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## **CLINICAL EVALUATION OF THE FIBER MATRIX APPLICATION EFFECTIVENESS DURING THE GUIDED BONE REGENERATION OF PERIODONTAL INTRAOSSEOUS JAW DEFECTS**

**Abstract.** *Modifications of the surgical manipulation algorithms aimed at providing the mechanism of periodontal regeneration requires detailed study in the course of clinical research and appropriate examination on sufficient clinical samples of patients under conditions of direct and remote monitoring of relevant criteria changes for assessing the success of the treatment. Objective was to determine the level of efficacy and substantiate the reasonability of application of fibrous matrix of polylactic acid foams as an alternative approach to target bone regeneration in the process of reconstruction of the intraosseous periodontal defects of the jaws. The total study involves 56 patients with diagnosed intraosseous jaw defects associated with the pathology of marginal periodontitis, and without available contraindications for the procedure of target bone regeneration. Treatment of intraosseous periodontal defects among the patients of the experimental group was performed by filling the prevailing defect volume by the developed fibrous matrix followed by overlapping it with the minimum portion of bone graft (CeraBone, Botiss) and polymeric membrane (KLS Martin), modified individually according to the defect configuration by thermosetting compression method. During evaluation of bone defect volume reduction after 12 months of surgery using the data of Cone-beam Computed Tomography and the graphic principle of super-imposition, it was found that in the experimental group bone defect volume decreased by  $31,19 \pm 4,07$  standard units (from  $62,56 \pm 4,25$  to  $31,37 \pm 4,18$  standard units), and in the comparison group by  $29,18 \pm 1,39$  standard units (from  $59,74 \pm 3,91$  to  $30,56 \pm 2,2$  standard units). The computer analysis of the treatment of periodontal defects with the use of fibrous matrix and xenografts enables us to recommend the use of fibrous polylactic acid foams matrix as a modification of the classical approach of target bone regeneration during rehabilitation of patients with periodontal lesions.*  
**Key words:** *periodontal surgery, regeneration, jaw defects, treatment.*

**Introduction.** The task of periodontal therapy is realization of the primary and secondary prevention of periodontal diseases by means of controlling the factors of infection and inflammation, maintenance and improvement of the condition and function of the gums, periodontal ligament, cement of the root and surrounding alveolar bone, which all together form the structure of the dental periodontium [1, 2, 3, 4]. Success of periodontal surgery depends on a number of local and patient-associated factors. It can be achieved only in case of complete elimination of an infectious focus and providing appropriate conditions for the following regeneration of the periodontal tissue [1, 2, 4].

Results of systematic examination conducted by Kao R.T. et al. (2015) determined that application of different biologically active agents with the purpose to improve the protocols of treatment of periodontal defects are characterized by the effect of the similar procedure to perform intraosseous damages by

means of allografts or manipulation of target tissue regeneration [5]. At the same time all the above approaches provide achievement of better results of treatment in comparison with performing mechanical cleaning of the area of a defect only.

Although, even in spite of such conclusions of a systematic examination and considering variability of the existing surgical approaches to treatment of periodontal defects, while choosing the method of surgery and appropriate materials a doctor should consider effect of a number of local and general factors with the aim to predict success of surgery [2, 6]. Modification of the algorithms of surgical manipulations with the purpose to provide the mechanisms of periodontal regeneration require a detailed examination in the course of clinical studies and appropriate checking on sufficient clinical sampling of patients under conditions of a direct and remote monitoring by the changes of appropriate criteria of assessment of the

conducted treatment success.

**Objective:** to determine the level of efficacy and substantiate the reasonability of application of fibrous matrix of polylactic acid foams as an alternative approach to a target bone regeneration in the process of reconstruction of the intraosseous periodontal defects of the jaws.

**Materials and methods.** With the aim to realize a stated objective the process of investigation was divided into two interrelated stages. At the first stage the search and systematization of data were performed concerning the results of treatment of intraosseous periodontal defects of the jaws using various surgical algorithms and osseous agents of different origin in order to fill intraosseous lesions. Google Scholar (<https://scholar.google.com.ua/>) was used as the main search system, providing the process of search by the main key words. The publications selected for further work were processed by means of content-analysis method with formulation of appropriate categories of the study.

The second stage of the study expected treatment of intraosseous defects of the jaws among periodontal patients at the clinical base of Ivano-Frankivsk National Medical University applying two different surgical approaches. According to their peculiarity the group of comparison and the group of control were formed.

Formation of the generally examined number of patients included consideration of a number of clinical factors used as inclusion criteria: 1) periodontitis at the remission stage without pronounced inflammatory changes on the moment of performing surgery; 2) availability of three or two-walled intraosseous periodontal defects in the area of the afflicted teeth evidenced clinically and by X-ray; 3) the lack of performing surgery in the area of intraosseous defect during the previous 12 months; 4) rejection from antibiotics during the previous 3 months; 5) possibility to correct the degree of oral hygiene and maintenance of its appropriate level during a long period of time by means of teaching, motivation and controlling a patient; 6) a patient's written consent to perform a complex of diagnostic (conical-radiation computed examination, probing, instrumental diagnostics) and surgical manipulations with the aim to restore intraosseous defects of the jaws and controlling

the results of treatment. The following exclusive criteria were included: 1) acute periodontitis or chronic periodontitis at the stage of exacerbation; 2) systemic somatic pathology available, that potentially could influence on the result of surgery; 3) one-wall periodontal defects available; 4) smoking as a patient's bad habit, pregnancy of breastfeeding.

The final amount of the total examined sampling included 56 patients with diagnosed intraosseous defects of the jaws associated with periodontal pathology and without contraindications available concerning the procedure of direct osseous regeneration. All the patients before realization of surgery underwent detailed periodontal examination and the procedure of Cone-beam Computed Tomography. Using the method of a randomized distribution the total number of examined patients was distributed into the experimental group (29 individuals – group I) and comparison group (27 individuals – group II). Surgery was performed with the aim of directed osseous regeneration of intraosseous periodontal defects in both groups by one and the same surgeon according to the following protocol: 1) infiltration anaesthesia; 2) intra-sulcate cuts from the buccal and lingual sides; 3) separation of the mucous-periosteal flap; 4) curettage and irrigation of osseous defect, mechanical cleaning of the root of an afflicted tooth; 5) filling the area of periodontal defect; 6) reposition of the mucous-periosteal flap; 7) suture.

Treatment of intraosseous periodontal defects of patients from the experimental group was conducted by means of filling of the prevailing amount of defects developed by the article's authors by means of the fibrous matrix followed by overlapping with a minimum portion of the osseous augment (CeraBone, Botiss) and polymeric membrane (KLS Martin), modified individually according to the peculiarities of the defect configuration by means of thermosetting compression method (Certificate for Invention of Ukraine № 114143). The fibrous matrix was made of polylactic acid polymeric foams Resorb X produced by KLS Martin, by means of polymer phase separation method followed by gamma sterilization. The applied fibrous matrix was on an average 30 mm thick, and the diameter of fibers – from 4 mcm to 10 mcm.

Osseous defects among the patients from the

comparison group were treated by mean of filling of the whole amount of the defect by bone-substitute material (CeraBone, Botiss) followed by its overlapping with a resorption membrane (Mucoderm, Botiss).

After defects were filled, the following stage of surgical manipulation included reposition of the mucous-periosteal flap to the level of the enamel-cement region with the aim to reduce apical migration of the gingival border. After the procedure of a directed osseous regeneration was over the wound was sutured completely by means of interrupted suture removed 10 days later.

Repeated periodontal examination of patients was conducted 6 months and 12 months later. Repeated procedure of the Cone-beam Computed Tomography with the purpose to analyze the amount of filling periodontal defects with the osseous tissue 12 months after primary surgery was made. A controlling tomographic examination a year later after primary surgery was proved by peculiarities of the osseous tissue visualization on the tomographic sections in the process of its formation and considering principles of radiological safety [7].

The outcome volume of osseous defects was determined in the software Materialise Mimics (Materialise NV) by means of their segmentation from the imported scans of computed tomography [8, 9, 10]. The similar procedure was performed with Cone-beam Computed Tomography (CBCT) – sections obtained a year later after surgery. Applying the principle of superimposition the initial and residual sizes of intraosseous defects were compared determining the volume of filling the defect with the osseous tissue in standard units [11].

The depth of periodontal probing in the region of intraosseous defects was measured by means of a periodontal probe designed by the University of North Carolina marking a working part with the interval of 1 mm. The volume of the periodontal attachment loss was determined by means of summarizing the results of depth of periodontal pockets and assessment of apical migration of the gingival border [12, 13]. With the purpose of representation mean values in every group of patients, mean difference of the given parameters after 6 and 12 months of monitoring, the level of statistical significance of the obtained results and their difference were determined.

The results were statistically processed in the software Microsoft Excel 2016, included in the

software packet of Microsoft Office 2016 (Microsoft).

**Results.** The total examined sampling involved 56 patients including 29 patients (51,79%) from the group I (experimental group) and 27 patients (48,21%) from the group II (comparison group). By gender signs the patients were distributed in the following way: 13 men (44,83%) and 16 women (55,17%). Statistically this distribution did not differ from that registered in the comparison group including 14 men (51,85%) and 13 females (48,15%). An average age of patients from the experimental group was  $47,9 \pm 1,54$  years, and the patients from the comparison group –  $43,2 \pm 2,12$  years.

On the moment of making periodontal examination before surgery an average parameter of the depth of periodontal probing in the region of defect in the experimental group was  $5,72 \pm 1,34$  mm, and in the comparison group –  $5,04 \pm 1,28$  mm; average parameters of the level of periodontal attachment loss were  $6,88 \pm 1,34$  mm and  $6,51 \pm 1,28$  mm in the experimental and comparison groups respectively. There was no statistical difference found between the initial parameters of the depth of periodontal probing and the level of periodontal attachment loss in the region of intraosseous defects between the two groups of the study ( $p > 0,05$ ). Therefore, they are eligible for further comparative analysis of clinical parameters at different stages of monitoring.

6 months after performed surgery the mean parameter of the depth of periodontal probing in the region of defects in the experimental group was  $3,08 \pm 0,56$  mm, and the average values of the periodontal attachment loss –  $4,24 \pm 0,59$  mm. In the comparison group after the similar period of observation the mean parameter of the depth of periodontal probing in the region of defects decreased to  $3,19 \pm 0,71$  mm, and the level of periodontal attachment – to  $4,32 \pm 0,39$ . 12 months later an average depth of periodontal probing in the region of defects in the experimental group where defects were filled with the use of fibrous matrix made of polylactic acid foams was  $2,95 \pm 0,32$  mm, and in the comparison group where osseous defects were filled with bone-substitute material –  $3,01 \pm 0,57$  mm. Statistical difference between the parameters of the probing depth in the region of periodontal defects marked in the experimental and comparison groups 12 months after treatment was not registered ( $p > 0,05$ ). It enables

to summarize that under the above conditions of the study both applied agents demonstrate similar clinical effect from the view of criteria changes of periodontal probing depth reduction. At the same time, in both groups the parameters of probing depth registered 12 months later after treatment were  $2,77 \pm 1,02$  mm and  $2,03 \pm 0,71$  mm ( $p < 0,05$ ) statistically smaller concerning the parameters registered before surgery respectively. A similar tendency was found during analysis of the parameter of periodontal attachment loss: 12 months after treatment an average parameter of it in the experimental group was  $3,55 \pm 0,12$  mm, and in comparison group –  $3,22 \pm 0,41$  mm (statistical difference between the groups was absent -  $p > 0,05$ ). At the same time an average level of reduction of periodontal attachment loss 12 months after surgery was  $3,33 \pm 1,22$  mm and  $3,29 \pm 0,87$  mm respectively in the group I and group II. The difference between the parameters registered before treatment and in 12 months of monitoring was statistically valuable ( $p < 0,05$ ).

While determining the reduction level of the volume of osseous defects 12 months after surgery applying the data of Cone-beam Computed Tomography and graphic principle of super-imposition it became possible to determine that in the experimental group the volume of osseous defect decreased by  $31,19 \pm 4,07$  standard units (from  $62,56 \pm 4,25$  to  $31,37 \pm 4,18$  standard units), and in the comparison group – by  $29,18 \pm 1,39$  standard units (from  $59,74 \pm 3,91$  to  $30,56 \pm 2,52$  standard units). The difference between the parameters registered before treatment and 12 months after surgery was statistically valuable ( $p < 0,05$ ).

The obtained results are indicative of the fact that application of the fibrous matrix from polylactic acid foams can serve as an effective alternative for filling of intraosseous periodontal defects of the jaws in the process of performing the procedure of target osseous regeneration. Statistical difference between the efficacy of application of the suggested fibrous matrix and bone xenograft from the view of assessment of parameters of periodontal probing depth reduction, decreased level of the periodontal attachment and filling defects with the osseous tissue after 12 months of observation under conditions of the above study was not registered ( $p < 0,05$ ). The advantages of the fibrous matrix and bone substitute of xenogenic origin consist of

availability to actually unlimited volume of the material necessary for replacement of periodontal defect, exclusion of the necessity to take autogenic osseous tissue, decrease of discomfort for a patient during surgery and improvement of the algorithm of surgical manipulation directed to restoration of osseous tissue deficiency in the region of afflicted periodontal units of the dentition.

**Discussion.** Thus, on the basis of the conducted investigations approbation of the modified protocols of periodontal surgery was found to be reasonable with the aim to find the variants able to provide achievement of the most predicted result under certain clinical conditions. Due to this fact the use of the fibrous matrix made of polylactic acid and polymeric membranes can be considered as a relevant alternative to classical algorithms of target osseous regeneration in the process of reconstruction of intraosseous periodontal defects of the jaws requiring appropriate clinical reasoning.

Reynolds M.A. et al. (2015) in the result of conducted systematic examination came to the point that positive changes in the structure of the periodontal complex manifested in the form of increasing level of clinical attachment, reduction of the depth of periodontal pockets and radiological increase of the osseous tissue level are indirect criteria of success of the conducted periodontal treatment and the signs of realization of the mechanism of an effective regeneration of the periodontal tissue. At the same time, the authors admitted that though in the course of periodontal surgery the application of different by origin bone-substitution grafts is characterized by evidence-proved high level of efficacy, such approaches as target bone regeneration and application of biologically active agents are clinically promising in the course of rehabilitation of stomatological patients with various forms of periodontal tissue lesions [14]. While choosing an approach to treatment not only the doctor's experience and availability of different grafts should be considered, but specificity of the mechanisms of periodontal regeneration and a potential effect of different types of surgery and applied materials on them.

**Conclusions.** Realization of the procedure of target bone regeneration with the use of the fibrous matrix made of polylactic acid foams as the main material to fill intraosseous defects of



the jaws is an effective alternative to classical approaches of surgical treatment of two- and three-wall periodontal lesions. This approach is characterized by the advantages similar to xenografts as bone-substitutes with the analogical aim, excluding the need to remove autogenic osseous tissue, minimize discomfort during surgery and not restricting a doctor in access to the necessary volume of an applied agent. The conducted comparative analysis of the results of treatment of periodontal defects with the use of fibrous matrix and xenograft according to the parameters of reduction of the periodontal probing depth, decrease of the level of periodontal attachment loss and the volume of filling in the region of affliction with the osseous tissue as the assessment criteria, determined the lack of statistical difference between the examined parameters. In its turn, it enables to recommend application of the fibrous matrix made of polylactic acid foams as a modification of a classical approach of target bone regeneration in the course of rehabilitation of patients with periodontal lesions.

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