

## Optimization of Treatment Approach in Patients with Moderate and Severe Generalized Periodontitis Using Interdisciplinary Approach and Modern Regenerative Techniques

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### Abstract

The effective treatment of generalized periodontitis (GP) is among priorities in modern dentistry, knowing the fact of different proposed approaches and techniques. Also it is well known the connection and influence of GP on development of chronic diseases, that is very important point for health of citizens of every country. According to Biloklytska G. the effective treatment of GP is very actual for citizens of Ukraine, where statistics of disease prevalence shows very high percent of patients involvement. But even knowing this, our patients continue to loose periodontally involved teeth that lead to different consequences: esthetic, phonetic, articulation and occlusion problems, need for expensive prosthodontics. That is also often cannot be solved effectively because of timing and treatment cost in case of big reconstructive treatment. But growing tendency among our patients to treat and to leave natural tooth on place and not to extract it-enforce us to search for more favour and adapted to our patients expectations, treatment approaches, or to modify the classical methodics. Also the situation can be explained with existing situation in Ukraine where periodontology still is not recognized speciality in the country, this fact leads to such consequences as absence of precise postgraduate educational course and specialization, treatment of GP can be provided by each general dentist. Effective treatment of GP in Ukraine should be solved according to the provided and adopted treatment protocols, screening, development of dispensary system. In the review the proposed complex treatment approach will be showed and discussed in patients with moderate and severe GP, clinical occasion will be showed.

**Keywords:** *Periodontal disease, Moderate and Severe Periodontal Disease, Diode Laser, Flap Operation, Surgical Technique, Emdo-gain, Complex Treatment Approach of Generalized Periodontal Disease.*

### Introduction

It is well known that huge amount of experimental and clinical data were collected for last 50 years about etiology, pathogenesis and treatment of GP [1-8]. Also it is known that treatment of moderate and severe GP is more complicated, because of questionable prognosis of plural teeth and more complicated treatment in most of cases [5-7, 9-13].

But until know the tooth lost because of GP still takes first place among other reasons of tooth lost, especially this is actual for Ukraine, where the prevalence of GP is 92.6%, where the predominant affect of the disease occurs among working contingent of patients in age of 40 years (86%). From the other side, our patients show tendency with growing want to find practitioner, who will treat the disease maximally effectively, meaning will leave as more natural teeth, even instead of implant placement, if it's possible. And for today it can be

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also after establishment of principles of Minimally Invasive Surgery (MIS) according Harrel SK and Rees TD [4], Minimally Invasive Surgical Technique (MIST) and modifications according Cortellini P and Tonetti M [9,14] were developed. Hammaström L. [3] started with investigations with enamel matrix proteins and cementum development and regeneration; the scientific and clinical data were systematized by Sculean A., *et al.* [13]. Also great scientific and practical attention was paid on different lasers application for treatment of GP [17-19] and their role in support of periodontal regeneration [1,19-24].

It is well known that initial therapy usually involves instruction, reinforcement and evaluation of the patients plaque control as well as supra and subgingival scaling and root planning to remove microbial plaque and calculus [25]. An analysis of studies performed over the past 25 years on conventional scaling and root planning (SPR) showed that, on average pockets of 4 to 6 mm associated with moderate periodontitis could be reduced by 1, 19 mm, with gains in attachment of 0, 55 mm. In addition, pockets  $\geq 7$  mm associated with more severe periodontitis could be reduced on average by 2, 16 mm with gains in attachment of 1, 19 mm [1]. Adjuncts to SPR such as local and systemic antibiotic therapy, host modulation and laser therapy have been used with a wide range of results [1,2,21,25].

Cavitation effect that is created by the irrigation\cooling solution and oscillating tip of the device provides blood-free surgical area, as a result greater visibility for operator [26].

With regard to bone formation and healing, it has been showed that ultrasonication influences and enhances bone regeneration in experimental animal model [27]. As with different regenerative surgeries and other techniques for periodontal regeneration the effect of instruments that used for bone preparation, influence on structure of bone and viability of cells that are of great importance [26,28,29]. Also it was noted that bone surgeries applied with round on low-speed hand-piece, bur on high-speed hand-piece, spiral implant bur, safe scraper have certain details that are of great importance in case of providing regenerative periodontal surgeries [9,13,14, 26,29,30].

Moritz A *et al.* [18,31] determined presence of *A. actinomycetemcomitans* (A. a.) not only colonizing onto periodontally diseased root surface, but also invading adjacent soft tissues and that makes eradication more difficult when using only mechanical periodontal instruments. Because of this different lasers were developed aimed to provide deep cleaning of soft and hard periodontal tissues, promote periodontal regeneration [1,17-21,23,24,31-33]. Kreisler M *et al.* [24] demonstrated that proliferative activity of ligament fibroblasts was considerably higher after 890 nm wavelength diode laser irradiation. Moritz A., *et al.* [18,31] concluded that laser treatment following scaling and root planning had a bactericidal effect on A. a. and reduced inflammation. Coletan S [33] indicated about usage of diode lasers adjunct to periodontal surgery, leading to decrease of tissue inflammation level. Andreana S [34] concluded that laser should be used as an adjunct to conventional therapy both for its decontaminating and bio stimulating effects. Soft tissue lasers are good choice in bacterial reduction and coagulation [32].

Many studies showed increased coagulation, relatively dry surgical field and better visualization that is very useful during periodontal surgeries [33]. Laser increases tissue surface sterilization which reduces bacteremia and decreases swelling, edema and scarring, blocks the pain signals transmitted from injured parts of the body to the pain, increases the production and release of endorphins and enkephalins which are natural pain-relieving chemicals within our bodies [21]. Laser stimulation increases the energy available to these cells, causing them to absorb nutrients and expel waste products more rapidly [35]. Laser therapy reduces formation of scar tissue (fibrous tissue) following tissue damage related to cuts, burns and surgery. Influences on speeding up the healing process, improving the blood flow to the injured area, and more effectively carrying away waste products. Faster healing always leads to less scar tissue form [36].

During usage of Modified Widman Flap (MWF) it was concluded that during healing, some crestal bone resorption and osseous repair can be expected with establishment of a long junctional epithelium between the bone and the root surface [37]. Also one of the important

goals of the periodontal surgery is to eliminate or to remove the epithelium of the pocket using special surgical techniques, which allow a better connective tissue formation [38].

Ramfjord SP, *et al.* [8,39] evaluated the results of four different periodontal treatment techniques: pocket elimination or reduction surgery, MWF, subgingival curettage and SRP on pocket depth (PD) and attachment loss (AL). The authors concluded that the treatment of choice for periodontal pockets of  $\leq 6$  mm was SRP and for pockets  $\geq 7$  mm the results were similar for all the 4 methods. Histological findings presented in *in vitro* study by Romanos GE, *et al.* [38] using the pig model showed that instrumentation of the soft periodontal tissues (no flap surgery) with diode laser (980 nm) leads to a complete epithelial removal in comparison to conventional treatment methods with hand instruments in the pocket. The power setting used in the laser unit must be relatively low in order to eliminate the risk of collateral damage to the healthy underlying tissues [17,19,24,38]. The additional antibacterial effects of diode laser have a significant benefit in order to regenerate the destroyed periodontal tissues [31]. Epithelial removal using the diode (980 nm) laser (with the additional instrumentation of the root surface using conventional techniques) may be of significant clinical importance [38].

The proper laser application allows not only adequate rate of coagulation [13,40,41], but also does not damage the surrounding healthy tissues and may stimulate new bone formation.

Enamel matrix proteins [3,13,42], bone grafting materials and membranes [13,43] have been clinically used with different success rates as presented in different papers.

From the biological point of view, the periodontal barriers of the epithelium are able to enhance the connective tissue attachment [3,9,13,14,38,42].

In the periodontal wound, special macromolecules of the fibrin clot may initiate these mechanisms for further periodontal regeneration [13,44]. Growth factors and cytokines present in the fibrin clot signal the start of the wound repair process. Instrumentation of the root surface as well as the removal of the inflamed connective tissue and the pocket epithelium, using surgical techniques it is possible which allows a maturation of the healthy tissue matrix contraction or soft tissue scarring [44,38,13].

The proper timing and combination of different techniques can be very useful having patients with moderate and severe GP that also can permit to reduce the volume of operation and postoperative consequences for patients. The staged continued non-surgical tissue preparation may promote reduction of soft tissue inflammation and bacteriemia that can also influence on regeneration promotion and less medication in postsurgical period.

### Materials and Methods

The 30 patients were taken for treatment with chronic moderate and severe GP (PD 5-12 mm, intra-bony containing defects involving 1-3 sides of the root, with inter dental spaces  $> 2$  mm), who were undertaken only into symptomatic treatment in different municipal polyclinics, without any previous surgical procedures on periodontal tissues, except of emergency procedures (Table 1). Multiple tremas and diastemas were in 100% of occasions, as consequence of fan-shaped movement of involved teeth, teeth mobility 1, 2, 3 stages. Patients were divided into 2 main groups according to provided pre-surgical and surgical treatment stages (Table 2). In the main group the surgical phase was provided according principles of MIS (Minimally Invasive Surgery) established by Harrel SK and Rees TD [4] and MIST (Minimally Invasive Surgical Technique) established by Cortellini P and Tonetti M [9,14] with usage of enamel matrix proteins (EMD) and proposed suturing technique. In the control group during surgical stage Modified Widman flap [7,8] operation was provided according standard demands. The treatment plan was discussed and established for each group of patients. Adjacent dental practitioners were including into main treatment plan formation. All treatment stages according to interdisciplinary cooperation principle were provided in Dental Medical Practical Scientific Centre (Kyiv, Ukraine) (Scheme 1).

## Optimization of Treatment Approach in Patients with Moderate and Severe Generalized Periodontitis Using Interdisciplinary Approach and Modern Regenerative Techniques

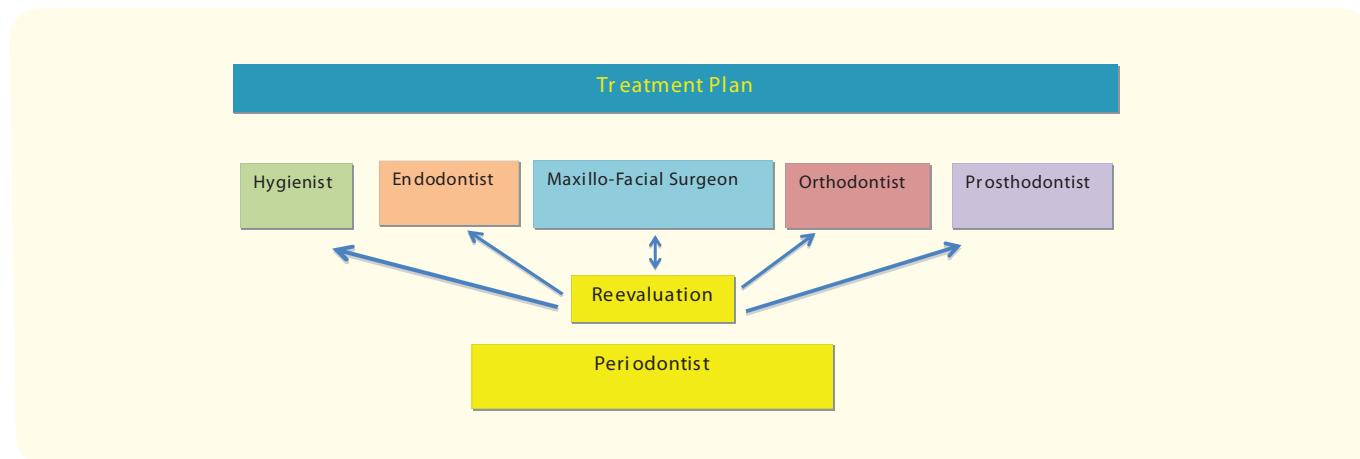
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Provided Treatment						
Patients	Symptomatic					
30	Scaling root planing 1-2 times per year, current age Without reevaluation	Injections of antibiotics and other medicines into mucogingival fold	Irrigations of PP with antiseptics (CHX, H <sub>2</sub> O <sub>2</sub> , metronidazolium, betadine)	Gingival applications with different topical medicines in form of gels, unctions	General antibiotic therapy (5-7 usually)	Staged extraction of mobile teeth

**Table 1:** Distribution of the patients according to provided previous symptomatic treatment in other instances before main treatment.

Group of Patients	Details of Surgical Phase			
	Surgical Approach	Root and bone pockets debridement	Curettage methodic	Deepitalization Methodic
Main (15 Patients)	MIST + Emdogain (Straumann) + autogenous bone+ Modified suturing technique	Ultrasonication	Diode laser	
Control (15 Patients)	Modified Widman flap operation		Hand Currets	

**Table 2:** Distribution of patients according to applied surgical phase details.



During hygienic phase the following periodontal indexes were assessed: (PI) Plaque index, (BOP) Bleeding on Probing Index, (PMA) Schour & Massler, (PD) Pocket Depth, (CAL) Clinical attachment loss and (RP) residual pockets, type of exudate from periodontal pockets (PP), tooth mobility (TM).

The pre-surgical tissue preparation was provided after hygienic and therapeutic (endodontic) phases. The hygienist was permitted to work only supra-gingivally, providing scaling ("Cavitron Select SPS", Dentsply) and superficial root planning (not deeper than 3 mm sub-gingivally into PP), polishing (pastes, air-flow devices). The precise and accurate cleaning in area of the interdental spaces was applied. The results are presented in (Table 3).

Group of Patients	Treatment Phase	Primary Assessment	Procedure Stages: I Procedure	Interval (days)	Reevaluation
Main Group	Hygienist Phase	PI = 50% BOP = 60% PMA = 50% PD = 5-12 mm TM 1-2 stage Exudate - serous with presence of pus not less than in 3 PP per sextant. Presence of periodontal abscess with involvement of 2-3 teeth.	Motivation	7 days	PI = 40% BOP = 50% PMA = 40% PD = 5-12 mm TM 1-2 stage 6) Exudate – serous with presence of pus in 1-2 deepest pockets per sextant
Control Group			Oral hygiene instructions: Bass technique and interdental brushes. Irrigations with CHX (0,05%), 3% H <sub>2</sub> O <sub>2</sub> applications. Metronidazole “Metrogil-Denta” (Unique)-in case of occurrence periodontal abscess.		
			Supragingival scaling and root planning		
			Supragingival polishing of tooth surfaces, correction of restorations		

**Table 3:** The hygienic phase and periodontal indexes value in groups of patients.

The pre-surgical observation of patients included staged index assessment of PI, BOP, PD, PMA, CAL, type of exudate, tooth mobility stage. During surgical stage, the flap operations were applied in area of incisors, premolars and molars of upper and lower jaws, the main surgical operations were carried on per sextants, maximally 6 teeth per one operation. The tissues preparation before flap operation was staged and was provided under dynamic evaluation of main periodontal indexes on each stage.

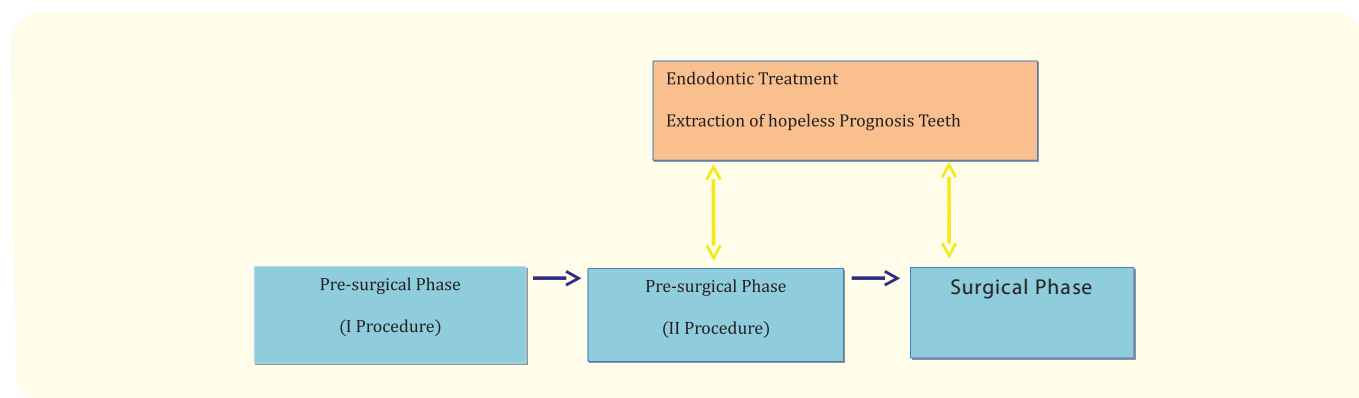
The pre-operation tissue preparation was applied in main group and included pre-surgical phase (Table 4) with combination of simultaneous diode laser “Granum” curettage under local anaesthesia. The pre-surgical phase was staged and included: supra-gingival and sub-gingival scaling and root planning with usage of ultrasonication (“Cavitron Select SPS”, Dentsply) in combination with simultaneous diode laser curettage (“Granum”, wave length - 980 nm, 2.0 watts, continuous regimen, exposition time per each PP was 3-5 sec per PP, depth of tip insertion 2 mm) under local anaesthesia. The usage of hand instruments on soft gingival tissues was excluded. In case of presence of large granulation tissue portions, they were removed with hand currents “Hu-Friedy” after complete coagulation, without cutting of gingival tissues. In case of hardly reachable PP areas, after provided irradiation, the usage of hand instruments was excluded also to protect interdental tissues and marginal gingival edge injuries.

The pre-surgical phase procedures in main group was repeated 2 times with interval of 7 days (I and II pre-surgical procedures) in aim to provide and assess periodontal tissues inflammation reduction before surgical phase. Laser irradiation during curettage aimed to reduce amount of residual granulation tissue and epithelial overgrowth into PP, to provide additional bactericidal, biostimulative effects on soft gingival tissues. During provided stage, tissues were irrigated by “Decasanum” 0.02% and “Betadine” 10%. After each pre-surgical phase 0.05% Chlorhexidine (CHX) irrigations and applications with 3% Hydrogen Peroxide (H<sub>2</sub>O<sub>2</sub>) were prescribed for 3 times per day during 2 weeks. The hygienic habits control and patient’s skills were realized every 7 days during visits. The criteria for over-passing to surgical stage were periodontal indexes value reduction assessed by periodontist (Table 4).

## Optimization of Treatment Approach in Patients with Moderate and Severe Generalized Periodontitis Using Interdisciplinary Approach and Modern Regenerative Techniques

Treatment Phase/Group	Primary Assessment	Procedure Stages	Interval (days)	Reevaluation	Next Treatment Phase
Pre-surgical phase I procedure\ <b>Main group</b>  Initial therapy\ <b>Control group</b>	1) PI = 40% 2) BOP = 50% 3) PMA = 40% 4) PD = 5-12 mm 5) TM 1-2 stage 6) Exudate-serous with presence of pus in 1-2 deepest pockets per sextant	Motivation, hygienic habits control	7 days	1)PI = 30% 2)BOP = 32% 3)PMA = 30% 4)PD = 5-12 mm 5)TM 1-2 stage 6) Exudate-serous in all PP	Endodontic Phase Temporary splinting  Pre-surgical phase II procedure
		Scaling and root planning with ultrasonic device		1)PI = 30% 2)BOP = 35% 3)PMA = 35% 4)PD = 5-12 mm 5)TM 1-2 stage 6) Exudate-serous in all PP	
		Diode laser irradiation for current age			
		0,05% CHX, 3% H <sub>2</sub> O <sub>2</sub>			
Pre- surgical phase II procedure <b>Main group</b>	PI = 30% BOP = 32% PMA= 30% PD = 5-10 mm TM 1-2 stage Exudate-serous with presence of pus in 1-2 deepest pockets per sextant	Motivation, hygienic habits control	7 days	PI = 18% BOP = 20% PMA = 25% PD = 5-10 mm TM 1-2 stage Exudate – serous in all PP	Surgical phase
		Scaling and root planning with ultrasonic device			
		Diode laser irradiation for current age			
		0, 05% CHX, 3% H <sub>2</sub> O <sub>2</sub>		PI = 30% BOP = 35% PMA = 35% PD = 5-12 mm TM 1-2 stage Exudate-serous in all PP	

**Table 4:** The pre-surgical I and II phases details and periodontal indexes value.



## Optimization of Treatment Approach in Patients with Moderate and Severe Generalized Periodontitis Using Interdisciplinary Approach and Modern Regenerative Techniques

Treatment Phase	Group	
	Main (15 patients)	Control (15 patients)
<b>1. Hygienic</b>	Hygienic indexes assessment. Supragingival scaling and root planning with Ultrasonication and hand instruments; hygienic recommendations; hygienic habits control. Hygienic indexes evaluation.	
<i>Endodontic treatment, extraction of hopeless prognosis teeth</i>	In cases of emergency	+
7 days		
<i>Reevaluation</i>	Hygienic indexes assessment. Hygienic habits control. Recommendations.	
<b>2. Pre-surgical (I procedure)</b>	Periodontal indexes assessment. Subgingival scaling and root planning with ultrasonic device. Simultaneous diode laser curettage. Occlusion check-up to avoid traumatic contacts.	-
<i>Endodontic treatment, extraction of hopeless prognosis teeth</i>	Endodontic treatment of endo-perio, perio-endo lesions, endodontic treatment due to prosthodontic indications.	-
7 days		
<b>3. Pre-surgical (II procedure)</b>	Periodontal indexes assessment. Subgingival scaling and root planning with ultrasonic device. Simultaneous diode laser curettage. Occlusion check-up to avoid traumatic contacts.	-
7 days		
<i>Reevaluation</i>	Periodontal indexes reevaluation. Traumatic occlusion check-up. In case of insufficient inflammation reduction, repeat pre-surgical procedures. Reevaluation.	-
<b>4. Temporary splinting</b>	Orthodontic buttons, elastic chain for splinting with slight tension. Occlusion check-up.	Flowable composite into interdental spaces to provide temporary immobilization for surgery.
<i>Time for procedure application</i>	Temporary splinting according proposed technique can be provided after I pre-surgical stage. If the reduction of main indexes after initial therapy doesn't satisfies, it can be provided after II pre-surgical stage or directly before surgical stage.	Directly before surgical stage
7-21 days		
<i>Reevaluation</i>	Periodontal indexes reevaluation. Occlusion check-up. Temporary splinting correction. Traumatic occlusion check-up.	-
<b>5. Surgical stage</b>	MIST, interdental papilla preservation technique. Main surgical stages and postsurgical carriage according proposed approach. Implant placement, excluding immediate loading.	Periodontal indexes assessment after hygienic phase only. Modified Widman Flap, standard surgical and postsurgical prescriptions. Implant placement.
<i>Suturing technique</i>	According MIST approach with proposed technique modification	Interrupted sutures
<i>Sutures removal (days)</i>	14 days	7 days

<i>General and local therapy in post-surgical period</i>		Antibiotics: Amoxycillin 625mg X 1 Tab. 2 times per day 7 days.
	Analgetics: Nimesulide 100mg X 1 powder 2 times per day during 3 days. Antiedemous: Loratadine 0,01gr X 1 Tab. 1 time per day 5 days. Irrigations: CHX 0, 05% X2-3 times per day during 3 weeks. General hygienic recommendations.	
<b>6. Permanent splinting</b>	Usage of fiberglass baulks, cords for strong permanent splinting. To provide maximal closure of tremas and diastems before permanent splinting procedure, maximally correct and adapt occlusion. To start with splinting procedure not earlier than 14 days -1 month postoperatively.	The splinting was provided after suture removal -7-10 days postoperatively.
<b>7. Maintenance</b>	Reevaluation during each check-up	
<i>in early post-operative period</i>	Supra-gingival scaling and root planning with ultrasonic device on 5 <sup>th</sup> , 10 <sup>th</sup> , 14 <sup>th</sup> day post-operatively. Hygienic recommendations.	After suture removal, usage of ultrasonic device and hand instruments. Hygienic recommendations.
<i>in deferred post-operative period</i>	Supra-gingival scaling and root planning with ultrasonic device after 1, 3, 6 months post-operatively. To repeat scaling and root planning every 3-4 months after reconstructive treatment. Hygienic recommendations. Inter dental brushing.	Scaling and root planning every 6 months, usage of ultrasonic device and hand instruments. Hygienic recommendations. Interdental brushing.
<i>Reevaluation</i>	After 6,9,12 months postoperatively. Occlusion checks –up. Hygienic recommendations.	
<b>8.Prosthetic reconstruction</b>	After reevaluation	
<i>temporary reconstruction</i>	Temporary splinting bridges for 4-6 months after operation, supragingival position of crowns edge. Temporary removable prosthesis to complete functional occlusion. Hygienic recommendations.	Temporary splinting bridges for 2-3 months after operation, supragingival position of crowns edge. Temporary removable prosthesis to complete functional occlusion. Hygienic recommendations.
<i>Permanent Prosthetic Construction</i>	Splinting non-removable constructions after 3-6 months post-operatively, adequate margin edge selection: feather, chamfer, shoulder. Non-removable prosthetic constructions preferable, implants. In case of removable constructions – clasp prosthesis preferable. Hygienic recommendations.	Splinting non-removable constructions after 2-3 months post-operatively, adequate margin edge selection: feather, chamfer, shoulder. Non-removable prosthetic constructions preferable, implants. In case of removable constructions – clasp prosthesis preferable. Hygienic recommendations
<i>Maintenance</i>		
<i>After Reconstructive Phase</i>	Scaling and root planning with ultrasonic device every 3-4 months after reconstructive treatment. Occlusion check-up. Hygienic recommendations including proper inter dental brushing, usage of electric toothbrush.	Scaling and root planning every 6 months, usage of ultrasonic device and hand instruments. Occlusion check-up. Hygienic recommendations including proper inter dental brushing and usage of electric toothbrush.

**Table 5:** Distribution of the patients into main groups depending on scheme of provided treatment stages.

Oral hygienic and endodontic procedures were applied properly. Traumatic occlusion check-up was provided during every control visit to periodontist. Temporary splinting (TS) was performed in patients of main group and included: fixation of orthodontic buttons on every tooth and ligation with elastic orthodontic chain (with different step length depending on distance in between teeth) with slight tension. TS could be applied directly after hygienic phase or after endodontic treatment, the over passing to next treatment



stages was realized after ligation of mobile teeth. All mentioned pre-surgical preparation procedures were provided previous to surgical and reconstructive prosthodontic phases in patients of main group. In patients of main group all the stages were applied according presented data from Table 6. All patients included into treatment of GP were non-smokers and were generally healthy.

Depending on type of applied surgical procedures, patients were divided into two groups: Group I - basic (15 patients). The flap operation was provided according principles of MIS (Minimally Invasive Surgery) established by Harrel SK and Rees TD [4] and MIST which is established by Cortellini P and Tonetti M [14] with modifications for saving of the interdental papillae [9]. The flap elevation was provided only buccal for deep pockets access, excluding elevation palatally and lingually, preventing additional flap trauma regarding vascular breakage, edema and wound enlargement. All the periodontal tissues were preserved in aim to provide primary wound stability after surgery and recontamination.

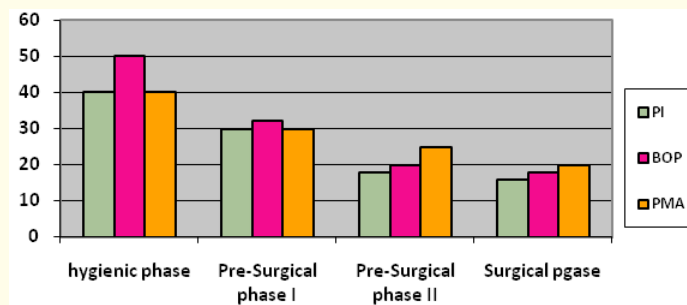
The full-thickness vestibular flap (FTVF) was formed and mobilized in aim to provide sufficient access into deep bone pockets (BP). Lingual and palatal flaps weren't performed to exclude additional tissue exposition and trauma, supply sufficient blood clot fixation, primary wound closure in interdental space (IS) and prevent postsurgical tissue recession. After flap preparation the simultaneous ultrasonication of roots, BP and of mobilized flap ("Cavitron Select SPS", Dentsply) was performed. The criteria of sufficient ultrasonication were visibly cleaned and smooth root surfaces and dehematized soft granulations in BP and on FTVF. The usage of hand currents on hard tooth surfaces and flap were excluded. All visible granulation tissue (GT) in BP, on gingival margins including formed FTVF and IS, were coagulated with help of diode laser "Granum" (980-nm, 2 watts, continuous regimen, 2-3 sec point wisely into each GT portion). Only big portions of coagulated tissues were removed accurately with hand currents (Hu-Friedy) or forceps. The processed tissues were irrigated by "Decasanum" 0.02%. After ultrasonication and sufficient degranulation of bone in BP, the grid-like compactosteotomy and osteotomy were applied in area of BP and adjacent bone with small round-shaped surgical burr (d-2 mm) and thin cone-shaped surgical burr, depth of drilling penetration was 2 mm. The grid-like compactosteotomy in area of adjacent bone was applied accurately to avoid root trauma. After grid-like compactosteotomy, the autogenous bone was collected properly and saved in small portion of 0, 9% NaCl until usage. The ultrasonication ("Cavitron SPS", Dentsply) of produced round - shaped bone perforations in area of BP and adjacent bone (3 sec ultrasound exposition per each bone perforation) was provided. The flap deepithelization was provided with help of diode laser "Granum" irradiation (980 nm, 2 watts, continuous regimen), the length of coagulation on flap was not less than 2 mm from vestibular, palatal or lingual sides. During this stage in main group, the hand currents were excluded for flap deepithelization. After all applied stages tissues were irrigated by 0, 9% NaCl and were softly dried. The root surfaces were free from blood, the level of hemostasis was sufficient to continue work with tissues without bleeding. BP and root surfaces were filled with "Emdogain" (Straumann). Than BP were filled with autogenous bone precisely to prevent contamination of adjacent root surfaces with blood. The flap was adopted to permit coronal reposition, wound was sutured with single modified horizontal suture, the proximal ends of thread were fixed on orthodontic buttons with knots (one proximal end on each button fixed with one knot) to provide additional coronal repositioning of the flap (2-3 mm additionally to cover CEJ) and stabilize primary fixation of the reached flap reposition.

In control group the presurgical stage was absent. The overpass to surgical phase was provided after hygienic and therapeutic stages. During surgical stage flap operation was provided according Modified Widman flap technique. For root planning, deepithelization hand currents (Hu-Friedy) were used.

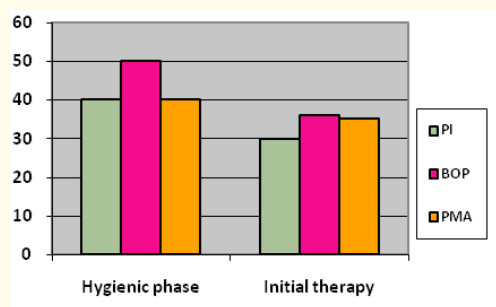
### Results

The estimation and comparison of the main periodontal indexes values during hygienic and repeated pre-surgical phases in main and control groups revealed that dynamic reduction of the main indexes (PI, BOP, PMA) was detected mainly in main group (Figure 1). The repeated staged tissue preparation using ultrasonication and diode laser irradiation may be beneficial for deep anti-inflammatory and bactericidal effects in soft periodontal tissues. Repeated coagulation of soft granulation tissue in PP (2 mm depth of laser tip

insertion) during pre-surgical stage in main group) with help of diode laser (980 nm, 2 Watts, continued regimen), reduces soft-tissue inflammation, enhances healing, reduces pain, improves soft tissue contour and elasticity, doesn't need special operators training. Because of biostimulative effects of laser irradiation, it was detected that interval of 7 days between procedures may be enough for supplying tissue regeneration afterwards and index reduction. The reduction of index scores in main and control groups of patients is demonstrated in Figure 1, 2. Also it is important to mention that patients from control group passed over surgical phase with slightly reduced scores of periodontal indexes, where PI-30%, BOP-35%, PMA-35% in comparison with main group: PI-18%, BOP-20%, PMA-25%. This also can be explained by importance the goal of all pre-surgical procedures - to reach the rates of PI and BOP index below 20%. The PD was reduced on up to 2 mm in main group after 14 days from the beginning of the pre-surgical stage of patients at the end of pre-surgical stage that can be connected with additional edema reduction in soft periodontal tissues due to diode laser irradiation. Also according to index rates in control group of patients, it is possible to conclude that patients over passed to surgical phase with insufficient soft tissue inflammation reduction in soft periodontal tissues. This may influence on post-operative results, operating time, complications, healing and regenerative process that are crucial for patients with moderate and severe GP.



**Figure 1:** The dynamic index reduction in main group during staged pre-surgical stages.



**Figure 2:** The dynamic index reduction in control group before surgical stage.

Also it was detected the influence of provided preparation procedures on level of patients motivation and participation in treatment process. It is possible to conclude that the result after first treatment procedure (initial therapy or pre-surgical stage) with periodontologist plays crucial role for future cooperation and motivation of the patient. During treatment of the patients from both groups it was investigated the main influencing factors on patients motivation and cooperation in treatment process (Figure 3).

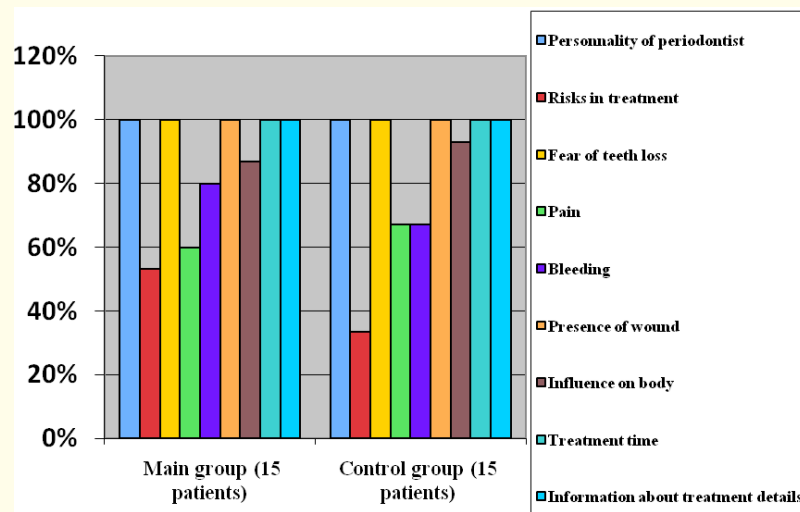


Figure 3: The influencing factors on level of patient's motivation during pre-surgical tissue preparation.

The data shows that the most important influencing factors on pre-surgical stage of periodontal treatment are: personality of periodontist, fear of teeth loss, presence of wound, treatment time, and information about treatment details. These data permit us to conclude that our patients expect for well qualified specialist that will develop treatment plan with less teeth loss, injury, less prolonged healing time and accelerate restorative phase. Patients are ready to accept all treatment risks and any temporary discomfort connected with general influence on body during treatment, bear appearance of bleeding, pain in aim to save as many teeth.

After surgical phase of treatment in both groups the details of postsurgical period were estimated. The pain reaction in main group of patients after flap surgery continued only during 1-3 days and had slight character in most of the cases. In control group the pain reaction was more prolonged and continued during 5-7 days postoperatively. Such results can be explained with important role of staged pre-surgical phase due to occurrence of biostimulative effects of laser irradiation, more spared and accurate surgical technique due to soft tissue components saving (interdental papillae, avoid hand currets usage for flap deepithelization, precise PP and bone ultrasonication for regeneration stimulation, grid-like compactosteotomy and osteotomy avoiding mechanical bone re-contouring of PP using drilling with burs). Usage of EMD during flap operation may have additional benefits enhancing healing process of soft and hard periodontal tissues enhancing biological ways of tissue regeneration. Less wound exposition due to reduction of operation time promotes shortening of postoperative complications and supports regeneration. Also it is important to notice that all patients from main group didn't take any antibiotics in comparison with control group where general antibiotic therapy with Amoxycillin and Metronidazolom were applied. In 100% of patients from main group any postsurgical complications or complaints were determined. 60% of patients from control group had complaints on stomach and intestinal upset, 40% - vomiting, 80% - diarrhea symptoms during having antibiotic therapy. But most of these symptoms we cannot connect with consequences of antibiotic therapy, most of them are probable complications that can appear during treatment with Amoxycillin and are permitted due to activity of its components. Deep ultrasonication of periodontal tissues in combination with diode laser irradiation may provide deep bactericidal and biostimulative effects that can be interrupted by antibiotics.

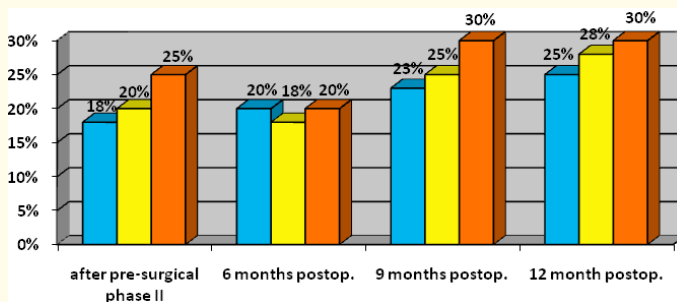
The PD and attachment gain scores and their comparison in groups are presented in Table. 6.

Group	Initial PD	PD in Post-Operation Period			Attachment Gain		
		6 months	9 months	12 months	6 months	9 months	12 months
Main	5-12 mm	4-10 mm	3-8 mm	3-7 mm	1,0 mm	1,5 mm	1,5-2 mm
		4-10 mm	4-10 mm	4-8 mm	0,3-0,5 mm	0,5 mm	1,0 mm

**Table 6:** The comparison of PD and attachment gain scores in groups postoperatively.

These data shows that in main group of patient’s reduction of PD continued from 6 till 12 months postoperatively and compounded in the middle 2-3 mm, clinical attachment gains were 1-2 mm. The dynamic reduction of PD in main group was seen from 6-9<sup>th</sup> months postoperatively in comparison with control group on 9-12<sup>th</sup> month and had slight reduction rate of 2 mm. The attachment gain was 03,-1 mm postoperatively. These data may indicate the importance of surgical methodic selection in case of moderate or severe GP, details of post-operative period maintenance, appropriate terms for reconstructive phase and final tissue maturation. Less successful results in control group can be connected with healing of periodontal tissues due to long junctional epithelium during usage of MWF technique.

The data about periodontal indexes values in main group in post-operative period is presented in Figure 4.



**Figure 4:** The periodontal indexes values in main group post-surgically.

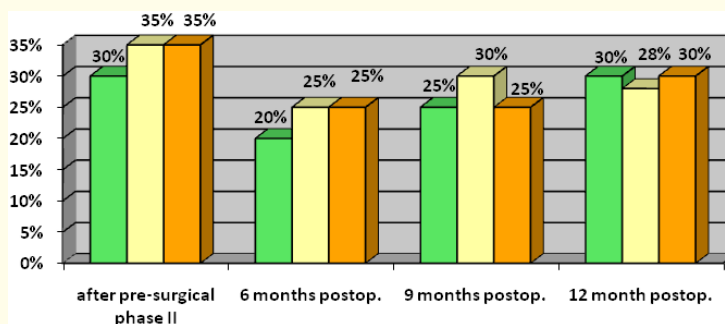
These data remains that the main indexes values in main group were improved during first 6 month post-operatively and these results were stabile from 6-12 months post-operatively. There was slight index values increase detected from 6<sup>th</sup> to 12<sup>th</sup> months that can be connected with presence of permanent prosthetic constructions that are also demand high hygienic level, especially in case of patients with severe or moderate periodontal disease.

The data about periodontal indexes values in control group in post-operative period is presented in Figure 5.

Presented data shows that the main decrease of index values was achieved 6 months post-operatively and consistent increase of index values started to appear from 6<sup>th</sup> till 12<sup>th</sup> month post-operatively. These results may be explained due to details of regeneration after MWF technique and terms of permanent prosthetic reconstruction phase that may influence final tissue maturation and hygiene level.

The permanent prosthetic constructions including bridges were made to patients according to the group division after reevaluation of periodontal status by periodontist: in main group - not earlier than 4-6 months post-operatively; in control group - after 3 months post-operatively. The early prosthetic terms selection in control group can be explained by general terms of soft tissue maturation after operation (about 2 months). But according our preliminary observations, terms of prosthetic reconstruction in cases of moderate and

severe GP play crucial role that can be explained by such points: non-removable prosthetic construction is among priorities and plays role of reinforced splinting construction for mobile teeth in case of moderate and severe bone resorption; splinting of involved into GP teeth may be beneficial promoting staged tissue regeneration due to physiologic functioning; proper selection of prosthetic time may enhance further additional periodontal tissues regeneration due to function; more prolonged temporary wearing of temporary constructions may additionally train and adopt involved teeth into function, reducing their mobility due to traumatic occlusion reduction. Also in case of questionable prognosis for group of teeth it is possible to check up the future prognosis after loading.



**Figure 5:** The periodontal indexes values in control group post-surgically.

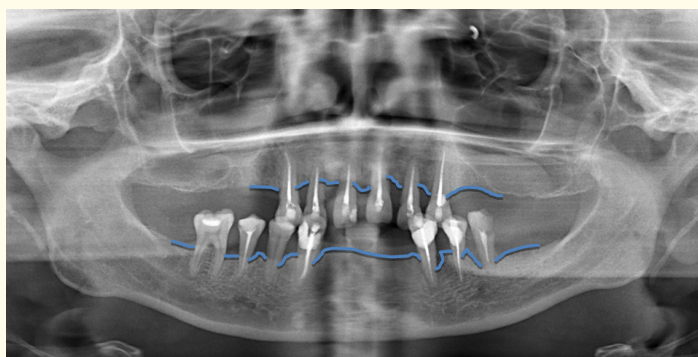
The criteria to overpass to permanent prosthetic construction in main group were: complete tissues healing and maturation after surgical phase, mobility reduction (0-1 stage), stability of main periodontal indexes values during first months post-operatively, fixed functional occlusion excluding traumatic contacts, sufficient hygienic level provided by motivated patient, absence of edema, bleeding on probing, stabile marginal gingival contour. The comparison between prosthetic treatment approaches presented in Table 6.

Prosthetic Phase		
Timing post-operatively	5-6 month	3 month
Index values according noted time post-operatively.	PI-20% BOP-18% PMA-20%	PI-25% BOP-less 35% PMA-30%
Teeth mobility	0-1	1-2
Marginal gingival contour formation, final relief.	+	?
Amount of teeth with questionable prognosis included into prosthetic construction.	Reduced amount, due to mobility reduction, tissue maturation, regeneration time.	The same as at the beginning, short time for regeneration.
Functional occlusion adaptation.	+	? In case of teeth mobility existence more time is needable.
Hygienic habits, patients motivation.	+	? May be reduced due to continued teeth mobility and quick prosthetic reconstruction and less attention to hygienic habits training

**Table 7:** Prosthetic phase of treatment, comparison between groups.

### Conclusions

Treatment of patients with moderate and severe GP is one of the most complicated and prolonged in time, needs high qualification not only from periodontist but from all working team of dentists who participate in rehabilitation of such patients. The significant inflammatory reaction reduction can be achieved during staged pre-surgical stage that can be included into treatment plan. This can be beneficial because initial periodontal tissues condition before surgical stage. It plays crucial role in healing process that is important in case of moderate and severe GP, occurrence of plural teeth with questionable prognosis that can be useful in prosthetic phase from the other side. Usage of diode laser irradiation in combination with ultrasonication may influence positively on soft tissue healing due to all known characteristics. Using grid-like compactosteotomy, osteotomy in area of PP and adjacent bone, ultrasonication, filling of PP with EMD and autogenous bone may be beneficial for bone regeneration, avoiding all complications connected with usage of other materials for regeneration. The demonstrated suturing technique provides healing with primary intension, protects exposed periodontal tissues due to maximal coronal reposition and sufficient fixation (14 days), promoting primary stabilization of the wound and conditions for it's cleaning. According to our preliminary observations, it is need able to conclude that periodontal tissues, in case of moderate and severe GP, need more prolonged time for deep reconstruction and regeneration to supply future occlusional functioning. More prolonged temporary prosthetic reconstruction wearing (for 4-6 months) may adopt and train periodontal tissues for future firm prosthetic constructions, can permit to the patient to take care properly of hygienic level and motivation. Using all proposed treatment stages properly (keeping up all the terms) due to interdisciplinary treatment approach, makes possible to save more natural teeth, reduce usage of many medications (antibiotics, high percentage of used irrigational solutions), avoid different post-surgical complications, permit physiological healing course. Long term GP stabilization can guarantee future long-term functioning of involved natural teeth that are 'golden standard'. This can additionally motivate our patient to take care of his health, plan future treatment with implants avoiding totally presence of chronic infection locuses and prevent other possible general health complications that are essential. Proper maintenance of GP may prevent teeth loss in middle-age working citizens, which is important for their lifestyle and psychologic condition, workability.



**Picture 1:** Patient G.E. 40 year old moderate GP, chronic course. Treatment planning according proposed methodic (main group). Bone level before treatment.



**Picture 2:** Temporary splinting with orthodontic buttons before pre-surgical stages and temporary prosthodontic constructions. Teeth are splinted to avoid fan-like divergent, prevent enlargement of tremas and diastema, roots movement.



**Picture 3:** Due to temporary splinting the access to PP is comfortable, this permits additional blood clot fixation after staged pre-surgical phases, teeth stability avoids additional traumatic occlusion trauma of periodontium.



4

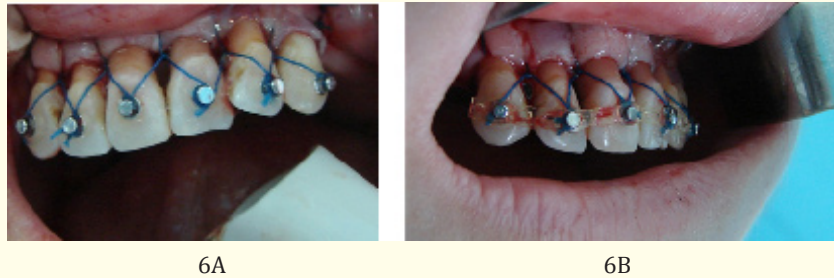


5A



5B

**Picture 4. 5a. 5b:** Due to temporary splinting the access to PP is comfortable, this permits additional blood clot fixation after staged pre-surgical phases, teeth stability avoids additional traumatic occlusion trauma of periodontium.



6A

6B

**Picture 6a. 6b:** Suturing technique. Vestibular flap coronally repositioned, additionally fixed on orthodontic buttons to permit additional reposition and primary wound stability. Sutures fixed by elastic chain on buttons for 14 days.



7A

7B

7C

**Picture 7a. 7b. 7c:** Condition of the tissues after 14 days of healing. Fan-like divergence of the teeth and roots avoided.



8A

8B

**Picture 8a. 8b:** Surgical phase of treatment on lower jaw. Depth of PP, before surgery (Picture. 8.1). Tissue condition after 14 days of healing (Picture. 8.2).



9A

9B

**Picture 9a. 9b:** Soft tissue condition during preparation to temporary prosthetic constructions on upper jaw.





**Picture 10:** Soft tissue condition during preparation to temporary prosthetic constructions on lower jaw.



**Picture 11:** Temporary prosthetic constructions, occlusional contacts, adaptation of functional occlusion.

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Demonstration of clinical case in patient with moderate generalized periodontitis of 40 year old that was treated according to proposed methodic.

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