blood during experiment

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Table 3. ***MDA content in the 2nd control group (traditional treatment)***

Observation period	jugular lymph		jugular blood		femoral blood	
Outcome	0.05±0.003	100%	0.17±0.05	100%	0.15±0.05	100%
45 days (chr. Pt)	0.14±0.01	280%	0.27±0.04	158.8%	0.23±0.14	153%
75 days (treatment)	0.1±0.007	200%	0.2±0.005	117.6%	0.17±0.003	113%

Table 4. ***MDA content in the experimental group (combined treatment)***

Observation period	jugular lymph		jugular blood		femoral blood	
Outcome	0.05±0.003	100%	0.17±0.05	100%	0.15±0.05	100%
45 days (chr. Pt)	0.14±0.01	280%	0.27±0.04	158.8%	0.23±0.14	153%
75 days (treatment)	0.08±0.007	160%	0.17±0.006	100%	0.168±0.003	112%

At the same time, the evaluation of AOD enzymes transportation has revealed that after 45 days the SOD content in the jugular lymph of the 2nd control and the experimental group amounted to 46.5%, while in the jugular blood – to 49.37%. Thus, the SOD content in the blood and the lymph was similar. The treatment conducted by traditional method demonstrated 84.6% of SOD in the jugular lymph, and in case of combined treatment - 98.0%, and in the jugular blood - 88.2% of SOD during traditional treatment and 94.2% of SOD in case of combined method (Fig. 5, 6).

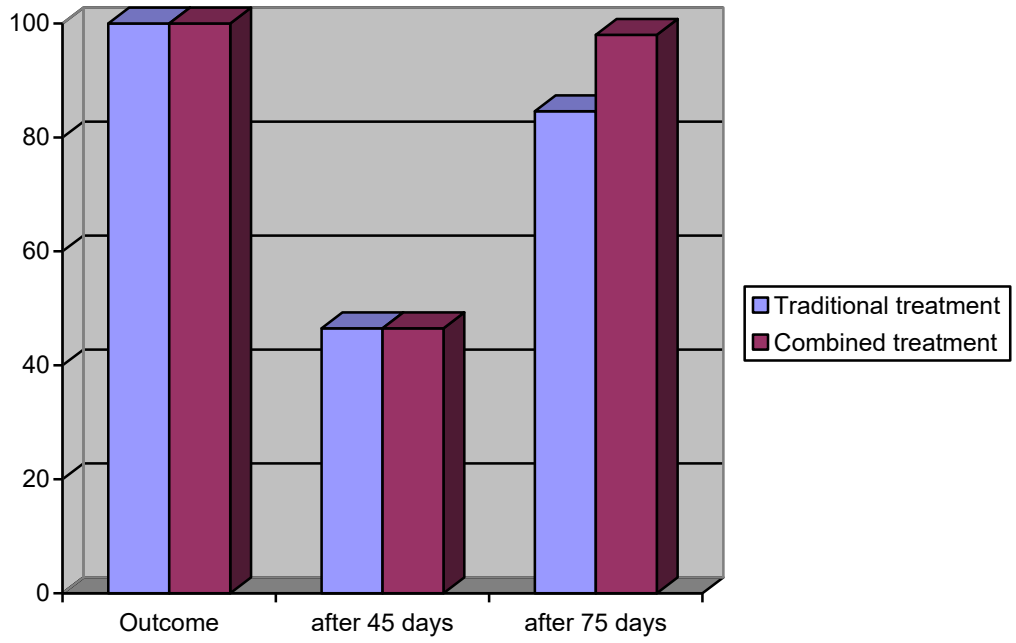

Fig. 5. Superoxide dismutase content in the jugular lymph during experiment

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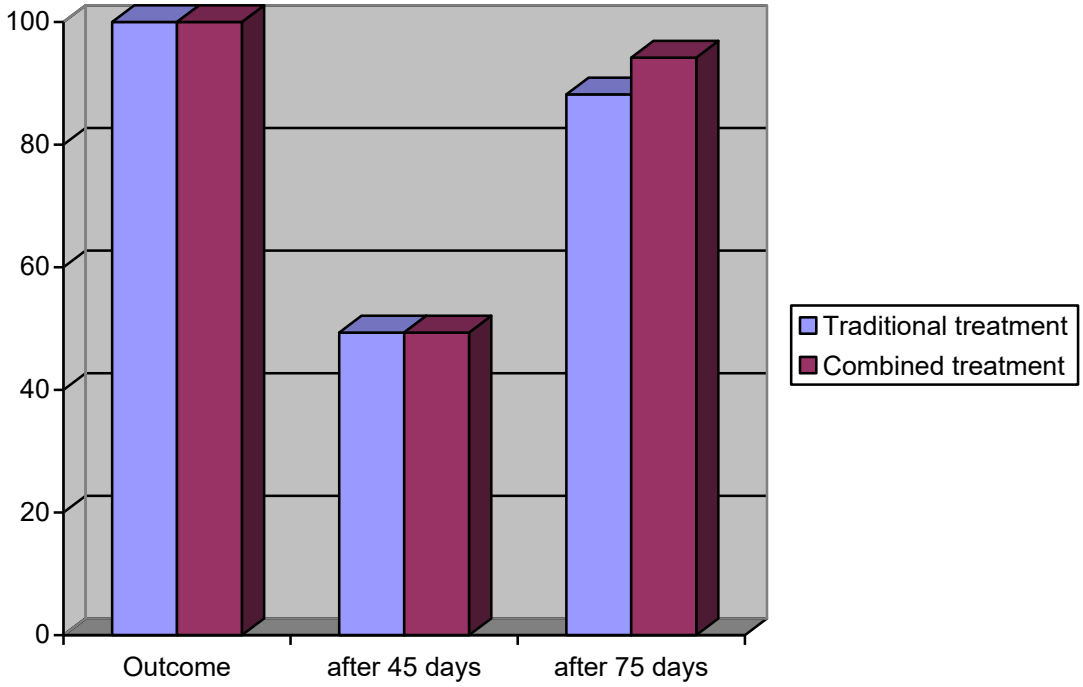

Fig. 6. Superoxide dismutase content in the jugular blood during experiment

Table 5. *SOD content in the 2nd control group (traditional treatment)*

Observation period	jugular lymph		jugular blood		femoral blood	
Outcome	9684±58.4	100%	6684±58.4	100%	5768±46.4	100%
45 days (chr. Pt)	4500±59.4	46.5%	3300±60.4	49.37%	4560±54.1	79%
75 days (treatment)	8200±77.4	84.6%	5900±87.3	88.2%	5410±77.5	93.8%

Table 6. *SOD content in the experimental group (combined treatment)*

Observation period	jugular lymph		jugular blood		femoral blood	
Outcome	9684±58.4	100%	6684±58.4	100%	5768±46.4	100%
45 days (chr. Pt)	4500±59.4	46.5%	3300±60.4	49.37%	4560±54.1	79%
75 days (treatment)	9500±87.4	98%	6300±97.4	94.2%	5510±77.5	95.5%

The evaluation of catalase AOD enzyme content demonstrated that after 45 days its content in the jugular lymph of the 2nd control and the experimental groups was 39.46%, while in the blood - 55.6%. The content of catalase in the jugular lymph in case of a combined treatment was 103.0%, and in case of a traditional method - 86.6% against 39.46%. The content of catalase in jugular vein was 108.0% in case of a traditional treatment, and in case of a combined treatment - 92.0% against 55.6% (Fig. 7, 8).

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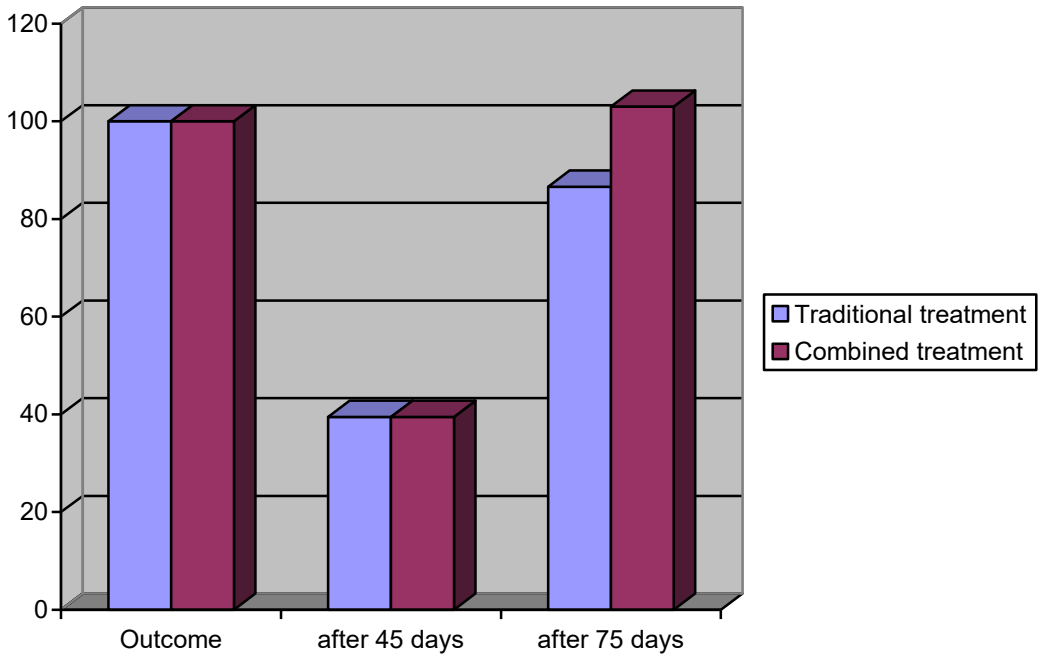

Fig. 7. Catalase content in the jugular lymph during experiment

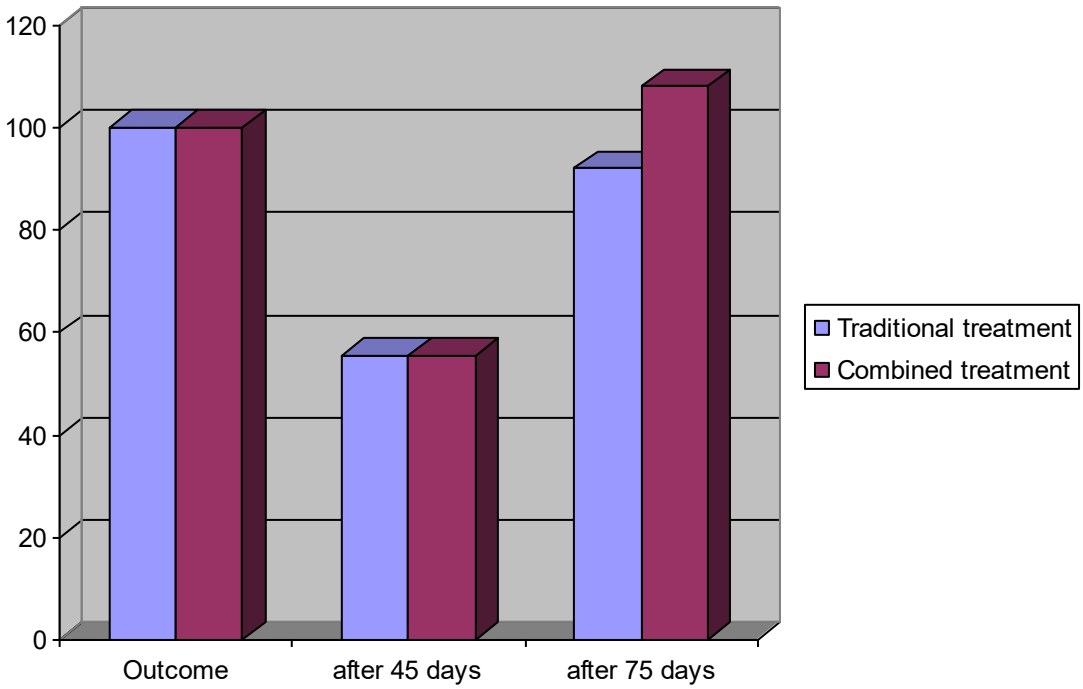

Fig. 8. Catalase content in the jugular blood during experiment

Table 7. ***Catalase content in the 2nd control group (traditional treatment)***

Observation period	jugular lymph		jugular blood		femoral blood	
Outcome	679±23	100%	413±33.0	100%	600±42	100%
45 days (chr. Pt)	268±4.0	39.46%	230±4.0	55.6%	468±6.0	78%
75 days (treatment)	588±19.5	86.59%	380±19.4	92.0%	570±16.9	95%

Table 8. ***Catalase content in the experimental group (combined treatment)***

Observation period	Jugular lymph		jugular blood		femoral blood	
Outcome	679±23	100%	413±33.0	100%	600±42	100%
45 days (chr. Pt)	268±4.0	39.46%	230±4.0	55.6%	468±6.0	78%
75 days (treatment)	700±22.5	103%	450±22.5	108%	585±18.7	97.5%

SUMMARY

- The development of the experimental apical periodontitis is accompanied by the formation of lipid peroxidation products and antioxidant enzymes that mainly come into the jugular lymph outflowing from the source of inflammation, and into the jugular and femoral blood to a lesser extent. At the same time, the content of lipid peroxidation products increases: Conjugated dienes by 3.75 times, malondialdehyde by 2.8 times' and the antioxidant enzymes decrease: superoxide dismutase by 2 times, and catalase by 2.5 times.

- After treating the experimental apical periodontitis, the content of lipid peroxidation products in jugular lymph showed decreases in the content of Conjugated dienes during combined treatment by 3.4 times, during traditional - by 2.8 times; malondialdehyde content during combined treatment decreases by 1.75 times, during the traditional - by 1.4 times; antioxidant enzymes increase: superoxide dismutase during a combined treatment - by 2.1 times, during the traditional - by 1.9 times; catalase during combined treatment - by 2.6 times, upon traditional - by 1.8 times.

CONCLUSION

If our developed combined method of treatment is applied, the changes in the studied parameters are manifested to a greater extent than in case of conventional treatment that indicates its higher effectiveness.

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