

**Galina F. Biloklytska<sup>1</sup>**  
**Valery V. Grigorovsky<sup>2</sup>**  
**Iuliia E. Braun<sup>3</sup>**

# Analysis of morphological changes of periodontal tissues in patients with generalized periodontitis under combined surgical treatment

Stomatologia Współczesna;  
vol. 23, nr 3, 2016, 8-16

## Key words:

generalized periodontitis  
soft periodontal tissues  
periodontal indexes  
morphology  
morphopathology

## Słowa kluczowe:

uogólnione zapalenie  
przyzębia  
miękkie tkanki przyzębia  
indeksy przyzębia  
morfologia  
morfopatologia

From P.L. Shupyk National Medical  
Academy of Postgraduate Education  
in Kiev, Ukraine

<sup>1</sup> prof. *Galina F. Biloklytska* – doctor  
of medicine, head of the Department  
of Therapeutic Dentistry, president  
of Association of Periodontists of Ukraine

<sup>3</sup> *Iuliia E. Braun* – MS, PhD student  
of department of conservative dentistry

From Institute of Traumatology and  
Orthopaedics of National Academy  
of Medical Sciences of Ukraine

<sup>2</sup> prof. *Valery V. Grigorovsky* – MD,  
head scientific assistant in department  
of pathomorphology



prof. G.F. Biloklytska  
e-mail: beloklytska@ua.fm

## Analiza morfologicznych zmian w tkankach przyzębia u pacjentów z uogólnionym zapaleniem przyzębia w trakcie skojarzonego leczenia chirurgicznego

### Streszczenie

Celem obecnego badania było oznaczenie różnic średnich parametrów i częstości występowania istotnych w diagnostyce i prognozie zmian patologicznych w przebiegu uogólnionego zapalenia przyzębia w grupach porównawczych, w zależności od różnych zastosowanych metod leczenia. Ocenę klinicznych i histologicznych parametrów przeprowadzono po działaniu lasera diodowego i proponowanego złożonego leczenia chirurgicznego. Zastosowano stopniową i częstościową analizę w badaniu dystroficznych, hiperplastycznych i zapalnych zmian w tkankach przyzębia w porównywanych grupach. Uzyskano wiarygodne różnice środkowych parametrów indeksów przyzębia. Dzięki badaniu uzyskano i zanalizowano także wiarygodne różnice w urazach tkanek w wyniku zastosowanego leczenia, które zależały od topograficznych detali. Poza tym wykazano pewne zmiany klinicznych i histologicznych parametrów po zastosowaniu leczenia oraz ich częstości występowania w tkankach miękkich dziąsła w różnych okresach podjętego leczenia.

**The current study aimed to state the differences of middle parameters and frequencies of investigated pathological changes crucial for diagnostics and prognosis of course of generalized periodontitis in groups of comparison due to different applied treatment methods. The investigation of clinical and histological parameters was provided under action of diode laser irradiation and proposed combined surgical treatment. The gradational and frequency**

**analysis was provided for investigation of dystrophic, hyperplastic and inflammatory changes in periodontal tissues in comparing groups. The reliable differences of middle parameters of periodontal indexes, tissue injures under action of applied treatment depends on topographical details were obtained and analysed due to provided investigation. The certain changing clinical and histological parameters obtained under provided treatment, were stated and the**

frequency of their appearance in periodontal soft tissues in different periods of applied treatment were showed.

## Introduction

Diagnostics, treatment and prognosis of further course of chronic generalized periodontitis (GP) exist as constant problem of contemporary dentistry need to be solved (Maschenko, Samoylenko 2002, Sculean 2010, Solaria et al. 2010). The assessment of proposed plenty of different treatment methodics including modern surgical techniques, different types of substitute materials and regenerative techniques, laser application and their clinical efficiency mostly based on evaluation of obtained clinical results in different terms of observation (Perova 2005, Carranza 1979, Shklar 1979). Although pathomorphological investigation, in which the objective assessment of current status of periodontal tissues provided according to histological assessment of harvested samples, taken from patients with GP during different terms of dynamic observation using different treatment methodics, can be provided very rarely. This can be explained due technical reasons and need for repeated harvesting of vital tissues in different terms of observation after applied treatment. This may complicate the process from ethical reasons, patients agreement and technical demands. But exactly this type of investigation stays as one of the most evidence based in sphere of contemporary periodontics among other types of investigations (Michaleva et al. 2004, Hasan, Palmer 2014, Mittermayer 1984, Moskow, Polson 1991, Shafer et al. 1974).

## Aim of study

Due to investigation of selected periodontal indexes and quality-quantity morphological indexes of periodon-

tal tissues – to determine the difference of middle-level parameters and frequency of pathological changes that may be crucial for diagnosis and prognosis of GP course in main groups of comparison using combined surgical treatment.

## Materials and methods

Material for investigation became to be samples of soft periodontal tissues harvested from 20 patients, age 31-59 y.o. ( $45.5 \pm 1.62$  y.o.), periodontal pockets depth (PPD) =  $7.71 \pm 0.11$  mm, clinical attachment level (CAL) =  $9.02 \pm 0.13$  mm. The terms of course of GP in patients was from 5 till 15 years and comprised in middle  $8.33 \pm 0.69$  years.

Patients passed clinical and Rx investigation and were divided into 4 main comparing groups. They were assessed before applied treatment after passing only conservative therapy of GP (I group); after diode laser irradiation during repeated curettage due to preoperative tissue preparation (PTP) – immediately after application (II group); during dynamic observation after PTP and surgical treatment (IV group). The terms of observation for the moment of histological investigation in III group was – 7-60 days after PTP; in IV group terms after PTP and surgical operation for the moment of histological investigation was 7-540 days.

Into applied complex periodontal treatment (CPT) the additional phase was add before surgical treatment – preoperative tissue preparation (PTP). PTP was applied after conservative therapy (CT) and was provided in two stages on both of jaws with interval between procedures of 7 days lasting 14 days at average after CT. PTP included SRP therapy in conjunction with diode laser curettage (980 nm, 2 Watt, continuous regimen) with working tip insertion 2 mm subgingivally. Each periodontal pocket (PP) was processed twice for 5-10 sec around each tooth on both of jaws with in-

terval of 7 days between each procedure. After PTP stage the surgical phase of CPT was applied using proposed modification of surgical technique. In summary the period of applied CT and PTP lasted in average 35 days from the beginning of treatment of GP. Before passing to another treatment stage the periodontal status was assessed due to periodontal indexes (PMA, BOP, PPD, CAL, REC). All patients received hygienic recommendations. The manual skills were controlled during treatment and further regular check-ups. During provided treatment no antibiotics were used. Only topic antibiotics (Metronidazole in combination with CHX 20%) in form of gel was prescribed after PTP (14 days) and surgical operation (10 days). The prescribed concentration of CHX was 0.05% during all applied treatment, the same solution was recommended for long-term usage after treatment.

**Surgical technique** – in IV group the surgical phase of CT was applied and included application of proposed modified surgical technique (MST). Into MST the basic surgical principals of few approved techniques: MIS – minimally invasive surgery (Herrel, Rees 1995) and M-MIST – Modified Minimally invasive surgical technique (Cortellini, Tonetti 2007, Cortellini, Tonetti 2009, Cortellini, Tonetti 2011) were included. The flap was minimally exposed in area of interdental space and palatal (lingual side), the interdental papillae were leaved on place and the main access into PP was provided from the vestibular side. The vestibular flap was exposed and mobilized until reaching ability for coronal displacement with cement-enamel junction CEJ coverage up to 1-2 mm. The root surface and bone in PP were accurately cleaned by ultrasonication (Cavitron SPS) reaching smooth surface. Grid-like compactosteotomy and osteotomy were provided in area of bony walls and bottom of PP and surrounding bone by insertion depth of 2 mm di-

ameter carbide round burr of 2 mm. Each perforation was additionally ultrasonicated for 5 sec providing final cleaning of perforated bone surface. Additional usage of diode laser irradiation (980 nm, 2 Watt, continuous regimen) was applied during work on exposed flap and inner gingival wall of each PP for precise degranulation and flap deepithelization, excluding usage of manual instruments aiming marginal soft tissue preservation. The root surfaces were etched (24% EDTA) and bony pockets were filled with enamel matrix proteins (Emdogain). For flap suturing the single internal horizontal mattress sutures were used that were temporary fixed on orthodontic buttons during 14 days proving slight coronal flap tension with CEJ coverage (fig. 1). All teeth with fixed orthodontic buttons were united by thin elastic orthodontic chain without tension, stabilizing the sutures (fig. 2), the removal of sutures was simplified (fig. 3). In postsurgical period the generally approved hygienic recommendations were given to all patients. The supporting periodontal therapy was applied every 3 months postoperatively with manual control of hygienic skills of patients.

**Periodontal status measurement** – included periodontal screening before treatment and during provided terms of observation in groups by using assessment of main indexes: PMA, BOP, PPD, CAL, REC. The collected data was used for comparison in between main groups and control group (20 patients, 35.5 ±1.4 y.o.) with clinically healthy periodontium (tab. I). The obtained middle parameters were compared in groups using Student criteria.

**Morphological and morphometric methods** – all patients were informed previously and filled the agreement forms for participating in stated phase of investigation. Under local anaesthesia the soft tissue periodontal samples (2x3 mm) were taken including interdental papillae

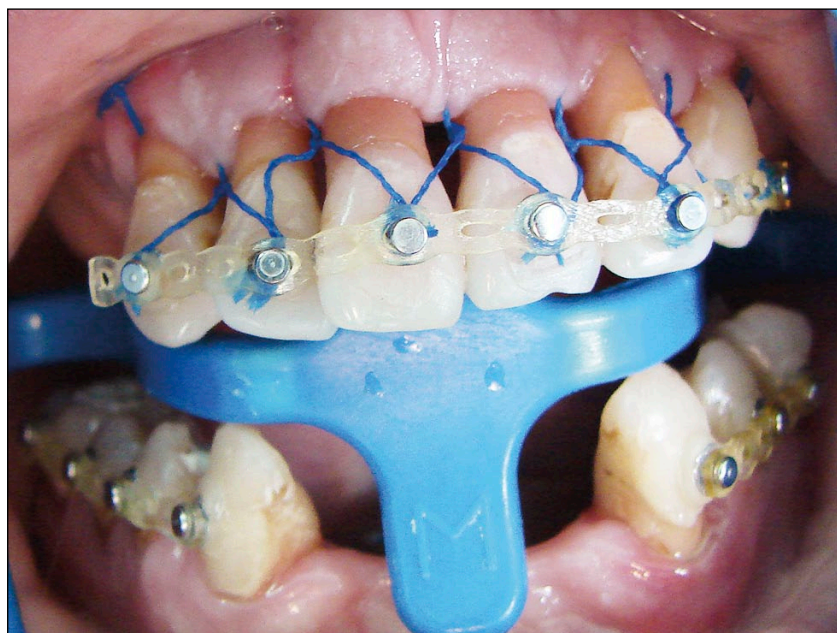


Fig.1. Single internal horizontal mattress sutures temporary fixed on orthodontic buttons

Ryc. 1. Pojedyncze wewnętrzne poziome szwy materacowe czasowo mocowane na ortodontycznych zaczepach

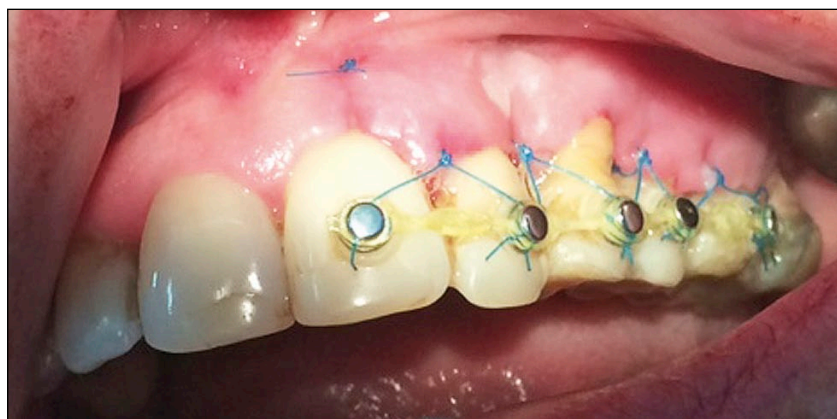


Fig. 2. Elastic orthodontic chain stabilizing the sutures and coronal flap displacement

Ryc. 2. Elastyczny ortodontyczny łańcuch stabilizujący szwy oraz koronowe przesunięcie płata

and marginal gingiva after each stage of treatment in main groups. The amount of investigated samples was 58. The soft tissue fragments preparation included: fixation in 10% formalin solution, histotechnical preparation with action of organic solvents in growing concentration, fixation with cellulidin, preparation of samples with thickness of 10 mkm, staining by hematoxyllin and eosin (Merkulov 1969, Sarkisov, Perova 1996).

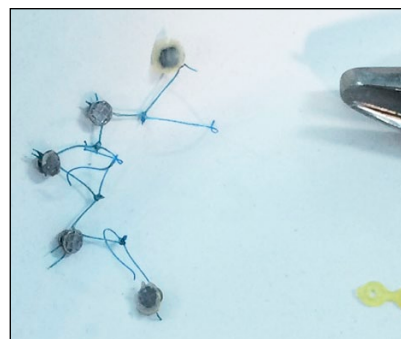


Fig. 3. Simplified sutures removal

Ryc. 3. Uprozczone usuwanie szwów

Tab. I. The parameters and statistical differences of periodontal indexes, characterizing condition of patients with generalized periodontitis

Tab. I. Parametry i statystyczne różnice indeksów przyzębia, charakteryzujące stan pacjentów z uogólnionym zapaleniem przyzębia

Periodontal index	Clinical comparison groups				
	Control group	I group (laser irradi., surgical oper.), terms of biopsy 0 days	II group (laser irradi. PTP+, surgical oper.), terms of biopsy 0 days	I group (laser irradi. PTP+, surgical oper.), terms of biopsy 7-60 days	IV group (laser irradi. PTP+, surgical oper.), terms of biopsy 7-540 days
PMA (%)	20 20.23 1.47	19 39.30 2.09	16 35.47 3.39	16 28.43*** 1.56	7 38.29 2.73
BOP (%)	20 10.74 3.32	19 63.53 <sup>ooo</sup> 2.42	16 59.19 3.06	16 48.69*** 1.65	7 51.71* 5.17
PPD (mm)	20 1.11 0.027	19 6.36 <sup>ooo</sup> 0.31	16 6.18 0.37	16 5.73 0.30	7 4.16** 0.44
CAL (mm)	20 0.66 0.043	19 4.68 <sup>ooo</sup> 0.24	16 4.67 0.29	16 5.05 0.26	7 4.04 0.23
REC (mm)	20 0.68 0.041	19 2.22 <sup>ooo</sup> 0.17	16 2.08 0.16	16 2.27 0.17	7 1.98 0.21

Remarks:

° – credible difference comparing to control group during assessment using Students criteria with  $p < 0.05$

°° – credible difference comparing to control group,  $p < 0.01$

°°° – credible difference comparing to control group,  $p < 0.001$

\* – credible difference comparing to parameter in I group,  $p < 0.05$

\*\* – credible difference comparing to parameter in I group,  $p < 0.01$

\*\*\* – credible difference comparing to parameter in I group,  $p < 0.001$

Under gradational-frequency analysis the statistic comparison of occurrence frequency in cases with definite gradations of morphological indexes with usage of  $\chi$ -quadrate was provided (tab. II).

## Results

The analysis of periodontal indexes in main groups (tab. I) revealed that due to laser curettage during PTP (III group), the levels of PMA, BOP indexes were significantly reduced ( $p < 0.05-0.001$ ). After applied treatment in IV group (CT, PTP, surgical phase of treatment) in comparison with primary pretreatment tissue condition – I group, significant changes were detected in levels of BOP, PPD indexes that were highly reduced ( $p < 0.05-0.001$ ).

### Pathomorphological changes in gingival epithelium

The covering epithelium in all investigated cases had character of multilayer plate-like, the basal and prick layers mostly were voluminous, with enlargement of pricks forming akantotic vegetations in direction of gingival lamina propria (GLP). In some samples the epithelial layer was significantly thin down or the interruption of epithelial layer was disturbed having absence of epithelial cells, forming defect with bottom formed of fibrous tissue of GLP, being in condition of exudative inflammation (fig. 4). In saved part of epithelial layer the dystrophic and inflammatory changes were detected, the infiltration of epithelium by neutrophil leucocytes was various by density and spreading (fig. 5).

### Pathomorphological changes in lamina propria of gingiva

The basis of GLP was presented in form of dense connective tissue that was in different maturity stages, mostly as fully matured revealing partial sclerosis with relatively voluminous collagenous fibers with buried fibrocytes between them. However in certain areas, especially in areas of intensive inflammatory infiltration, the connective tissue of GLP had the same signs as granulation tissue, with high amount of vessels of capillary type with young fibroblasts (fig. 6).

The inflammatory infiltrates in area of GLP had different cell formulation and topography of distribution. The cell formulation of inflammatory infiltrates included mononuclears (lymphocytes, monocytes) macrophages, plasmocytes, neutrophils. The stated cell populations

Tab. II. Gradations of morphological parameters of pathological changes of soft periodontal tissues and statistical frequency differences in patients with generalized periodontitis using different treatment actions

Tab. II. Gradacja morfologicznych parametrów zmian patologicznych tkanek miękkich przyzębia oraz częstość statystycznych różnic u pacjentów z uogólnionym zapaleniem przyzębia stosuje różne sposoby leczenia

Parameter	Gradations of occurred changes	Occurrence of frequency of stated gradations in comparison groups and difference frequency according criteria $\chi$ -quadrate			
		I group (laser irradi., sugical oper.-), terms of biopsy 0 days	II group (laser irradi. PTP+, sugical oper.-), terms of biopsy 0 days	I group (laser irradi. PTP+, sugical oper.-), terms of biopsy 7-60 days	IV group (laser irradi. PTP+, sugical oper.+), terms of biopsy 7-540 days
Pathological changes in gingival epithelium					
Dystrophic, necrotic, ulcerous injuries of gingival epithelium	Low stage: dystrophic, necrotic, ulcerous changes are absent in epithelium	17/19	9/16	11/16	5/7
	High stage: dystrophic, necrotic, ulcerous changes in epithelium are detected histologically	2/19	7/16	5/16	2/7
Hyperplasia in gingival epithelium	Low stage: occurrence of epithelial hyperplasia is low or absent	3/19	3/16	6/16	<b>5/7*</b>
	High stage: signs of epithelial hyperplasia are middle or high stage	16/19	13/16	10/16	<b>2/7*</b>
Spreading of dystrophic – destructive and inflammatory – infiltrative changes in gingival epithelium	Low stage: changes are absent	8/19	4/16	5/16	3/7
	High stage: changes are present irrespectively to their spread – «local», «diffuse» or «extensive»	11/19	12/16	11/16	4/7
Type of inflammation in GLP					
Type of inflammation in papillary layer of GLP	Low stage: inflammation is minimal, productive, without signs of exudation	12/19	9/16	7/16	6/7
	High stage: productive-exudative inflammation	7/19	7/16	9/16	1/7
Type of inflammation in superficial parts of reticulated layer of GLP	Low stage: inflammation is minimal, productive, without signs of exudation	4/19	6/16	5/16	1/4
	High level: productive-exudative inflammation	15/19	10/16	11/16	3/4
Type of inflammation in deep parts of reticulated layer of GLP	Low stage: inflammation is minimal, productive, without signs of exudation	2/17	2/12	6/14	1/2
	High level: productive-exudative inflammation	15/17	10/12	8/14	1/2
Spreading of inflammation in gingival lamina propria					
Spreading of inflammation in papillary layer of GLP	Low stage: inflammation is «localized», infiltrates take less than 20% of area in GLP in samples	7/19	8/16	6/16	5/6
	High stage: inflammation is «localized», infiltrates take more than 20% of area in GLP in samples	12/19	8/16	10/16	1/6
Spreading of inflammation in superficial part of papillary layer of GLP	Low stage: inflammation is «localized», infiltrates take less than 20% of area in GLP in samples	1/19	2/16	4/15	1/4
	High stage: inflammation is «localized», infiltrates take more than 20% of area in GLP in samples	18/19	14/16	11/15	3/4
Spreading of inflammation in deep part of papillary layer of GLP	Low stage: inflammation is «localized», infiltrates take less than 20% of area in GLP in samples	2/17	0/12	<b>9/14**</b>	<b>2/2*</b>
	High stage: inflammation is «localized», infiltrates take more than 20% of area in GLP in samples	15/17	12/12	<b>5/14**</b>	<b>0/2*</b>

References:

part of data for calculation of  $\chi$ -quadrate criteria were calculated including Yate's correction for continuity to low volume of samples

° – credible difference of frequencies of certain gradation in I and II groups according to  $\chi$ -quadrate criteria, with credibility  $p < 0.05$

∞ – credible difference of frequencies in I and III groups,  $p < 0.01$

∞∞ – credible difference of frequencies in I and III groups,  $p < 0.001$

\* – credible difference of frequencies of certain gradation in I and IV groups according to  $\chi$ -quadrate criteria, with credibility  $p < 0.05$

\*\* – credible difference of frequencies in I and IV groups,  $p < 0.01$

\*\*\* – credible difference of frequencies in I and IV groups,  $p < 0.001$

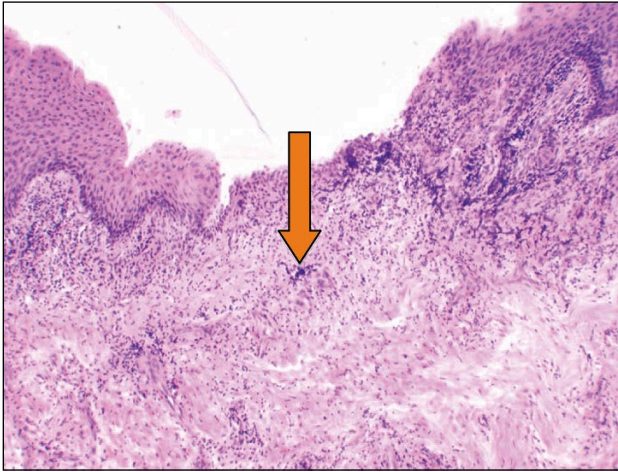


Fig. 4. Dystrophic-necrotic changes in multilayer gingival epithelium, with defect formation (marked by arrow); the defect bottom was covered by thin fibrinous layer of exudate. Photo of biopsy sample of gingiva of patient 45 y.o. Staining hematoxyllin, eosin, x75  
Ryc. 4. Dystroficzno-nekrotyczne zmiany w wielowarstwowym nabłonku dziąsła z tworzeniem defektu (zaznaczone strzałką); dno zmiany pokryte cienką warstwą fibrynowego wysięku. Obraz biopsji dziąsła 45-letniego pacjenta. Barwienie hematoksylina i eozyna, x75

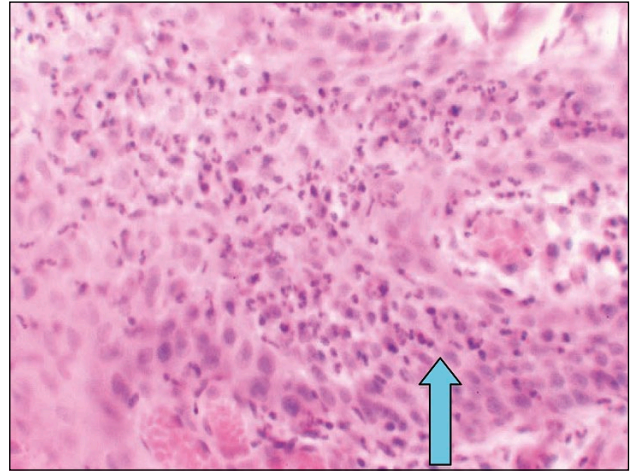


Fig. 5. The inflammatory infiltration of gingival epithelium of high stage of spreading. Agglomeration of neutrophils marked by arrows. In the papillary layer of GLP the severe hyperemia. Photo of biopsy sample of gingiva of patient 59 y.o. Staining hematoxyllin, eosin, x200  
Ryc. 5. Naciek zapalny w nabłonku dziąsła znacznie rozprzestrzeniony. Skupiska neutrofilii zaznaczone strzałką. W warstwie brodawkowej GLP znaczne przekrwienie. Obraz biopsji dziąsła 59-letniego pacjenta. Barwienie hematoksylina i eozyna, x200

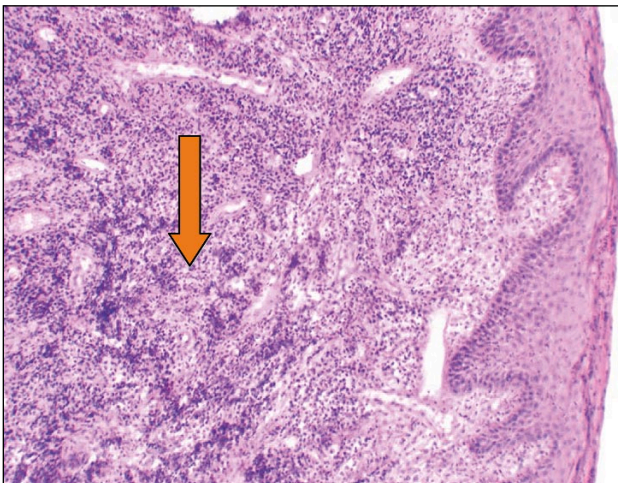


Fig. 6. The granulation tissue and dense diffuse inflammatory infiltrates (marked arrows) principally in reticulated layer of GLP. Photo of biopsy sample of gingiva of patient 60 y.o. Staining hematoxyllin, eosin, x75  
Ryc. 6. Tkanka ziarninowa z gęstymi rozproszonymi naciekami zapalnymi (zaznaczone strzałką) głównie w warstwie siateczkowej GLP. Obraz biopsji dziąsła 60-letniego pacjenta. Barwienie hematoksylina i eozyna, x75

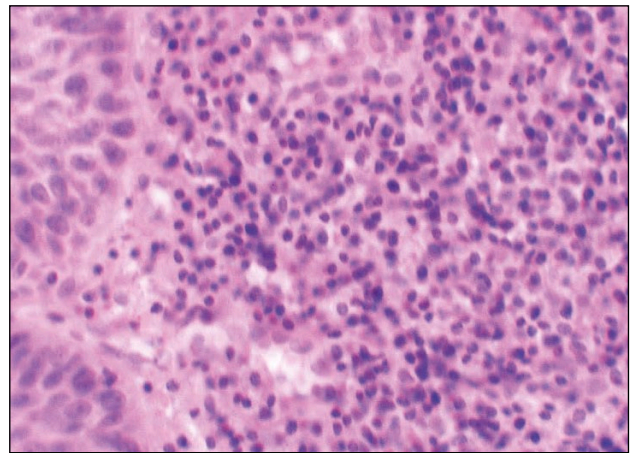


Fig. 7. The cell consist of inflammatory infiltrates during productive inflammation in papillary and reticulated layers of GLP: the infiltrate almost consist of mononuclears and plasmocytes. Photo of biopsy sample of gingiva of patient 51 y.o. Staining hematoxyllin, eosin, x300  
Ryc. 7. Komórki z naciekami zapalnymi w czasie wytwórczego – proliferacyjnego zapalenia w warstwie brodawkowej i siateczkowej GLP: naciek głównie złożony z komórek jednojądrzastych i plazmocytołów. Obraz biopsji dziąsła 51-letniego pacjenta. Barwienie hematoksylina i eozyna, x300

formed in tissue of GLP insular-like or disseminated conglomerates. Insular-like conglomerates were pre-

sented in form of small loci or local aggregations, with wide portions of fibrous tissue in between them,

without inflammatory infiltrates. The disseminated conglomerates were extensive, confluent or dif-

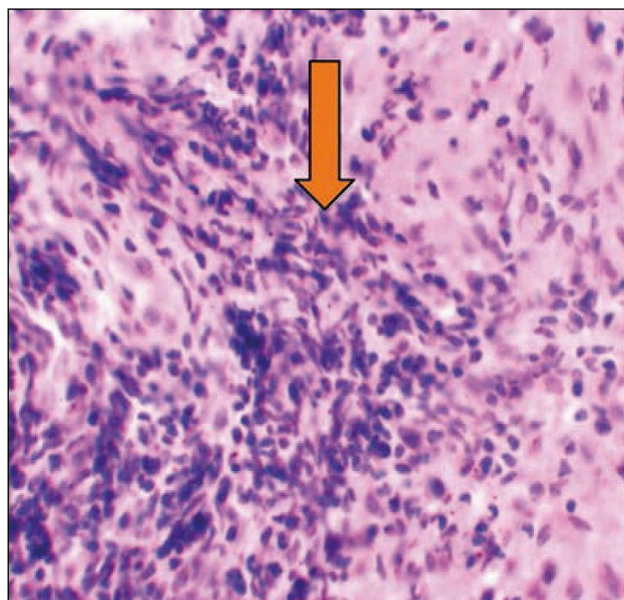


Fig. 8. The cell consist of inflammatory infiltrates during productive-exudative inflammation in GLP: the infiltrate almost consist of mononuclears and plasmocytes with addition of neutrophils (marked by arrow). Photo of biopsy sample of gingiva of patient 33 y.o. Staining hematoxillin, eosin, x300

Ryc. 8. Komórki z naciekami zapalnymi w czasie wytwórczego – proliferacyjnego zapalenia w GLP: naciek prawie zawiera komórki jednojądrzaste i plazmocyty z dodatkiem neutrofilii (zaznaczone strzałką). Obraz biopsji dziąsła 33-letniego pacjenta. Barwienie hematoksylina i eozyna, x300

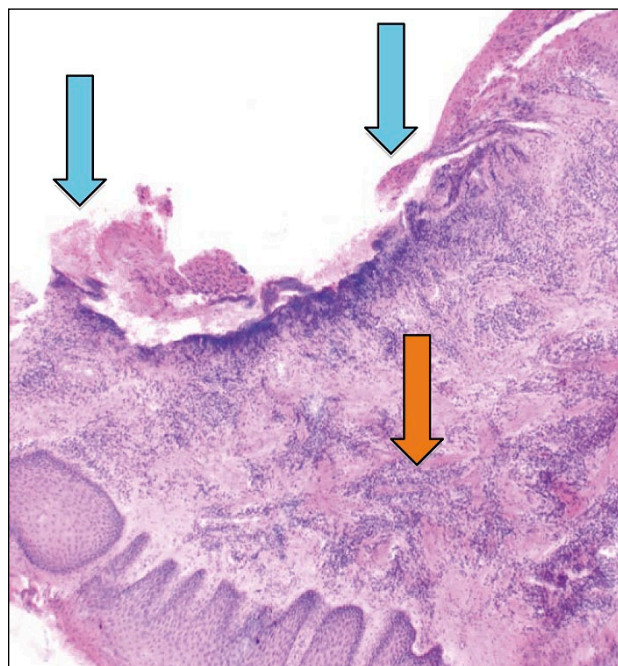


Fig. 9. The deep periodontal pocket (borders marked by blue arrows) in gingival sample. In GLP – diffused productive inflammation (marked by orange arrow). Photo of biopsy sample of patient 40 y.o. Staining hematoxillin, eosin, x30

Ryc. 9. Głęboka kieszonka dziąsłowa (brzeży zaznaczone niebieskimi strzałkami) w próbce dziąsła. W GLP rozproszone wytwórcze zapalenie (zaznaczone pomarańczową strzałką). Obraz próbki biopsji 40-letniego pacjenta. Barwienie hematoksylina i eozyna, x30

fuse (fig. 7). The inflammation of low activity level was presented in form of small mononuclear infiltrates situated among fibrous GLP. If in content of infiltrates the small portion of neutrophils was present, the inflammation assessed as productive-exudative (fig. 8). If the amount of neutrophilocytes in inflammatory infiltrates was high, present inflammation assessed as exudative-productive. Both variants of detected inflammation was assessed as inflammatory reaction of higher activity, comparing to common productive type. Only in singular cases in tissues of GLP the micro abscesses were detected.

Part of biopates (18 samples) of pathologically changed soft periodontal tissues contained walls of periodontal pockets (fig. 9). They were characterized by heterogeneity of structure: the epithelial coating

was heterogeneous by it's thickness with bands and outgrowths, having parts uncovered by epithelium. In these cases the periodontal pocket wall consisted mostly of granulation tissue or immatured fibrous tissue in condition of intensive inflammatory infiltration. On epithelial surface and surfaces of granulation and fibrous tissues the agglomerates of deposits, bacteria, fibrinous exudate and pus were determined. In most of investigated cases of these samples in periodontal pocket wall the intensive inflammatory reaction with severe exudative component was detected.

**Comparison of soft periodontal tissues morphological status in between groups**

The obtained data is presented in tab. II, revealed that frequency of cases where dystrophic, necrotic

and ulcerous pathologic changes were absent, was the biggest in patients undergone CT of GP. The frequency of obtained pathological changes was minimal (more than in 50% of analyzed samples) – in samples of patients who passed the repeated laser curettage (PTP) and biopsies were taken immediately after laser irradiation application – II group. The obtained results in II group can be explained by immediate cytopathogenic action of diode laser in stated regimen on epithelium of vestibular wall of PP. During further treatment in other groups (III, IV) the frequency of cases with injuries of epithelium was reduced, that can be explained by tissue reparation ( $p > 0.05$ ). The hyperplasia of gingival epithelium in most of the cases corresponded to middle and high stage of this parameter and only

in patients of IV group undergone CT including surgical stage, the cases with high frequency of hyperplasia were detected credibly ( $p < 0.01$ ) less comparing to patients of II, III groups.

The inflammation in papillary layer of GLP in comparing groups mostly had character of productive inflammation. Only in III group, where biopsy samples were obtained after laser irradiation during PTP in terms of 7-60 days after procedure, cases with productive-exudative inflammation were detected. These changes can be explained by activation of inflammatory process in GLP under direct laser action on soft periodontal tissues. The minimal frequency of cases with productive-exudative inflammation (parameter of high frequency) was detected in patients undergone CT – IV group.

The frequency of detection of inflammation of different activity in superficial layers of reticulated layer of GLP in comparison groups did not differ significantly, the frequency of cases with productive-exudative inflammation – were predominant. Laser irradiation during PTP and surgical phase of CT (II, III, IV groups), did not significantly influence on occurrence frequency of different gradations.

According to assessment of parameter “spreading of inflammation in deep layers of GLP” in III group after PTP using laser irradiation (7-60 days) as in IV group after PTP and surgical treatment (7-540 days) – the credible ( $p < 0.01$ ) reduction of frequency of biopsy cases with high level of investigated parameter were detected. Obtained data meant the occurrence reduction of widespread and diffuse character of inflammation in biopsy samples that took more than 20% of investigated space.

The results of current study confirmed the impression of considerable topographic variety and characteristics of chronic inflammatory process in periodontal tis-

suess, especially – in gingiva and periodontal pocket wall (Michaleva et al. 2004, Perova 2005, Aykol et al. 2011, Mittermayer 1984, Moskow, Polson 1991, Shafer et al. 1974). For more evidence based of occurrence or absence of frequency differences in different groups, the amount approach was used based on gradational assessment of stated morphological parameters. In the literature, the scientific works based on morphometry of parametric histological and cytological parameters under action of different biologically active preparations on periodontal structures were presented previously, including patients with diabetes (Seppälä et al. 1997, Van der Weijden, Timmerman 2002) and other pathology. But analogous comparison study with assessment of periodontal soft tissues condition under action of different treatment phases during CT were not found previously.

## Conclusions

1. The current study revealed that in patients with GP the middle parameters of investigated periodontal indexes were differ comparing with patients with healthy periodontium and were credibly raised ( $p < 0.01$ ): BOP, PPD, CAL, REC.
2. During treatment due to laser curettage (II, III groups) and after PTP and surgical phase of CT (IV group) the credible changes in parameters of investigated periodontal indexes, characterizing soft tissue condition were detected ( $p < 0.01$ ). The middle parameters of PMA, BOP – were reduced after laser curettage (III group); BOP, PPD – were reduced after PTP and surgical operation (IV group).
3. In patients with GP in soft periodontal tissues – marginal gingiva of periodontal pocket wall, the complex of dystrophic-destructive, inflammatory and reparative changes, reaching different

stages and spreading, occurred with different frequency – as before as after applied treatment.

4. The cases with high occurrence of epithelial hyperplasia of gingiva in groups of patients where laser curettage was used during PTP (III group) and further surgical treatment (IV group), were detected credibly ( $p < 0.01$ ) less comparing with I and II groups. Cases with high stage of investigated parameter “spreading of inflammatory layers of GLP” in III and IV groups of treated patients were detected credibly ( $p < 0.01$ ) less comparing to cases with high occurrence of this parameter, in comparison with I group, where only conservative treatment was applied.

## References

- Maschenko IS, Samoylenko AV:* New aspects of pathogenesis and treatment of generalized periodontitis. *Visnik Stomatologii* 2002; 1: 12-5.
- Sculean A:* Periodontal regenerative therapy. *Quintessence Publ* 2010; 294.
- Solaria SK, Madaan V, Bala D:* A report of laser-assisted modified Widman flap for periodontal regeneration: clinical and radiographic evaluation. *Contemp Clin Dent* 2010; 1: 115-8.
- Perova MD:* Periodontal tissues: norma, pathology, ways of recovering. *Triada* 2005; 312.
- Carranza FA:* Glickman’s clinical periodontology. Philadelphia London: Saunders 1979; 201-7.
- Shklar G:* The oral cavity, jaws, and salivary glands. [In] Robbins SL, Cotran RS: *Pathologic basis of disease*. Saunders, Philadelphia-London 1979; 886-917.
- Michaleva LM, Shapovalova VD, Barchina TG:* Chronic periodontitis. Clinical morphology and immunology. *Triada* 2004; 125.



*Hasan A, Palmer RM:* A clinical guide to periodontology: Pathology of periodontal disease. *Brit Dent J* 2014; 216, 8: 457-61.

*Mittermayer C:* Oralpathologie. Schattauer Verlag, Stuttgart 1984; 334.

*Moskow BS, Polson AM:* Histologic studies on the extension of the inflammatory infiltrate in human periodontitis. *J Clin Periodontol* 1991; 18, 7: 534-42.

*Shafer WG, Hine MK, Levy BM:* A textbook of oral pathology. Saunders, Philadelphia-London 1974.

*Herrel SK, Rees TD:* Granulation tissue removal in routine and minimally invasive surgical procedures. *Compend Contin Educ Dent* 1995; 16: 960-7.

*Cortellini P, Tonetti MS:* Minimally invasive surgical technique (MIST) and

enamel matrix derivative (EMD) in intrabony defects. (I) Clinical outcomes and intra-operative and post-operative morbidity. *J Clin Periodontol* 2007; 34: 1082-8.

*Cortellini P, Tonetti MS:* Improved wound stability with modified minimally invasive surgical technique in the regenerative treatment of isolated interdental intrabony defects. *J Clin Periodontol* 2009; 36: 157-63.

*Cortellini P, Tonetti MS:* Clinical and radiographic outcomes of the modified minimally invasive surgical technique with or without regenerative materials: a randomized-controlled trial in intrabony defects. *J Clin Periodontol* 2011; 38: 365-73.

*Merkulov GA:* Course in pathohistological technique. *Medicina* 1969; 423.

*Sarkisov DS, Perova UL:* Microscopic technique: manuals. *Medicina* 1996; 543.

*Aykol G, Baser U, Maden I, Kazak Z, Onan U, Tanrikulu-Kucuk ST, Ademoğlu E, Issever H, Yalcin F:* The effect of low-level laser therapy as an adjunct to non-surgical periodontal treatment. *J Periodontol* 2011; 82: 481-8.

*Seppälä B, Sorsa T, Ainamo J:* Morphometric analysis of cellular and vascular changes in gingival connective tissue in long-term insulin-dependent diabetes. *J Periodontol* 1997; 68, 12: 1237-45.

*Van der Weijden GA, Timmerman MF:* A systematic review on the clinical efficacy of subgingival debridement in the treatment of chronic periodontitis. *J Clin Periodontol* 2002; suppl 29, 3: 55-71.