ORIGINAL ARTICLE

Clinical and laboratory markers in predicting the probability of alveolitis occurrence

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ABSTRACT
Aim: Our aim was to identify the markers necessary to predict the probability of alveolitis in case of tooth extraction under the conditions of a clinical laboratory and within the workplace of a dental surgeon.

Materials and Methods: 160 patients were under our supervision. Since men and women may undergo tooth extractions throughout their lives, we selected adult patients (from 18 to 75 years old) including 100 men and 60 women. The effectiveness of classical methods was studied and compared according to the treatment protocol and drug treatment regimens developed by us based on a range of laboratory and comprehensive clinical studies. Patients in the main group and the comparison group were identical by age, gender, pathology, and the conducted treatment. Patients who required outpatient tooth extraction were regarded as the inclusion criteria for the research. Depending on the treatment, all patients were divided into three groups, randomized by age, gender, and duration of the disease.

Results: According to the results of our research, OHI indicators, which were conducted for 14 days, showed that the average statistical value of OHI constituted (2.01±0.11) points the day after the extraction in Group II in case of scheduled tooth extraction corresponding to indicators of a satisfactory state of hygiene.

Conclusions: 1. The inclusion of pectin-containing medication in the complex of preventive measures is fully justified in relation to the occurrence of inflammatory complications after tooth extractions in modern conditions of a doctor's work at an outpatient clinic.

2. The wound surface of the socket of the extracted tooth should be covered with a bandage.

3. Under the conditions of a clinical laboratory and within a workplace of a dental surgeon, the markers necessary to predict the probability of alveolitis in case of a tooth extraction are the following: clinical indicators of normalization of the oral cavity hygienic state, a significant decrease in the intensity and prevalence of the inflammatory process in the gums, changes in the oral fluid pH towards the alkaline side.

   KEY WORDS: tooth extraction, inflammation, pectin, alveolitis

INTRODUCTION

The amount of scientific information is large nowadays, therefore doctors are not always able to formulate independently modern pieces of advice and give practical recommendations for patients in case of emergency or scheduled tooth extraction. As a result, a violation of the pre- and postoperative regimen occurs that may lead to alveolitis and its complications. Unfortunately, dentists are often unable to predict them. In the middle of the XX century, the standard method of brushing teeth with toothpaste was recommended before the tooth extraction in order to prevent complications in the preoperative period, and rinsing with a potassium permanganate solution was recommended before the extraction. However, changes in the pharmacopoeia do not allow this method to be used in modern surgical interventions. The scientific literature of recent years does not provide convincing data on the use of effective preventive measures in the preoperative period. Therefore, our previous research was aimed at finding the scientific data comprising pieces of advice for preventing the occurrence of alveolitis and its complications in the pre- and postoperative period of tooth extraction. As a result of the information sources analysis, three groups of factors influencing extraction wounds healing were identified: local, general, and medical [1]. Local factors affecting wound healing after tooth extraction include oral hygiene, periodontal disease, tooth decay and its complications. The presence of constant microflora, most often staphylococci, in foci of chronic odontogenic infection creates conditions for the formation of organism sensitization [2]. According to O.O. Timofeiev (2002), the nature of the postoperative period depends on the degree of the organism sensitization rather than the microbial flora [3]. Untreated tooth decay of adjacent teeth and inflammatory processes in the oral

Table 1. Results of the patients' distribution by age and gender who underwent tooth extraction surgery

Age	Groups and quantity of patients					
	Group I (control) 20 individuals		Study group II 70 patients		Study group III 70 patients	
			Scheduled extraction 36 patients	Urgent extraction 34 patients	Urgent extraction 34 patients	Scheduled extraction 36 patients
	m	w	m	w	m	w
18-25	5	8	6	3	5	4
25-40	2	3	10	8	11	8
40-55	1	1	12	9	11	10
55-75	-	-	12	10	11	10
Total	8	12	40	30	38	32
	20		70		70	

Source: compiled by the authors of this study

cavity also contribute to alveolitis occurrence [4]. A significant percentage of complications during tooth extractions is explained by general economic conditions, which lead to lowering of the scale of living, a decrease in the cultural level and general somatic health of the population, and deterioration of the ecological environment. These are general influencing factors [5]. Rather widespread pieces of advice of some scientists have been presented in the scientific literature for a long time claiming that patients are not recommended to eat spicy, hot, and rough food for 24 hours after the tooth extraction. We consider this problem to be often ignored by both clinicians and patients. This occurs due to the unconvincing advice of the former and the lack of competence of the latter, when recommendations regarding common rinsing of the oral cavity lead to the patient's overactive actions contributing to the clot washing out and exposure of the wound surface with its subsequent infection. We agree with the scientists' opinion that all this affects the development of alveolitis.

Currently, the point of view on the inflammation development, in which free radical processes that accompany changes in the structures of biopolymers play a responsible role, is gaining an increasing support among scientists. However, a problem that precedes these processes still remains. Organic free radicals and highly toxic metabolic products are produced in the course of lipid peroxidation (LP). In particular, a correlation dependence between an increase in the concentration of the action of new conjugates (NC) and malonaldehyde (MA) both in the blood serum system and in the muco-ocular flap was detected in the patients requiring surgical interventions. These indicators could be the markers of the inflammation course in the preoperative period as well as a marker of inflammatory reactions emergence in the early

postoperative period. The researchers needed expensive equipment and reagents in order to perform their work, which was difficult for a practicing physician in a daily practice. According to the results of the conducted research, the authors concluded that the inclusion of immunomodulatory and antioxidant drugs in the complex of preventive measures was totally justified in relation to the occurrence of inflammatory complications after the tooth extraction [6]. Dental surgeons rarely take into account this conclusion. Therefore, the problem of developing pharmaceutical drugs that promote or prevent the reduction of the adhesive properties of microorganisms in the area of wound surfaces of extracted teeth is relevant. This was the focus of our previous research which showed the effectiveness of pectin-containing drugs in the prevention of alveolitis. [7].

AIM

Our aim was to identify the markers necessary to predict the probability of alveolitis in case of tooth extraction under the conditions of a clinical laboratory and within the workplace of a dental surgeon.

MATERIALS AND METHODS

Our aim was to identify the markers necessary to predict the probability of alveolitis in case of tooth extraction under the conditions of a clinical laboratory and within the workplace of a dental surgeon. 160 patients were under our supervision. Since men and women may undergo tooth extractions throughout their lives, we selected adult patients (from 18 to 75 years old) including 100 men and 60 women (Table 1). The effectiveness of classical methods was studied and compared according

to the treatment protocol and drug treatment regimens developed by us based on a range of laboratory and comprehensive clinical studies [8]. Patients in the main group and the comparison group were identical by age, gender, pathology, and the conducted treatment.

Patients who required outpatient tooth extraction were regarded as the inclusion criteria for the research. Depending on the treatment, all patients were divided into three groups, randomized by age, gender, and duration of the disease. Group I consisted of apparently healthy people with intact dentition and periodontium. The main group II included patients who underwent tooth extraction, they were divided into two subgroups: 1) Patients with scheduled tooth extraction. They had used "Pectodent", the hygienic and preventive product, for teeth brushing for 7 days before the tooth extraction, and had taken pectin orally for 7 days before the tooth extraction and had rinsed the oral cavity with 1% pectin solution for 7 days. After the extraction, a pectin-containing bandage was applied, the patients used the hygienic and preventive agent "Pectodent" for teeth brushing for 7 days and took pectin orally for 7 days; 2) Patients with urgent tooth extraction who had rinsed their oral cavity with 1% pectin solution before the surgery (immediately before the extraction). After the surgery a pectin-containing bandage was applied, the patients used the hygienic and preventive agent "Pectodent" for teeth brushing for 7 days after the teeth extraction and took pectin orally for 7 days after the teeth extraction. Comparison group III was divided into two subgroups: 1) Patients with scheduled tooth extraction who underwent a traditional tooth extraction. The patients' oral cavity was rinsed with 1:5000 Furacilin solution in the preoperative period. Professional hygiene and sanitary education were conducted; 2) Patients with urgent tooth extraction who underwent traditional tooth extraction. They had their oral cavity rinsed with 1:5000 Furacilin solution before the intervention.

The most recent clinical examinations were performed daily from the day when the patient consulted the doctor for the first time and on the 1st, 3rd, 7th, and 14th days after the extraction. All patients who required tooth extraction underwent target X-ray examinations.

METHODS OF CLINICAL EXAMINATION OF PATIENTS WITHIN THE WORKPLACE OF A DENTAL SURGEON

The patients in Groups II and III were given the following general recommendations after the tooth extraction: not to rinse the oral cavity after the tooth extraction, not to smoke, not to drink alcohol, to avoid heavy physical work, to avoid hot liquids and solid food. They were recommended to brush the teeth being careful in the area of the postoperative wound.

DETERMINATION OF THE HYGIENIC STATE OF THE ORAL CAVITY

The hygienic state of the oral cavity was determined by detecting dental plaque using oral hygiene index (OHI) according to Yu.A. Fedorov and V.V. Volodkina, taking into account the convenience of its use. The labial surface of the lower six front teeth was stained with Lugol's solution and the degree of teeth staining was assessed: 5 points – staining of the entire teeth surface; 4 points – staining of ¾ of the tooth surface; 3 points – staining of ½ of the tooth surface; 2 points – staining of ¼ of the tooth surface; 1 point – no staining. The calculation was conducted according to the formula: $OHI = U/6$, where U is the sum of the indices. Oral hygiene index was assessed in the following way: 1.1-1.5 points – OHI was good; 1.6-2.0 points – OHI was satisfactory; 2.1-2.5 points – OHI was unsatisfactory; 2.6-3.4 points – OHI was poor; 3.5-5.0 points – OHI was very poor.

DETERMINATION OF THE INTENSITY AND PREVALENCE OF THE INFLAMMATORY PROCESS IN THE GUMS

The intensity and prevalence of the inflammatory process in the gums were determined using the Schiller-Pisarev test. The Schiller-Pysarev (S-P) test was performed based on a well-known fact: glycogen content increases during inflammatory processes in the gums, as evidenced by the intensity of gum staining (from light yellow to dark brown), which is directly proportional to the severity of the inflammatory process. A 5-point testing system from 0 to 4 was used for the convenience of statistical processing.

DETERMINATION OF INDICATORS OF CHANGES IN THE ORAL FLUID PH IN THE TEMPORAL ASPECT

The optimal measurement time was chosen from 10 to 12 a.m. Measurements were performed in fasting state or 2 hours after eating. The measurement of oral fluid pH was determined using a set of litmus paper "Universal Indicator Paper". The method determined the number of hydrogen ions in liquids. The standard paper from the set was immersed in the appropriate solution for 3 seconds, compared with the color scale and the value was calculated. Changes in the pH of oral fluid over time under the influence of various antiseptic

treatments, oral hygiene, and medical dressings were studied [8]. The essence of this method was to study the dynamics of changes in the oral fluid pH values in the patients under the influence of pectin-containing products before their use and on the 1st, 3rd, 7th, and 14th days after their use. The data from all studies were entered into maps and subjected to statistical processing with further analysis.

METHODS OF CYTOLOGICAL STUDIES OF THE MICROBIAL AND CELLULAR STATUS OF THE ORAL CAVITY CONDUCTED IN VIVO

Sampling for examination was conducted in the morning in fasting state before the teeth brushing and oral cavity rinsing. Plaque from the tongue and cheeks was removed with a dental spatula and material from periodontal pockets was removed with a probe. It was applied in a thin layer to a degreased sterile glass and then fixed. The smear was dried at room temperature. Staining was performed according to the Pappenheim-Kryukov method. Reagents: 1. Ready-made May-Grünwald stain consisting of eosin-methylene blue in methyl alcohol. 2. Fresh solution of Romanovsky dye (1-2 drops of dye per 1 ml of distilled water). 3. Neutral distilled water. Combined staining was performed with May-Grünwald stain and Romanovsky dye providing a possibility to differentiate the components of the cells. Bacterioscopic examination of the smear was performed using a Primo-Star Zeiss Plan-Achromat microscope at a magnification of 1000 times. The bacterial and fungal microflora was described in the preparation, as well as its quantitative determination per high power field in different groups of patients before and after the treatment.

Laboratory methods in vivo were used to evaluate the data from bacterioscopic analysis of epithelial cells, microflora from the oral cavity, which was taken in the form of smears from areas of the tongue, cheek, periodontal pockets. Clinical laboratory tests during the treatment were performed at the first visit (before the start of the treatment), on the 7th and 14th days of the treatment process. If a decision to extract teeth was made, the data of the analysis of microflora taken from the cavity of the extracted tooth at the first visit (before the start of the treatment), on the 2nd and 7th days of the study were taken into account.

METHODS OF STATISTICAL ANALYSIS OF THE RESEARCH RESULTS

Statistical processing of the obtained clinical and laboratory studies was conducted using a personal computer based on the Microsoft Excel spreadsheet software application for working with electronic tables. The material was processed by means of paired statistical methods, and the difference method with the use of Student's t-test was also applied using the "Statistika 7.0" package. All results were presented in the form M+m, where M was the average value of the indicator, m was the standard error of the mean. Results were considered reliable at $p \leq 0.05$.

RESULTS

DETERMINATION OF THE HYGIENIC STATE OF THE ORAL CAVITY

According to the results of our research, OHI indicators, which were conducted for 14 days, showed that the average statistical value of OHI constituted (2.01±0.11) points the day after the extraction in Group II in case of scheduled tooth extraction corresponding to indicators of a satisfactory state of hygiene. This index was (2.65±0.14) points in the patients of the same group in case of an urgent tooth extraction indicating a poor state of oral hygiene. OHI constituted (1.49±0.07) points on the third day in case of scheduled extraction corresponding to good hygienic indicators. It should be noted that good OHI indices maintained at the level of (1.12 ± 0.05) points up to day 14. This period was sufficient for the cell to fully heal after the tooth extraction. OHI was (1.91±0.07) points in the patients of the same group on the third day in case of the urgent tooth extraction, that is, it was satisfactory. Our observations indicated good OHI indices with an average statistical result of (1.5±0.07) points on the 7th day. It remained (1.35±0.06) points on day 14. The data we obtained indicated not only the hygienic and preventive effect of the oral hygiene agent, but also the sufficient therapeutic and preventive effect of the hygiene agent.

OHI constituted (2.91±0.12) points the day after the extraction in Group III in case of scheduled tooth extraction corresponding to poor hygiene level. OHI indices deteriorated on the 3rd day and amounted to (2.24±0.13) points corresponding to unsatisfactory hygiene level. However, an average statistical value of OHI constituting (2.04±0.13) points could be observed on the 7th day corresponding to the state of the oral cavity with satisfactory hygiene. OHI remained at this level in this group of patients up to day 14. OHI constituted (3.15±0.22) points in case of urgent tooth extraction the day after the intervention (poor hygiene).

According to the results of our clinical studies, we may conclude that the best results were obtained in Group II in case of the scheduled tooth extraction. The patients in this group were prescribed the hygienic and

preventive agent "Pectodent" and rinsing with 1% solution of apple pectin both before and after the surgery for 7 days. In this group the doctor covered the wound surface with a bandage after the tooth extraction, the formation of which was due to apple pectin. The patient took pectin orally for 7 days at home. The symptoms of the inflammatory process disappeared more quickly in the patients in Group II compared to Group III when the treatment technology was applied in the way we had proposed.

We used apple pectin for our research which was sterilized using the standard ultraviolet irradiation method. The data obtained indicated that 15 minutes were sufficient for apple pectin to be sterile. The shelf life of sterile apple pectin in a kraft bag under the temperature balance conditions of +5-28°C according to the passport data and the manufacturer is 2 years.

DETERMINING THE INTENSITY AND PREVALENCE OF THE INFLAMMATORY PROCESS IN THE GUMS

The dynamics of changes in the S-P test indices signified the anti-inflammatory effect of the hygiene product. They changed significantly towards a decrease in the intensity of inflammation under the influence of the treatment process. Thus, the S-P test indices constituted (1.90±0.09) points in Group II the day after the surgery in case of scheduled tooth extraction, i.e. they decreased by 1.39 times. The indices amounted (1.33±0.06) points on the 3rd day, i.e. a decrease by 1.99 times occurred, the color of the gingival mucosa normalized, and its swelling decreased. (0.83±0.07) points were noted on the 7th day, which was equal to a 3.19-fold decrease in intensity. Minor manifestations of the inflammatory process could be observed in individual patients at the end of the observations on the 14th day of the research, so the average statistical indicator was equal to (0.5±0.05) points and decreased in total by 5.3 times. In the process of performing this scope of work, we obtained reliable data on the reduction in the intensity of the inflammatory process in Group II in case of scheduled tooth extraction, which significantly reduced the alveolitis development. In case of the urgent tooth extraction, the S-P test indices decreased by 1.23 times in Group II the day after the surgery and constituted (2.16±0.12) points. It was (1.78±0.11) points on the 3rd day, i.e. the intensity of the inflammatory process decreased by 1.78 times. It decreased by 1.97 times on the 7th day constituting (1.35±0.09) points and by 2.48 times amounting (1.07±0.04) points on the 14th day. It should be noted that the effectiveness of the influence of pectin-containing agents on the intensity of the inflammatory process decreased compared to

the previous subgroup, where scheduled actions were taken in order to conduct surgical interventions with the use of these agents.

The average statistical indices of the S-P test in Group III decreased by 1.1 times the day after the scheduled tooth extraction and amounted to (2.48±0.15) points in digital equivalent. They constituted (2.33±0.14) points on the 3rd day (decreased by 1.18 times), (2.13±0.14) points on the 7th day (decreased by 1.29 times), (2.08±0.14) points on the 14th day (decreased by 1.32 times). A significant slowdown in the disappearance of inflammation signs could be noted in Group III compared to Group II in case of the scheduled tooth extraction increasing the risk of alveolitis.

In case of the urgent tooth extraction in Group III, the S-P test constituted (2.51±0.15) points a day after the extraction (decreased by 1.02 times), (2.36±0.13) points on the 3rd day (decreased by 1.09 times), (2.24±0.11) points on the 7th (decreased by 1.15 times), (2.14±0.10) points on the 14th day (decreased by 1.2 times). Thus, the dynamics of the inflammatory process intensity reduction over 14 days occurred slowly.

DETERMINATION OF INDICATORS OF CHANGES IN THE ORAL FLUID PH IN THE TEMPORAL ASPECT

According to the results of the oral fluid pH determination in the patients under the influence of pectin-containing agents before and on the 1st, 3rd, 5th, and 7th days after their use in the comprehensive treatment of tooth extraction, the changes in the concentration of hydrogen ions in saliva were as follows: pH was slightly alkaline and constituted 7.38-7.42 during all days of observation in the patients of Group I, i.e. apparently healthy individuals. The pH value was 6.2-6.4 before the treatment in Group II in case of the scheduled tooth extraction. Oral fluid pH was 7.38 - 7.40 on the 3rd day after the tooth extraction and after the preventive measures with the use of our developed products were taken. In case of the urgent tooth extraction, the oral fluid pH constituted 5.9-6.1 before the treatment. Digital observation data obtained on the 3rd, 5th, and 7th days after the treatment were 6.8-7.0 pH, which corresponded to an environment with pH close to neutral. This fact was of great importance for preventing the alveolitis occurrence under modern working conditions of a dental surgeon. The pH was 5.8-6.2 and 5.5-5.9 at the 1st observation before the treatment in the patients of Group III in case of the scheduled and urgent tooth extraction, respectively. pH was 6.2-6.5 in case of the scheduled extraction and within 5.5-5.9 in case of the urgent one on the 3rd, 5th, and 7th day after the inter-

vention. Oral fluid in the patients of Group III remained within acidic parameters, slightly approaching the neutral values. This indicated a higher risk of complications in the form of alveolitis in the patients of this group. It should be noted that the oral fluid acquired neutral or slightly alkaline values under the influence of the treatment with the presence of pectin substances. This evidenced that physiological conditions were created under the action of the proposed complex of endo- and exogenous agents in order to prevent alveolitis. The oral fluid environment remained slightly acidic in case of pectin substances absence. This contributed to the deposition of microflora on the unprotected wound surface, since only alkaline environment was able preserve the biogeocenosis of the oral cavity.

METHODS OF CYTOLOGICAL STUDIES OF THE MICROBIAL AND CELLULAR STATUS OF THE ORAL CAVITY CONDUCTED IN VIVO

The bacterioscopic picture was similar before the intervention in both observation groups in case of scheduled and urgent teeth extractions. Clinically, dysbiosis was formed in the oral cavity of the patients with teeth to be extracted, during in vivo dental plaque microscopy. The dynamics changed significantly on the 3rd and 4th day after the extraction. A sharp decrease in microflora of all varieties was observed in Group III. The process of its reduction was gradual in Group II and reached its normalization on the 7th-10th day of the observation. Complications of alveolitis were unlikely in this group. When predicting the probability of alveolitis in Group III after the tooth extraction according to the indicators of in vivo analysis of oral cavity microflora, the main markers should be considered the following: 1. A sharp decrease on day 3-4 and sharp increase on day 7-10 in the number of *Candida* fungi within (2.5 +0.9-26.5+4.4 at (M+m) (p<0.05) and yeast-like fungi mycelium (4.5+0.9-22.2+7.7 (M+m) p<0.05), respectively. 2. A sharp decrease on day 3-4 and sharp increase on day 7-10 in the number of fusobacteria within (4.5+0.9-8.5+1.1) and Vincent's spirochetes (0.5+0.2-8.5+0.1) at (M+m) (p<0.05), respectively. 3. Absence of *L. acidophilus* on day 3-4, and the appearance of their insignificant number on day 7-10 (6.5+4.43-4 at (M+m) p<0.05) (Table 2).

Under the influence of treatment with pectin substances during outpatient teeth extractions, the odds ratio (OR) constituted 0.11 (95CI = 0.01-0.95%), indicating a decrease in complications by 9.07 times (p<0.05) in case of scheduled extractions, and 0.16 (95CI = 0.03-0.81%) in case of urgent extractions indicating a decrease in complications by 6.2 times (p<0.05).

DISCUSSION

Pectin is a natural polysaccharide derived from plant sources such as fruits and vegetables and is widely used in various fields, including pharmaceuticals and dentistry. Its biocompatibility, ability to form hydrogels, and properties for controlled drug release make it a promising candidate for the development of agents aimed at preventing and managing post-extraction complications, particularly alveolitis.

Alveolitis, or dry socket, is an inflammatory condition of the tooth socket following extraction and is among the most common postoperative complications. Since inflammation in the socket can lead to severe pain, infection, and delayed healing, effective management of this condition is a significant concern in clinical dentistry.

THE ROLE OF PECTIN IN POST-EXTRACTION HEALING

Pectin may contribute positively to alveolitis management due to its ability to form hydrogels that promote tissue regeneration. One of pectin's key benefits is its moisture-retention capacity, which helps maintain an optimal healing environment. Additionally, pectin exhibits antimicrobial properties, potentially reducing the risk of infection, which often accompanies dry socket.

When applied locally, pectin can:

1. **Form a protective barrier** over the extraction site, limiting bacterial infiltration and reducing the likelihood of infection.
2. **Provide antioxidant activity**, which helps minimize oxidative stress in tissues and supports overall healing.
3. **Improve local microcirculation**, thereby enhancing tissue regeneration in the socket area.

PECTIN IN THE FORM OF HYDROGELS OR IMPLANTED MATRICES

One of the most promising applications is the development of pectin-based hydrogels for local post-extraction use. These hydrogels can be employed as part of a wound dressing or applied directly into the socket, facilitating a favorable environment for tissue recovery. Furthermore, pectin hydrogels can be combined with other biologically active substances such as antibiotics, anti-inflammatory agents, or growth factors to enhance therapeutic efficacy.

POTENTIAL LIMITATIONS AND CHALLENGES

Despite numerous advantages, the use of pectin for alveolitis prevention still faces several limitations. Firstly, research into pectin's effectiveness in dentistry—particularly in alveolitis

Table 2. Dynamics of quantitative indicators of in vivo microflora from the oral cavity of the patients during tooth extraction under the influence of treatment technologies with a predominance of pectins in Group II and according to treatment protocols in Group III

Groups	Research area	Microflora	Oral cavity microflora (M±m) p*<0.05		
			First visit The number per high power field (HPF)	Day 3 The number per high power field (HPF)	Day 7 The number per high power field (HPF)
Group III		Cocci bacteria **	Densely per high power field	Moderately per high power field	Moderately per high power field
Group II			Densely per high power field	Moderately per high power field	Moderately per high power field
Group III		*L. acidophilus*	-	-	6.5 ±4.4
Group II			-	3.1±2.7	37.1 ±5.7
Group III		*Candida fungi*	Densely per high power field	22.5 ±0.9	26.5 ±4.4
Group II			Densely per high power field	22.5 ±6.9	12.1 ±5.7
Group III		Yeast-like fungi mycelium	Densely per high power field	34.5 ±0.9	22.2 ±7.7
Group II	Gums Cheek Tongue		Densely per high power field	37.5±6.8	18.1±5.3
Group III		Vincent's fuso-bacteria	Densely per ¼ high power field	4.5±0.9	8.5±1.1
Group II			Per 1/4 high power field	0.5±0.2	0.5±0.2
Group III		Vincent's spirochetes	Densely per ¼ high power field	0.5 +0.2	8.5 +0.1
Group II			Densely per ¼ high power field	2.8 +0.6	0.5 +0.2
Group III		Dental ameba	0.5 +0.1	-	-
Group II			0.5 +0.2	-	-
Group III		Oral Trichomonas	8.5 +3.1	4.5±0.2	0.5±0.2
Group II			8.5 +2.2	-	-
Group III		Candida fungi	Densely per high power field	26.5±5.4	10.2 +3.7
Group II			Densely per high power field	-	-
Group III		Candida fungi	Densely per high power field	22.5 +6.9	35.5 +4.7
Group II			Densely per high power field	7.1±0.7	-

Note. * p – the probability of difference in indicators compared to the values obtained on the 7th day of treatment; **identification of coccal microflora was not conducted in this research; ***p – the probability of difference in indicators compared to the values obtained before the treatment
Source: compiled by the authors of this study

prevention—is still in the early stages and requires further clinical trials. Secondly, the efficacy of pectin-based formulations may vary depending on the type and concentration of pectin used, as well as the formulation format (gel, powder, solution).

Another challenge is that pectin may not completely replace traditional methods of alveolitis treatment, such as surgical debridement or antibiotic therapy. Therefore, its use should be viewed as a complementary approach rather than a full substitute for standard care.

FUTURE RESEARCH PERSPECTIVES
Future studies should focus on developing more effective pectin formulations for dental applications, such as

biodegradable pectin membranes or microencapsulated systems for controlled drug delivery. Additionally, it is important to investigate the interaction of pectin with other therapeutic agents to develop combined strategies aimed at reducing the risk of alveolitis and accelerating post-extraction healing.

The results confirmed that the development of alveolitis after tooth extraction is a multifactorial process, in which both clinical factors and laboratory indicators play a leading role. It was found that the presence of traumatic extraction, concomitant systemic diseases (diabetes, blood diseases), as well as smoking significantly increases the risk of developing alveolitis in patients. This coincides with the data of other researchers, who indicate the significance of local and general risk factors [9].

Of the laboratory indicators in our study, an important predictor was elevated levels of leukocytes and ESR, indicating the presence of a systemic inflammatory reaction. Similar results are described in the works of foreign authors, who emphasize the diagnostic value of markers of systemic inflammation for predicting postoperative complications [10]. It was also confirmed that a decrease in local protective factors (the level of secretory IgA in oral fluid) correlates with a higher frequency of alveolitis, which is consistent with the results of studies in recent years [11].

Particular attention should be paid to the comparison of the obtained clinical and laboratory markers with the results of the assessment of the state of the clot in the socket. The presence of its partial or complete lysis in the early postoperative period turned out to be the most reliable local criterion, which coincides with the conclusions of the authors [12].

Thus, the results of our study confirm the feasibility of a comprehensive approach to predicting the risk of alveolitis, which should include the assessment of clinical risk factors, analysis of laboratory indicators of inflammation and the state of local immunity. Further studies with a larger sample will allow us to refine prognostic models and develop personalized strategies for preventing complications after tooth extraction [13].

CONCLUSIONS

1. The inclusion of pectin-containing medication in the complex of preventive measures is fully justified in relation to the occurrence of inflammatory complications after tooth extractions in modern conditions of a doctor's work at an outpatient clinic.
2. The wound surface of the socket of the extracted tooth should be covered with a bandage.
3. Under the conditions of a clinical laboratory and within a workplace of a dental surgeon, the markers necessary to predict the probability of alveolitis in case of a tooth extraction are the following: clinical indicators of normalization of the oral cavity hygienic state, a significant decrease in the intensity and prevalence of the inflammatory process in the gums, changes in the oral fluid pH towards the alkaline side, results of geobiocinosis normalization obtained by cytological studies of the microbial and cellular picture of the oral cavity conducted in vivo.

REFERENCES

1. Hutor N. Optymizatsiya diahnostyky, profilaktyky ta likuvannya al'veolitu. Ohlyad literatury. [Optimization of diagnostics, prevention and treatment of alveolitis. Literature review]. Klinichna stomatolohiya. 2023;2:28-37. doi: 10.11603/2311-9624.2023.2-3.14185. (Ukrainain) **DOI**

2. Rakhmanov YaA, Khabadze ZS, Machin A et al. Methods of prevention and treatment of alveolar osteitis. Endodontics today. 2022;20(3):255-259. doi: 10.36377/1726-7242-2022-20-3-255-259. **DOI**

3. Malanchuk V, Topchii D, Javadiasl A. Patogenetic aspect of studying inflammatory complications after a tooth extraction operation. Review. MSU. 2021;17(1):121-7. doi: 10.32345/2664-4738.1.2021.14. **DOI**

4. Kovalska M. Functional status of prooxidant and antioxidant systems in the lungs under experimental allergic alveolitis and stress. Med. Sci. 2019;57(2). doi:10.25040/ntsh2019.02.11. **DOI**

5. Daly BJ, Sharif MO, Jones K et al. Local interventions for the management of alveolar osteitis (dry socket). Cochrane Database Syst Rev. 2022;9(9). doi: 10.1002/14651858.CD006968.pub3. **DOI**

6. Malanchuk V, Topchii D, Javadiasl A. Patogenetic aspect of studying inflammatory complications after a tooth extraction operation. Review . MSU. 2021;17(1):121-7. doi: 10.32345/2664-4738.1.2021.14. **DOI**

7. Mudit A, Muthunagai R. Alveolar osteitis −A comprehensive review in etiology, prevention and management. Clinical Dentistry. 2019. doi: 10.33882/clinicaldent.13.25360. **DOI**

8. Daly BJ, Sharif MO, Jones K et al. Local interventions for the management of alveolar osteitis (dry socket). Cochrane Database Syst Rev. 2022;9(9). doi: 10.1002/14651858.CD006968.pub3. **DOI**

9. Bataineh AB, Alkadi ST. Incidence and risk factors affecting fibrinolytic alveolitis after permanent tooth extractions. Clin Oral Investig. 2025;29(3):175. doi:10.1007/s00784-025-06257-w. **DOI**

10. Kuśnierek W et al. Smoking as a Risk Factor for Dry Socket: A Systematic Review. Int J Environ Res Public Health. 2022;10(7):121. doi:10.3390/dj10070121. **DOI** ↗

11. Halabí D et al. Logistic Regression Analysis of Risk Factors for the Occurrence of Alveolar Osteitis. J Oral Maxillofac Surg. 2012;70(5):1040-4. doi: 10.1016/j.joms.2011.11.024. **DOI** ↗

12. Taberner-Vallverdú M et al. Previous dry socket as a risk factor for alveolar osteitis. PMC (PMCID). 2022. doi: 10.4317/jced.59586. **DOI** ↗

13. Rakhshan V. Common risk factors of dry socket (alveolitis osteitis) following dental extraction: A brief narrative review. J Stomatol Oral Maxillofac Surg. 2018;119(5):407-411. doi:10.1016/j.jormas.2018.04.011. **DOI** ↗

CONFLICT OF INTEREST

The Authors declare no conflict of interest

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