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# OPTIMIZING THE DIAGNOSIS AND TREATMENT IN PATIENTS WITH ORAL FLOOR PHLEGMON

**323.01 - Dentistry**

**Summary of Ph.D Thesis in Medical Sciences**

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The present Ph.D. thesis was developed at the "Arsenie Guțan" Department of Oral and Maxillofacial Surgery and Oral Implantology of "Nicolae Testemițanu" State University of Medicine and Pharmacy

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**CONTENTS**

## INTRODUCTION

**The relevance and importance of the researched issue**. Phlegmon of the oral floor is defined as a bilateral and rapidly progressive inflammatory condition affecting the sublingual, submandibular, and submental spaces. This condition represents a medical emergency typically characterized by firm induration and swelling of the floor of the mouth, accompanied by a high risk of airway compromise and spread of infection along fascial planes into adjacent compartments and towards the mediastinum [8, 16].

Due to the increased incidence of comorbid conditions (such as immunosuppression and diabetes mellitus), which are also major risk factors for the oral floor phlegmon, the incidence of this condition is on the rise. Although the condition is rare, it remains an important disease that can be life-threatening, primarily due to airway obstruction [1, 2]. In approximately 90% of cases, the oral floor phlegmon is of odontogenic origin, with teeth 7 and 8 in the mandible accounting for 70-80% [2, 7].

Respiratory tract protection and early use of anti-inflammatory and antibacterial drug therapy show favorable outcomes. However, surgical intervention involving proper drainage of purulent collections, debridement of necrotic tissue to the limit of clinically healthy tissues, and lavage with antiseptic solutions is essential. Despite its benefits, the traditional surgical treatment approach also comes with some disadvantages: a high level of surgical aggression; rapid wound sealing with fibrin, obstructing the drainage of purulent discharge; challenging tissue regeneration with bulky and cosmetically unappealing postoperative scars [4, 9].

Thus, the findings of the specialized literature analysis and our clinical experience advocate for the opportunity to develop a new concept/protocol for minimally invasive surgical intervention of buccal floor phlegmon, which would contribute to early, effective, and less traumatic rehabilitation. In this regard, it is important to select the appropriate interventional strategy, taking into account the individual characteristics of the patient [12, 13].

Based on the aforementioned, the main **purpose of the study** is to enhance the diagnosis and treatment of patients with buccal floor phlegmon.

To achieve this purpose, the following **general research objectives** have been outlined:

1. To assess the local and systemic clinical characteristics over time in patients with oral floor phlegmon from the overall study cohort.
2. To conduct a comparative analysis of patient cohorts with oral floor phlegmon, considering the clinical progression of local and systemic conditions.
3. To outline indications and contraindications for minimally invasive interventions.
4. To develop a diagnostic and treatment algorithm for patients with oral floor phlegmon.
5. To develop a prehospital medical care protocol for patients with oral floor phlegmon,

**Scientific Novelty and Originality.** A novel surgical technique has been developed for the management of buccal floor phlegmon, by performing two incisions separated by a minimum of 2 cm of tissue. For the first time, a comparative analysis was conducted, by using mathematical and statistical methods, between two distinct surgical approaches for treating buccal floor phlegmon: the traditional surgical method and the newly developed procedure. Indications and contraindications of the new surgical approach have been also outlined. Furthermore, an algorithm for diagnosing and treating patients with buccal floor phlegmon, has been created.

**The practical value of the study** consists in the development of a personalized approach in managing the rare but potentially fatal condition of oral floor phlegmon, taking into account the specific characteristics of each patient. This tailor-made approach contributes to improving surgical outcomes and providing faster functional recovery for patients, while simultaneously reducing the risk of postoperative complications. Furthermore, the diagnostic and treatment algorithm developed for patients with phlegmon of the oral floor can decrease the time from patient addressing to surgical intervention and assist in identifying criteria for adjusting surgical strategies.

**Approval of Ph.D. thesis results.** The fundamental principles outlined in the thesis have been reported and discussed at various national and international scientific forums: The VIIIth International Congress of the Romanian Dental Association for Education. The 20th Edition of the Faculty of Dental Medicine Days. December 8-10, 2016, Iași, Romania; The IXth International Congress of the Romanian Dental Association for Education. The 21st Edition of the Faculty of Dental Medicine Days. May 18-20, 2017, Iași, Romania; National scientific-practical conference with international participation, dedicated to the 90th anniversary of the birth of the illustrious physician and scientist Nicolae Testemițanu. September 29, 2017, Chișinău, Republic of Moldova; University Days. Annual scientific conference. 2016, 2017, Chișinău, Republic of Moldova; ICMS - International Congress of Medical Sciences. For students and young doctors. May 11, 2018, Sofia, Bulgaria; 23rd Balkan Stomatological Society Congress. May 10-12, 2018, Iași, Romania; Annual scientific conference of young specialists within IMSP IMU "Performance and perspectives in medical-surgical emergencies". 2017, 2018, Chișinău, Republic of Moldova.

**Key words:** phlegmon of the oral floor, diagnosis, treatment, surgical intervention, minimally invasive, complication.

## 1. CONTEMPORARY ASPECTS OF ORAL FLOOR PHLEGMON

Phlegmon of the oral floor is a potentially life-threatening bacterial infection characterized by rapid, extensive, invasive gangrenous cellulitis involving the submandibular, sublingual, and submental spaces. This condition typically arises from mandibular dentoalveolar septic processes, particularly affecting the second and third molars, which account for over 90% of cases. Phlegmon of the oral floor is polymicrobial in etiology, involving both aerobic oro-pharyngeal flora (such as *Staphylococcus* and *Streptococcus*) and anaerobic organisms (including *Peptostreptococcus*, *Fusobacterium*, *Bacteroides*, and *Actinomyces*) [2, 11, 13].

While the oral floor phlegmon does not exhibit a significant gender predilection, some researchers have observed a higher incidence among males compared to females. In the pre-antibiotic era, the mortality rate of oral floor phlegmon exceeded 50%. However, significant strides in early diagnosis, optimal treatment strategies (including prompt airway management, appropriate antimicrobial therapy employing effective antibiotics, advanced imaging techniques, and modern surgical interventions), as well as comprehensive dental prophylaxis, have led to a notable reduction in mortality rates to 0-8%. Nonetheless, recent studies indicate mortality rates of up to 30%, particularly prevalent in developing countries [2, 15].

The diagnosis of oral floor phlegmon is established based on a clinical assessment, both externally and intraorally, rapid progression with severe deterioration of the patient's general condition, and symptoms indicating imminent airway obstruction. This diagnosis is confirmed through imaging investigations and complementary laboratory examinations to determine the extent of infection spread [4, 7].

The modern management of this condition is complex and involves ensuring airway patency, initiating prompt and appropriate antibiotic therapy, performing surgical decompression through drainage of affected spaces, debriding infected areas, excising necrotic tissue, providing general supportive care (such as correcting electrolyte imbalances and ensuring adequate nutritional support) and addressing the underlying cause [6, 11].

Although the wide incision is a traditional method of treatment for phlegmon of the oral floor, this surgical approach is not always the optimal choice. Wide incisions can bring about complications like excessive bleeding, infection and postoperative discomfort. Moreover, they often entail a longer, more difficult recovery process for patients. However, not all instances of buccal floor phlegmon present the same clinically or pathologically. Consequently, it's inappropriate to employ a one-size-fits-all surgical approach without considering individual patient characteristics. Sometimes, a wide incision may be necessary, but in other cases, a more conservative strategy may be sufficient.

# 2. MATERIALS AND METHODS OF RESEARCH

## 2.1. General Characteristics of Research Methodology

Patients were randomly divided into 2 subgroups: 49 patients with buccal floor phlegmon treated using the method proposed by us (study group) and 51 patients with buccal floor phlegmon treated using the conventional method (control group) (Figure 1).

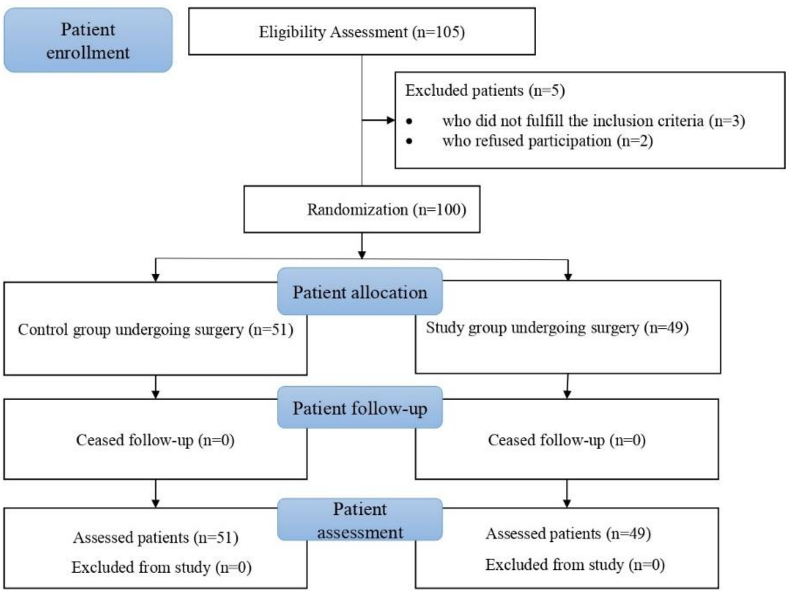


Figure 1**. The study design**

For better research accuracy, the present study adhered to a set of inclusion and exclusion criteria, thus outlining the study more effectively and focusing on a specific representative group.

**Inclusion criteria for patients with phlegmon of the oral floor:**

- Age over 18 years.
- Patients without associated pathologies.
- Patients with infections limited to the phlegmon of the oral floor.

**Exclusion criteria from the study for patients with the phlegmon of the oral floor:**

- Pregnant women.
- Patients with tumors.

- Complications of osteomyelitis.
- Patients with symptoms of septicemia.
- Patients with anaerobic infections.
- Patients with infections extending beyond the boundaries of the oral floor phlegmon.

Patients with anaerobic infections have been diagnosed based on the clinical picture:

1. Foul odor of the exudate.
2. Progressive, necrotizing nature of the tissue, with the presence of green-grayish detritus, sometimes with black and brown areas.
3. Presence of gas bubbles, a byproduct of bacterial metabolism.

The presence of at least 2 signs described above confirms the anaerobic nature of the infection. After confirming eligibility, patients with buccal floor phlegmon were fully informed about the purpose of the study, the benefits and risks of the investigations and treatment administered.

### 2.2. General Characteristics of Clinical Material

The research project studied 100 patients with oral floor phlegmon, including 55 males and 45 females aged between 18 and 83 years, admitted during the years 2016-2019 to the Oro-maxillofacial Surgery Department of the Emergency Medicine Institute. The study group consisted of 49 patients with oral floor phlegmon with a mean age of 38.8±15.6 years (ranging from 18 to 78 years, median 38 years), including 21 (42.9%; 95% CI: 30.2-56.8) males and 28 (57.1%; 95% CI: 43.2-69.8) females.

The control group comprised 51 patients with oral floor phlegmon with a mean age of 43.9±16.8 years (ranging from 18 to 83 years, median 40 years), including 34 (66.7%; 95% CI: 53.7-79.2) males and 17 (33.3%; 95% CI: 20.8-46.3) females. There was no statistically significant difference between the patient groups in terms of age ($p>0.05$).

In the study group, 28 (57.1%) patients were from rural areas and 21 (42.9%) patients were from urban areas, while in the control group, 39 (76.5%) patients were from rural areas and 12 (23.5%) patients were from urban areas.

### 2.3. Methods of Investigation and Diagnostic Criteria

The following investigation methods were used within the present study:

**Clinical examinations:** subjective and objective assessments, measurement of oral cavity opening in centimeters, evaluation of deglutition according to Luigi Bonavina's classification [5], assessment of respiratory frequency, phonation, clinical manifestations, determination of blood pressure, and thermometry.

During patient examination, the overall condition was objectively evaluated, as clinical appearances often do not accurately reflect the patient's general status. To this end, the QSOFA test was administered, relying on three clinical criteria (respiratory rate ≥22 breaths per minute; systolic blood pressure ≤100 mmHg; consciousness score ≤2 according to the Modified Glasgow Coma Scale). A QSOFA score ≥2 is considered positive [3, 14].

The Mallampati test was used to evaluate airways, wherein a higher score is associated with a higher risk of difficult intubation:

Class 1: Palatopharyngeal arches, soft palate, and uvula are visualized.

Class 2: Palatopharyngeal arches and soft palate are visible, but the uvula is masked by the base of the tongue.

Class 3: Soft palate and hard palate are visible.

Class 4: Only the hard palate is visible [10].

**Paraclinical investigation methods**. Blood samples, drawn via puncture of the cubital vein upon admission, were collected in EDTA tubes. Following collection, the blood samples were transported to the laboratory for testing. The analyses included general blood analysis, biochemical blood analysis, procalcitonin levels, bacteriological examination of the postoperative wound with antibiotic sensitivity testing following the EUCAST (*European Committee on Antimicrobial Susceptibility Testing*) standard, blood culture, and imaging techniques (*Orthopantomography, Computed Tomography)* [11, 17].

**The medical treatment** of patients with buccal floor phlegmon is essential for controlling and preventing the spread of infection to adjacent regions. Therapy includes systemic medications (antibiotics, antifungals, analgesics, corticosteroids, and crystalloid solutions) as well as local interventions (0.02% furacilin, 0.05% chlorhexidine, diluted povidone-iodine with saline in a ratio of 1:1 or 1:2, 3% H2O2, 70% alcohol, and oral antiseptics).

### 2.4. Surgical approaches employed

**Surgical management of buccal floor phlegmon in control group patients.**

Following treatment with antiseptic solutions, the surgical field is isolated, and the incision line is marked (see Figure 2 A). Subsequently, local anesthesia, in addition to general anesthesia, is administered to ensure vasoconstriction in the surgical area. To prevent injury to the marginal branch of the facial nerve, the incision is made according to the marked line, 2 cm below the basal margin of the mandible. This is followed by hemostatic control, debridement of wound edges, exposure, and dissection of the platysma along the entire length of the incision using hemostasis techniques (see Figure 2 B). After dissecting and suturing the artery and facial vein in the right and left submandibular regions, a hemostatic forceps is used to access the submandibular and sublingual spaces. Entry into the submental space is made among the anterior bellies of the digastric muscles. During surgery, the density, color, and odor of purulent discharge are noted, and samples are taken for bacteriological examination and antibiotic sensitivity assessment. Hemostatic control is ensured, and fenestrated tube drains are placed in the drained spaces, which are sutured to the skin (see Figure 2 C).

**A** **B** **C**

Figure 2. **Incision line marking (A), platysma sectioning (B), and immediate postoperative appearance in patients with oral floor phlegmon from the control group (C)**

Concurrently, sterile gauze sponges soaked in antiseptic solutions are applied along with the drainage tubes. These are removed during the first dressing change. Postoperative wound lavage is performed, followed by the application of an aseptic dressing.

**Surgical treatment of phlegmon of the oral floor in study group patients.**

In order to preserve the body's reparative forces and facilitate early, efficient, and less traumatic rehabilitation, a minimally invasive surgical intervention technique has been developed for patients with buccal floor phlegmon. The procedure entails creating two incisions in the right and left submandibular regions, separated by a bridge of intact soft tissue measuring a minimum of 2 cm in length. This approach to surgical treatment could solve a number of disadvantages of existing techniques by preserving the vascular support of the intact tissue bridge.

After processing with antiseptic solutions (0.5% chlorhexidine and 70% ethyl alcohol), the operative field is isolated, and the incision line is marked (see figure 3 A)

Local anesthesia was administered alongside general anesthesia to ensure vasoconstriction at the surgical site. To prevent injury to the marginal branch of the facial nerve, incisions were carefully made 2 cm below the mandibular basal margin, adhering to the recommended safety distance. Incision through the tegumentary and adipose tissues was performed along a marked line, followed by hemostatic control using a bipolar electrocoagulator, removal of wound margins with surgical elevators, exposure, and sectioning of the platysma along the entire length of the incisions with hemostasis.

A B C

Figure 3. **Incision line marking (A), facial artery preparation (B), immediate postoperative appearance in patients with oral floor phlegmon from the study cohort (C)**

After removing the incised margins of the platysma, access was created to the digastric muscles and the submandibular gland fascia. Subsequently, the facial artery and vein were identified, prepared, fixed, sectioned, and sutured in both the right and left submandibular regions (refer to Figure 3 B). Hemostatic forceps were used to enter the submandibular and sublingual spaces, medial to the submandibular gland and lateral to the anterior bellies of the digastric muscles.

On the contralateral side, an incision was performed while preserving a tissue bridge with a minimum distance of 2 cm between incisions. Following identical steps on the opposing side, the incisions were deepened and joined, maintaining the integrity of the skin and platysma muscle to ensure vascularization and decrease the risk of tissue necrosis.

Entry into the submental space was made between the anterior bellies of the digastric muscles. Intraoperatively, the spaces from which purulent discharges were collected were recorded, including their density, color, and odor. During the drainage of purulent collections, samples were taken for bacteriological examination and sensitivity to antibiotic groups.

Hemostatic control was performed, and perforated tube drains were applied to the drained spaces, which were sutured to the skin (Figure 3 C).

Simultaneously with the drainage tubes, sterile gauze pads soaked in antiseptic solutions were applied, which were removed during the first dressing. The postoperative wound was washed with gauze cloths soaked in 3% $H_2O_2$ antiseptic solutions, the punctured tubes were washed with a 10 ml syringe without a needle, and the wound edges were treated with 70% alcohol. Afterwards, an aseptic dressing was applied.

Regarding management of the causative tooth, the affected tooth should be extracted in a separate procedure, either prior to or following surgical intervention for the buccal floor phlegmon.

Secondary suturing in patients with buccal floor phlegmon was only carried out after reducing the inflammatory indices and purulent drainage (see Figure 4).


Figure 4. **Post-surgical secondary suture application in patients from both the control group (A) and in patients from the study group (B)**

### 2.5. Statistical data processing methods

The primary materials of the study were introduced into an electronic database and processed using the functions and modules of the SPSS software version 16.0 for *Windows* (SPSS Inc., Belmont, CA, USA, 2008) and *Microsoft Office Excel 2019* on a personal computer through descriptive and inferential statistical procedures. Absolute and relative frequencies were computed for nominal or categorical variables, while mean values, standard errors, and standard deviations of the mean were calculated for quantitative or continuous variables (interval or ratio). Various statistical tests were applied for analysis: the $\chi^2$ test according to Pearson, $\chi^2$ test with Yates' correction, or Fisher's exact test for comparing discrete variables; the Kolmogorov-Smirnov test for assessing the normality of interval-scaled variables; the "t" test or non-parametric statistical tests to ascertain statistical differences in mean values between groups. Additionally, one-way analysis of variance with post-hoc analysis tests and the non-parametric Kruskal – Wallis test were applied to assess multiple differences between mean values in study cohorts. Correlation analysis (Pearson's r, Spearman's ρ, Kendall's τ) was conducted to assess the intensity and direction of statistical relationships. Statistically significant differences were defined by a bilateral p-value of $<0.05$.

## 3. OUTCOMES ASSESSMENT OF PATIENTS WITH ORAL FLOOR PHLEGMON

### 3.1. Clinical and Paraclinical Analysis of the Overall Cohort

**Socio-demographic data.** The overall study cohort consisted of 100 patients aged between 18 and 83 years, diagnosed with oral floor phlegmon, including 55 (55.0%; 95% CI: 45.2-64.5) male patients and 45 (45.0%; 95% CI: 35.5-54.8) female patients.

The mean age of patients with phlegmon of oral floor at time of addressing for medical care was 41.38±16.4 (Md - 40.0, IQR: 27.0-53.75) years. Approximately 4/5 – 79 (79.0%; 95% CI: 70.3-86.1) of patients had a health insurance policy, while 21 (21.0%; 95% CI: 13.9-29.7) did not have one.

**Clinical examination and diagnosis**. The etiology of buccal floor phlegmon was non-odontogenic in 4 cases (4.0%; 95% CI: 1.4-9.2) and odontogenic in 96 cases (96.0%; 95% CI: 90.8-98.6), with mandibular molars 7 and 8 identified as the causative teeth in 73 (76.1%; 95% CI: 63.6-83.4) patients. Exooral examination revealed right-sided submandibular edema, left-sided submandibular edema, and submental edema in all 100 (100.0%) patients, right-sided submandibular hyperemia in 79 (79.0%; 95% CI: 70.0-85.8) patients, left-sided submandibular hyperemia in 82 (82.0%; 95% CI: 73.3-88.3) patients, and submental hyperemia in all 100 (100.0%) patients. Right-sided submandibular induration was observed in 71 (71.0%; 95% CI: 61.5-79.0) patients, left-sided submandibular induration in 73 (73.0%; 95% CI: 63.6-80.7) patients, and submental induration in 96 (96.0%; 95% CI: 90.2-98.4) patients.

The mean oral cavity opening value was 2.37±0.7; Md - 2.0, IQR: 2.0-3.0 cm (ranging from 1.0 cm to 4.5 cm). Oral cavity opening of 1 cm was observed in 4 patients (4.0%; 95% CI: 1.4-9.2), from 1.1 cm to 2.0 cm in 53 patients (53.0%; 95% CI: 43.3-62.5), from 2.1 cm to 3.0 cm in 38 patients (38.0%; 95% CI: 29.1-47.8), and >3 cm in 5 patients (5.0%; 95% CI: 2.2-11.2).

Patients with buccal floor phlegmon complained of dysphonia in 100 (100.0%) cases, oral floor pain in 100 (100.0%) cases, and swallowing disorders in 97 (97.0%; 95% CI: 91.6-99.0) cases.

According to Luigi Bonavina's classification, normal swallowing was observed in 3 patients (3.0%; 95% CI: 1.0-8.5), 40 patients (40.0%; 95% CI: 30.9-49.8) were capable of ingesting solid foods, 29 patients (29.0%; 95% CI: 21.0-38.5) could manage semi-liquid foods, and 23 patients (23.0%; 95% CI: 15.8-32.2) were able to consume liquids. However, 5 patients (5.0%; 95% CI: 1.1-11.2) exhibited complete dysphagia.

Class 1 of the Mallampati score was absent in all patients. Class 2 was identified in 15 cases (15.0%; 95% CI: 9.3-23.3), class 3 in 65 cases (65.0%; 95% CI: 55.3-73.6), and class 4 in 20 cases (20.0%; 95% CI: 13.3-28.9).

The mean procalcitonin level in patients with buccal floor phlegmon was 0.84±1.1; Md - 0.6, IQR: 0.04-0.88 ng/mL (ranging from undetectable to 5.0 ng/mL). Based on procalcitonin levels, values up to 0.5 ng/mL were observed in 29 patients (29.0%; 95% CI: 21.0-38.5), values between 0.5-2.0 ng/mL in 62 patients (62.0%; 95% CI: 52.2-70.9), and values exceeding 2.0 ng/mL in 9 patients (9.0%; 95% CI: 4.8-16.2).

**Intraoperatively**, purulent exudates were found in 97 (97.0%; 95% CI: 92.2-99.1) of patients. The mean surgical intervention duration was 40.24±14.1; Md - 40.0, IQR: 30.0-49.8 minutes (ranging from 20 to 80 minutes). Antibiotic drug treatment (1st-3rd generation cephalosporins, metronidazole, aminoglycosides, fluoroquinolones, lincosamides, penicillins, carbapenems, and vancomycin) was administered for a period of 8.00±3.5; Md - 8.0, IQR: 5.25-10.0 days (ranging from 2 to 19 days).

Postoperatively, the mean onset of buccal floor edema regression was observed at 5.19±3.0; Median - 5.0, IQR: 3.0-6.0 days (ranging from 2 to 19 days), and hyperemia at 3.90±2.2; Median - 3.0, IQR: 3.0-4.0 days (ranging from 1 to 15 days), while purulent discharge ceased at 5.59±3.9; Median - 5.0, IQR: 3.0-8.0 days (ranging from 1 to 19 days).

The mean hospital stay for patients with buccal floor phlegmon was 8.03±3.6; Median - 8.0, IQR: 5.3-10.0 days (ranging from 2 to 19 days). Secondary sutures were applied on average on day 13.62±4.0; Median - 13.0, IQR: 12.0-16.0 (ranging from 1 to 33 days).

### 3.2. Efficacy of minimally invasive surgical treatment in patients with oral floor phlegmon

**Socio-demographic data**. At the time of initial medical consultation, patients in both the study and control groups exhibited similar socio-demographic characteristics (p>0.05). This included age distribution (38.80±15.6; Md - 38.0, IQR: 25.5-50.0 years for the study group and 43.86±16.8; Md - 40.0, IQR: 28.0-56.0 years for the control group), insurance coverage (37 insured - 75.5%; 95% CI: 62.2-85.9 of study group patients and 42 insured - 82.4%; 95% CI: 70.3-90.9 of control group patients) and living environment (28 - 57.1%; 95% CI: 43.2-70.3 from rural areas in the study group and 39 - 76.5%; 95% CI: 63.6-86.4 from rural areas in the control group; 21 - 42.9%; 95% CI: 29.7-56.8 from urban areas in the study group and 12 - 23.5%; 95% CI: 13.6-36.4 from urban areas in the control group).

**Onset and hospitalization.** Analysis of the persistence and intensity of dental pain, assessed using the visual analog scale over time, revealed an earlier increase in the control group. Thus, in the study group, dental pain intensity surged on the 4th and 5th days, whereas in the control cohort, it increased on the 3rd and 4th days, compared to the 1st day of the study. A similar pattern was observed for pain intensity concerning the oral floor: it peaked on the 6th and 7th days in the study group, and on the 5th, 6th, and 7th days in the control group (see Table 1).

The mean durations from condition onset to hospitalization (4.86±2.0; Md - 5.0, IIQ: 3.0-6.0 days in the study group, and 4.84±2.5; Md - 4.0, IIQ: 3.0-6.0 days in the control group; p>0.05), from dental pain onset to edema onset (2.04±1.0; Md - 2.0, IIQ: 1.0-3.0 days in the study group, and 2.12±1.2; Md - 2.0, IIQ: 1.0-3.0 days in the control group; p>0.05), and from edema onset to seeking medical care (2.84±1.1; Md - 2.0, IIQ: 2.0-3.0 days in the study group, and 2.84±1.4; Md - 3.0, IIQ: 2.0-3.5 days in the control group; p>0.05) were comparable in both study cohorts.

**Clinical examination and diagnosis.** The etiology of buccal floor phlegmon was non-odontogenic in 3 cases (6.1%; 95% CI: 1.8-15.4) in the study group and 1 case (2.0%; 95% CI: 0.2-8.8) in the control group (p>0.05), and odontogenic in 46 cases (93.9%; 95% CI: 84.6-98.2) and 50 cases (98.0%; 95% CI: 91.2-99.8), respectively. In 35 patients (71.4%; 95% CI: 57.6-82.2) from the study group and 38 patients (74.5%; 95% CI: 61.1-84.5) from the control group, the causative teeth were the mandibular molars 7 and 8 (p>0.05).

Although the mean body temperature was similar in both study groups (38.13±0.7º; Md - 38.2, IQR: 37.5-38.5 in the study group patients and 38.00±0.8º; Md - 38.1, IQR: 37.4-38.5 in the control group patients; p>0.05), the mean fever time was significantly shorter in the study group patients (2.55±1.9; Md - 2.0, IQR: 1.0-3.0 days and 5.20±4.2; Md - 4.0, IQR: 2.0-7.0 days, respectively; p<0.001).

Table 1. **Dental pain and oral floor discomfort, assessed dynamically via the visual analog scale, in patients with oral floor phlegmon from both study groups**

| **Parameters** | | **Days** | | | | | | | **p** |
|---|---|---|---|---|---|---|---|---|---|
| | | **1st day** | **2nd day** | **3rd day** | **4th day** | **5th day** | **6th day** | **7th day** | |
| Dental pain | Study group | 3,92±1,8 | 5,57±2,2 | 6,94±2,3 | 5,73±2,2 | 5,04±2,2 | 3,73±0,9 | 3,42±0,9 | 1-4**, 1-5** |
| | Control group | 4,37±2,2 | 6,02±2,3 | 7,54±2,0 | 6,00±2,2 | 4,54±1,8 | 3,80±1,0 | 3,36±0,8 | 1-3*, 1-4*** |
| Oral floor pain | Study group | 0 | 2,16±2,7 | 4,36±2,8 | 5,74±2,2 | 6,50±2,2 | 7,20±1,2 | 7,80±0,8 | 1-6**, 1-7*** |
| | Control group | 0,04±0,3 | 1,66±2,5 | 4,15±2,7 | 5,46±2,1 | 6,25±1,8 | 7,21±0,8 | 8,27±0,9 | 1-5*, 1-6***, 1-7*** |

Note: * - p<0,05, ** - p<0,01, *** - p<0,001.

The frequencies of complaints among patients with buccal floor phlegmon were comparable (p>0.05) between the study and control groups. All patients with buccal floor phlegmon in both study groups reported dysphonia in 100.0% of cases, while buccal floor pain was reported by 49 (100.0%) patients in the study group and 50 (98.0%; 95% CI: 89.7-99.7) patients in the control group.

The extraoral examination revealed right submandibular edema, left submandibular edema, and submental edema in all patients in both study groups. Right submandibular hyperemia was found in 38 (77.6%; 95% CI: 64.1-87.0) patients in the study group and 41 (80.4%; 95% CI: 67.5-89.0) patients in the control group (p>0.05). Left submandibular hyperemia was present in 40 (81.6%; 95% CI: 68.6-90.0) patients in the study group and 42 (82.4%; 95% CI: 69.8-90.4) patients in the control group (p>0.05), and submental hyperemia was found in all 100 (100.0%) patients in both study groups. Right submandibular induration was recorded in 35 (71.4%; 95% CI: 57.6-82.2) patients in the study group and 36 (70.6%; 95% CI: 57.0-81.3) patients in the control group (p>0.05), whereas left submandibular induration was in 35 (71.4%; 95% CI: 57.6-82.2) patients in the study group and 38 (74.5%; 95% CI: 61.1-84.5) patients in the control group (p>0.05). Submental induration was present in 46 (93.9%; 95% CI: 83.5-97.9) patients in the study group and 50 (98.0%; 95% CI: 89.7-99.7) patients in the control group (p>0.05) (Figure 5).

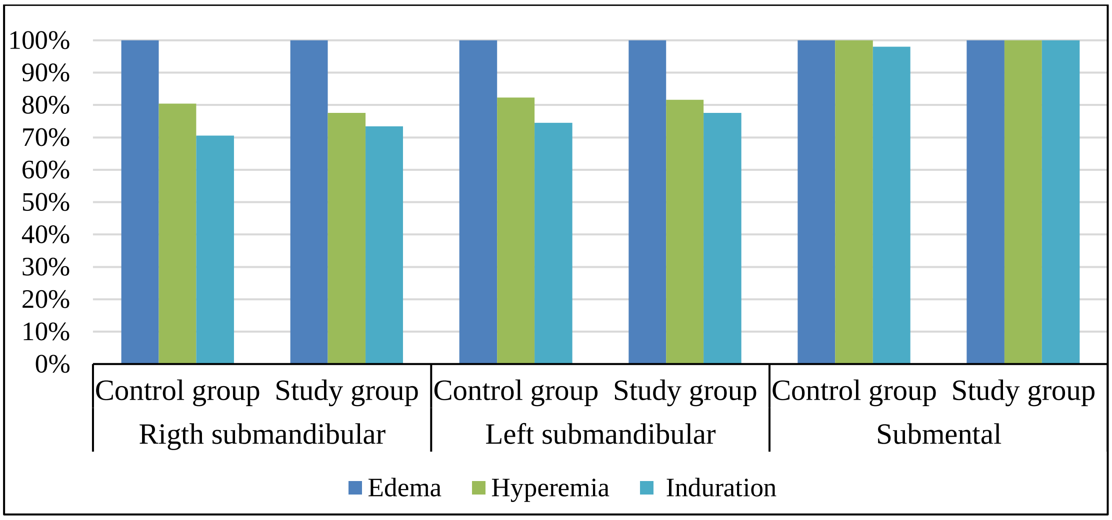


Figure 5. **The frequency of edema, hyperemia, and induration in patients the buccal floor phlegmon**

No statistically significant differences were observed in the mean values of oral cavity opening: 2.39±0.7; Md - 2.0, IQR: 2.0-3.0 cm in the study group patients and 2.35±0.7; Md - 2.0, IQR: 2.0-3.0 cm in the control group patients; (p>0.05), including a 1 cm oral cavity opening observed in 2 (4.1%; 95% CI: 1.1-13.7) and 2 (3.9%; 95% CI: 1.1-13.2) patients, from 1.1 cm to 2.0 cm – in 26 (53.1%; 95% CI: 39.4-66.3) and 27 (52.9%; 39.5-66.0) patients, from 2.1 cm to 3.0 cm – in 18 (36.7%; 95% CI: 24.7-50.7) and 20 (39.2%; 95% CI: 27.0-52.9) patients, and >3 cm – in 3 (6.1%; 95% CI: 2.1-16.5) and 2 (3.9%; 95% CI: 1.1-13.2) patients, respectively (Figure 6).

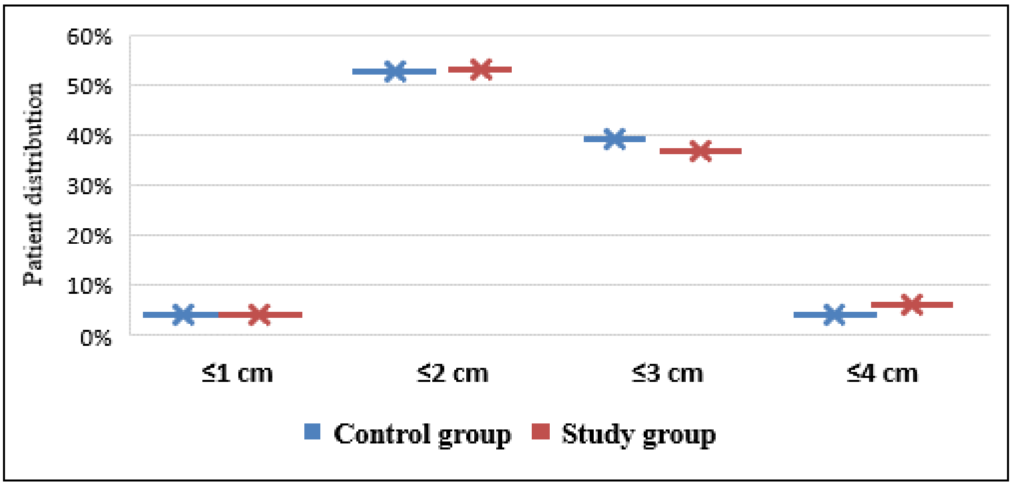


Figure 6. **Oral cavity opening size in patients with buccal floor phlegmon**

Based on the dysphagia assessment, there was no statistically significant difference between the patients in both study groups (p>0.05). According to Luigi Bonavina's classification, normal swallowing was observed in 1 patient (2.0%; 95% CI: 0.4-10.7) in the study group and in 2 patients (3.9%; 95% CI: 1.1-13.2) in the control group, both capable of swallowing solid foods. Additionally, 20 patients (40.8%; 95% CI: 28.2-54.8) in the study group and 20 patients (39.2%; 95% CI: 27.0-52.9) in the control group were able to swallow semi-liquid foods. 13 patients (26.5%; 95% CI: 16.2-40.3) in the study group and 16 patients (31.4%; 95% CI: 20.3-45.0) in the control group were capable of swallowing liquids. 13 patients (26.5%; 95% CI: 16.2-40.3) in the study group and 10 patients (19.6%; 95% CI: 11.0-32.5) in the control group, while 2 patients (4.1%; 95% CI: 1.1-13.7) in the study group and 3 patients (5.9%; 95% CI: 2.0-15.9) in the control group presented with total dysphagia (Figure 7).

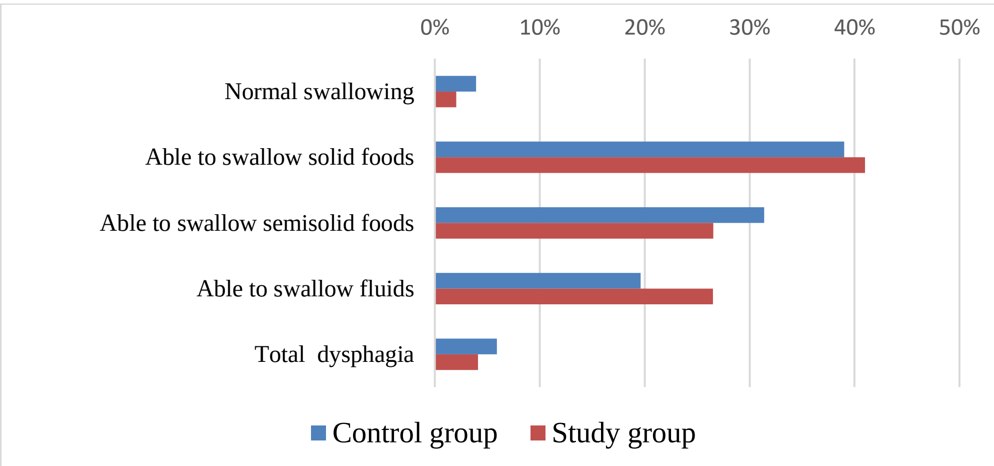


Figure 7. **The degree of dysphagia in patients with oral floor phlegmon according to the Luigi Bonavina classification**

Class 1 of the Mallampati score was not present in any patient in both study groups. Class 2 was observed in 10 (20.4%; 95% CI: 11.5-33.6) cases in the study group and in 5 (9.8%; 95% CI: 4.3-21.0) cases in the control group (p>0.05). Class 3 was found in 30 (61.2%; 95% CI: 47.3-73.6) cases in the study group and in 35 (68.6%; 95% CI: 55.0-79.7) cases in the control group (p>0.05), and class 4 was present in 9 (18.4%; 95% CI: 10.0-31.4) cases in the study group and in 11 (21.6%; 95% CI: 12.5-34.6) cases in the control group (p>0.05) (Figure 8).

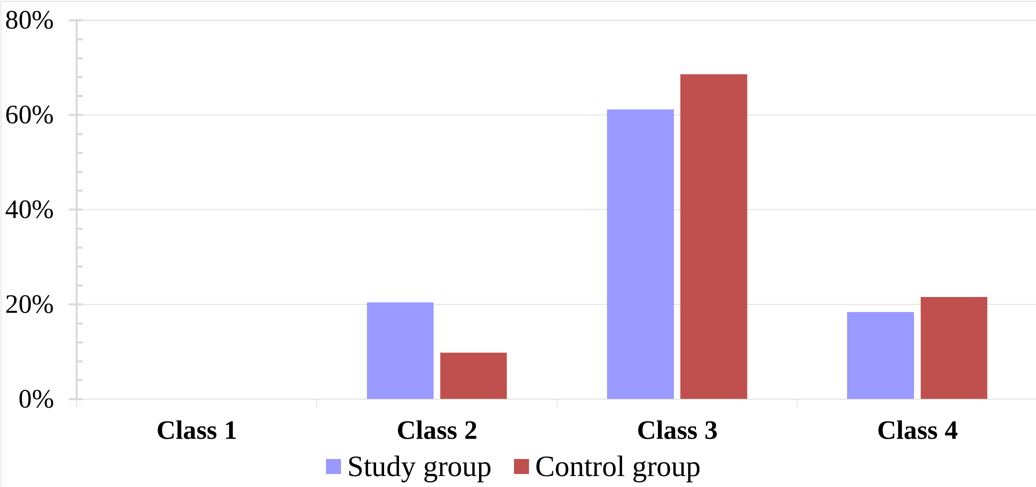


Figure 8. **Mallampati score in patients with buccal floor phlegmon**

Despite a noted trend towards elevated mean procalcitonin levels in the study cohort (0.87±1.1; Md – 0.55, IQR: 0.04-2.0 ng/mL for study group patients and 0.81±1.1; Md – 0.53, IQR: 0.04-0.79 ng/mL for control group patients; p>0.05), this difference did not achieve statistical significance.

**Intraoperatively,** purulent exudates were observed in 46 (93.9%; 95% CI: 83.5-97.9) patients in the study group and 51 (100.0%) patients in the control group (p>0.05). Clinically, purulent submandibular secretions were identified on the right side in 36 (73.5%; 95% CI: 59.7-83.8) patients in the study group and 36 (70.6%; 95% CI: 57.0-81.3) patients in the control group (p>0.05). Similarly, purulent submandibular secretions were found on the left side in 41 (83.7%; 95% CI: 71.0-91.5) and 45 (88.2%; 95% CI: 76.6-94.5) patients, respectively (p>0.05). Additionally, purulent sublingual secretions were present on the right side in 18 (36.7%; 95% CI: 24.7-50.7) and 28 (54.9%; 95% CI: 41.4-67.7) patients (p>0.05), while on the left side, they were observed in 24 (49.0%; 95% CI: 35.6-62.5) and 30 (58.8%; 95% CI: 45.2-71.3) patients (p>0.05). Submental purulent secretions were seen in 40 (81.6%; 95% CI: 68.6-90.0) and 38 (74.5%; 95% CI: 61.1-84.5) patients, respectively (p>0.05) (Figure 9).

The mean surgery time, despite an increasing tendency observed in the control group, was similar in both study cohorts: 41.14±15.0 (Md - 40.0, IQR: 30.0-50.0) minutes (range: 20 to 80 minutes) and 39.31±13.2 (Md - 40.0, IQR: 30.0-48.5) minutes (range: 20 to 65 minutes).

The predominant pathogens identified in the control group via intraoperative bacteriological analysis were *Staphylococcus epidermidis* (17.6%; 95% CI: 8.2-27.9), *Group G Streptococcus* (11.8%; 95% CI: 4.2-19.4), and *Enterococcus faecalis* (11.8%; 95% CI: 4.2-19.4). The prevailing pathogens found in the study group, were *Staphylococcus epidermidis* (18.4%; 95% CI: 8.0-29.3), *Group C Streptococcus* (14.3%; 95% CI: 5.0-25.3), *Enterococcus faecalis* (8.2%; 95% CI: 1.9-17.0), and *Streptococcus pyogenes* (8.2%; 95% CI: 1.9-17.0).

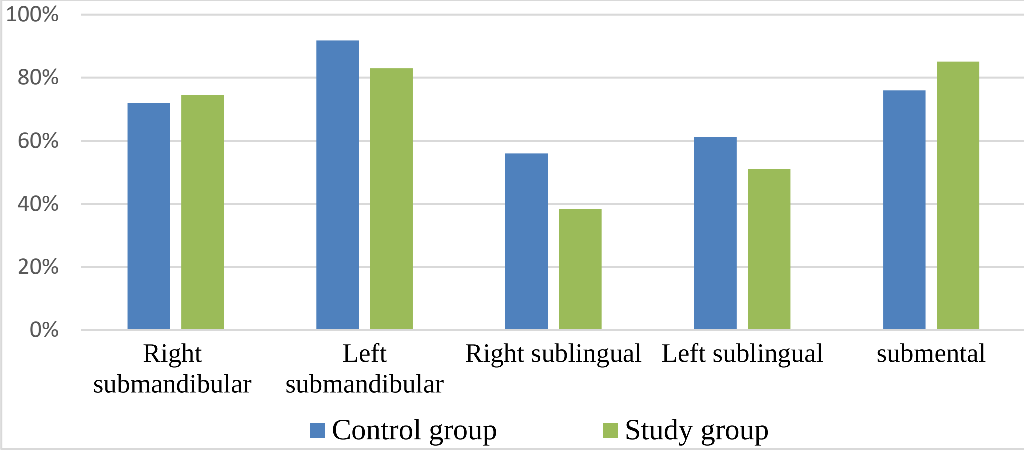


Figure 9. **Intraoperatively detected purulent accumulation in patients with buccal floor phlegmon**

The antibiotic drug treatment was similar (p>0.05) in both study groups and included the administration of first-generation cephalosporins in 6 (12.2%; 95% CI: 5.7-24.2) cases in the study group and 6 (11.8%; 95% CI: 5.5-23.4) cases in the control group; second-generation cephalosporins in 29 (59.2%; 95% CI: 45.3-71.8) and 35 (68.6%; 95% CI: 55.0-79.7) cases, respectively; third-generation cephalosporins in 27 (55.1%; 95% CI: 41.3-68.2) and 31 (60.8%; 95% CI: 47.1-73.0) cases, respectively; metronidazole in 32 (65.3%; 95% CI: 51.3-77.1) and 33 (64.7%; 95% CI: 51.0-76.4) cases, respectively; aminoglycosides in 19 (38.8%; 95% CI: 26.4-52.8) and 23 (45.1%; 95% CI: 32.3-58.6) cases, respectively; fluoroquinolones in 3 (6.1%; 95% CI: 2.1-16.5) and 4 (7.8%; 95% CI: 3.1-18.5) cases, respectively; lincosamides in 4 (8.2%; 95% CI: 3.2-19.2) and 4 (7.8%; 95% CI: 3.1-18.5) cases, respectively; penicillin group druds in 5 (10.2%; 95% CI: 4.4-21.8) and 4 (7.8%; 95% CI: 3.1-18.5) cases, respectively; carbapenems in 2 (4.1%; 95% CI: 1.1-13.7) and 1 (2.0%; 95% CI: 0.4-10.3) case, respectively and vancomycin in 3 (6.1%; 95% CI: 2.1-16.5) and 1 (2.0%; 95% CI: 0.4-10.3) case, respectively. However, the mean length of antibiotic therapy administration was statistically significantly higher (p<0.001) in patients in the control group: 9.80±3.2; Md - 9.0, IQR: 8.0-11.0) days (ranging from 5 to 19 days) compared to 6.12±2.8; Md - 6.0, IQR: 4.0-7.0 (ranging from 2 to 19 days) in the study group (Figure 10).

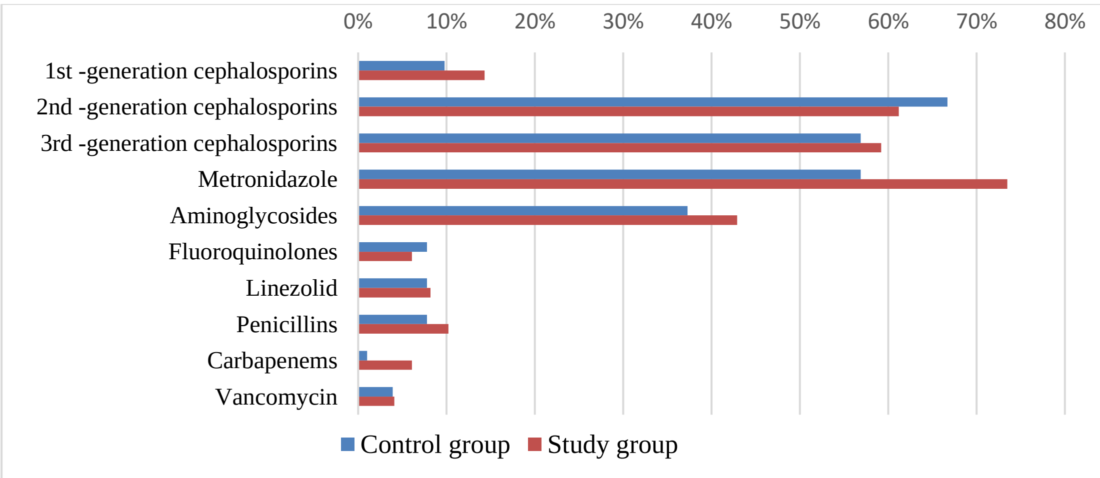


Figure 10. **Antibiotic groups administered to patients with buccal floor phlegmon**

Glycopeptides (vancomycin) and Oxazolidinones (linezolid) show excellent sensitivity (100%), being followed by Fluoroquinolones (20.1%), Penicillins (17.5%), Macrolides (8.3%), and Aminoglycosides (6.7%).

Following surgical intervention, the study group patients showed a significantly earlier onset of edema regression in the buccal floor (6.27±3.6; Md - 6.0, IQR: 3.0-7.0 days, and 4.06±1.6; Md - 4.0, IQR: 3.0-5.0 days, respectively; $p<0.001$), onset of hyperemia regression of in the buccal floor (4.61±2.8; Md- 4.0, IQR: 3.0-5.0 days, and 3.16±1.2; Md - 3.0, IQR: 2.0-4.0 days, respectively; $p<0.001$) and the disappearance of purulent discharges (7.25±3.9; Md - 7.0, IQR: 4.0-9.0 days, and 3.86±3.0; Md - 3.0, IQR: 1.0-6.0 days, respectively; $p<0.001$). The onset periods of edema and hyperemia regression, and the disappearance of purulent discharges in patients with buccal floor phlegmon from both study groups are presented in Figure 11.

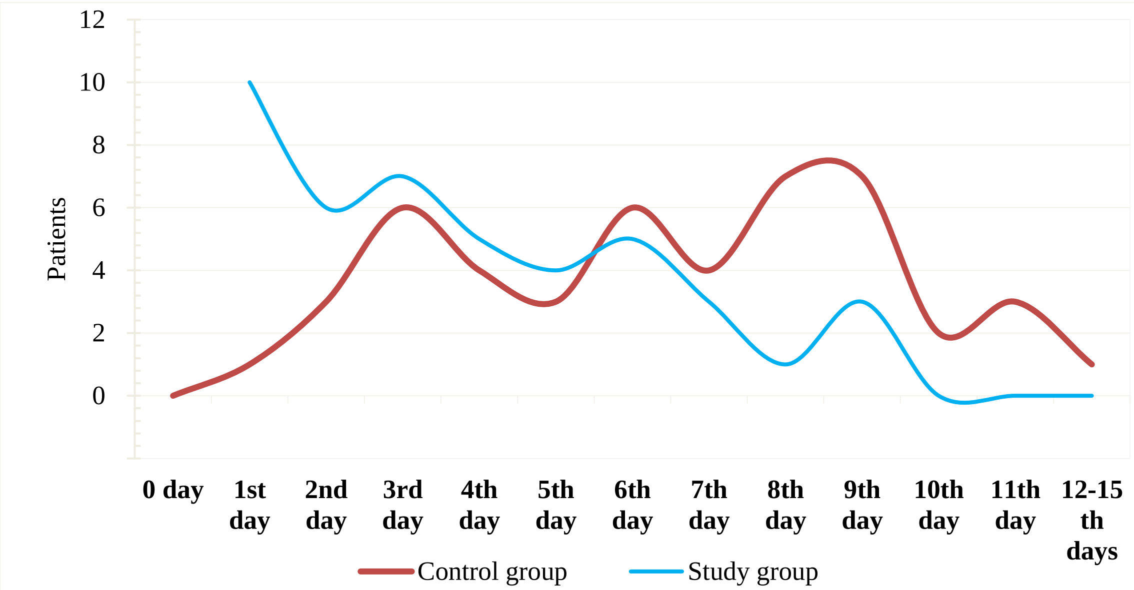


Figure 11. **The period of pus drainage cessation in patients with oral floor phlegmon**

The mean hospital stay for patients with buccal floor phlegmon was significantly shorter in the study group: 9.86±3.3 days (MD - 9.0, IQR: 8.0-11.0) compared to 6.12±2.8 days (MD - 6.0, IQR: 4.0-7.0) for controls ($p<0.001$).

## SYNTHESIS OF THE RESULTS OBTAINED

Buccal floor phlegmon typically starts as a dental infection from the second or third molar, rapidly extending to involve initially unilateral and subsequently bilateral submandibular, sublingual, and submental spaces. Various systemic symptoms such as fever, chills, and fatigue emerge due to the immune response triggered by bacterial infection [2, 6]. In comparison to the control group, patients in the study cohort exhibited a statistically significant decrease in mean febrile duration (2.55±1.9; Md - 2.0, IQR: 1.0-3.0 days and 5.20±4.2; Md - 4.0, IQR: 2.0-7.0 days, respectively; $p<0.001$).

In the initial stage of treatment, broad-spectrum empirical antibiotic therapy is administered, and after obtaining the sensitivity test results, targeted antibiotic therapy is employed [15]. The average time of antibiotic therapy administration (6.12±2.8; Md - 6.0, IQR: 4.0-7.0 days and 9.80±3.2; Md - 9.0, IQR: 8.0-11.0 days, respectively; $p<0.001$) in patients undergoing conventional treatment was statistically significantly higher.

According to the results of two studies, multiple small interrupted incisions (consisting of 2 incisions, each extending 1.5-2 cm below the bilateral mandibular margin for drainage of the submandibular and sublingual spaces, along with a similar incision beneath the mandibular symphysis for drainage of the submental space) offers a safer and less invasive alternative compared to the conventional approach. This method provides several advantages: early improvement in clinical presentation, reduced patient hospital length, faster wound healing with significantly better cosmetic results, without an increase in the complication rate. The authors explain this by the smaller size of the incisions and the minimally invasive nature of the procedure, resulting in faster healing.

Average time of surgical intervention, although showing an increasing trend in the control group, was similar in both cohorts in our study: 41.14±15.0 (Md - 40.0, IQR: 30.0-50.0) minutes and 39.31±13.2 (Md - 40.0, IQR: 30.0-48.5) minutes ($p>0.05$). Following surgical intervention, the symptoms persisted significantly shorter, whereas the onset of edema regression in the buccal region (6.27±3.6 and 4.06±1.6 days, respectively; $p<0.001$), onset of hyperemia regression in the buccal region (4.61±2.8 and 3.16±1.2 days, respectively; $p<0.001$), and resolution of purulent discharge (7.25±3.9 and 3.86±3.0 days, respectively; $p<0.001$) occurred significantly earlier in the study group patients.

The mean hospital stay length for patients with oral floor phlegmon was statistically significantly shorter (6.12±2.8 and 9.86±3.3 days, respectively; $p<0.001$), whereas the secondary sutures were applied significantly earlier (at 12.02±3.3 and at 15.16±4.1 days, respectively; $p<0.001$) in the study group.

The choice of surgical approach for patients with buccal floor phlegmon depends on the stage of clinical presentation. In cases of normal-weight patients with early-stage inflammatory processes without signs of anaerobic inflammation, surgical intervention can involve two incisions. However, in patients with obesity grades 2 or 3, where the buccal space adipose tissue is more substantial and fluid extravasation is increased, there is a risk of tissue and vascular compression leading to hypotrophy and potential areas of necrosis with anaerobic flora. In such patients, a single incision from one mandible gonion to the other one is recommended. Following the results obtained, we developed an algorithm for the diagnosis and treatment of patients with phlegmon of the oral floor (figure 12).

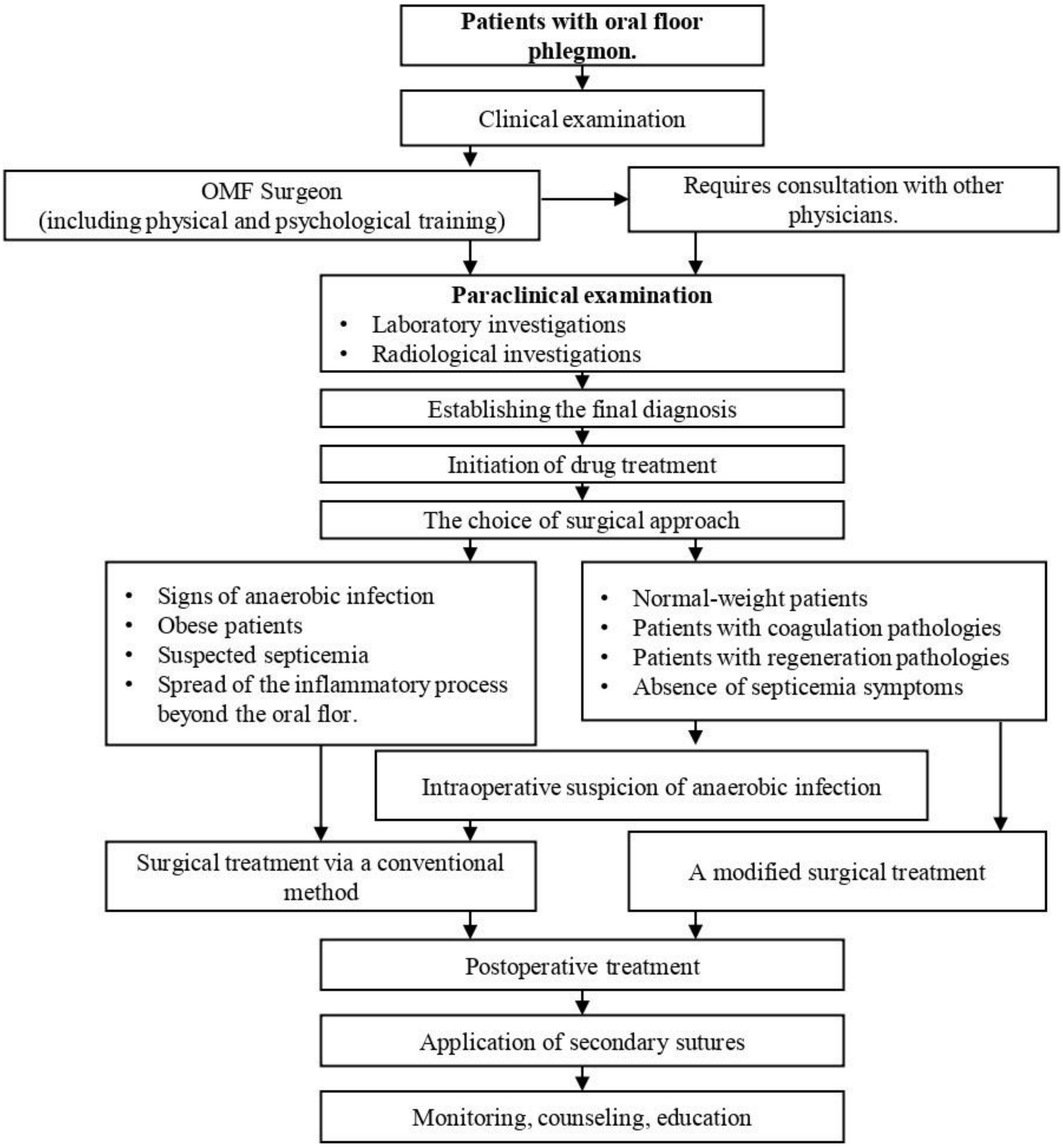


Figure 12. **Curative diagnostic algorithm for phlegmon patients of the oral floor at the hospital stage**

## GENERAL CONCLUSIONS

1. Following the dynamic assessment of local and general factors in patients with oral floor phlegmon from the overall study cohort, it can be observed that the general condition improves more rapidly than the local condition. The regression of edema in the buccal space occurred, on average, at 5.19±3.0 days, while hyperemia resolved at 3.90±2.2 days, and purulent discharges ceased at 5.59±3.9 days. General symptoms followed this progression over time: confusion – 0.25±0.5 days, nausea – 0.26±0.5 days, cold sweating – 0.43±0.9 days, headache – 1.62±1.3 days, apathy – 2.43±1.3 days, and fatigue – 4.73±2.7 days.
2. During the comparative study of the two groups of patients with oral floor phlegmon, we noted comparable socio-demographic data, onset and clinical course of the pathology, presentation

examination, and intraoperative characteristics ($p>0.05$). However, the postoperative evolution of both local and general clinical conditions showed statistically significant improvement ($p<0.05$), with a more favorable regenerative process observed in the study group.

3. Patients with reactive cervical edema, obesity, phlegmon extending beyond the boundaries of the oral floor, or with identification of necrotic tissues and gas bubbles during surgery represent situations where surgical processing with separate incisions is contraindicated. An approach with two separate incisions, connected by an area of tissues, is confidently recommended for normal-weight patients, whose phlegmon boundaries do not exceed the oral floor, in the absence of septic conditions and without clinical signs of intraoperative anaerobic infections. Under these conditions, statistically significant differences in treatment evaluation are statistically significant ($p <0.05$).
4. The diagnostic and treatment algorithm is derived from the inclusion and exclusion criteria of the study patients and the obtained results. Thus, regression of edema ($p<0.001$), hyperemia ($p<0.001$), and pus discharge ($p<0.001$), as well as the hospital stay length ($p<0.001$) in the study cohort, support the use of the proposed new algorithm. The algorithm includes both local and systemic clinical assessment, as well as the appropriate use imaging techniques, aimed at tailoring the surgical management approach for oral floor phlegmon based on preoperative or intraoperative clinical features.
5. Due to a higher risk of complications associated with oral floor phlegmon, such as descending necrotizing mediastinitis (6-13%), necrotizing fasciitis (8-16.66%), sepsis (8-30%), septic shock (40-70%), and even death (0-8%), a pre-hospital medical assistance protocol is required. Implementing this protocol can contribute to reducing evaluation time and effectively managing the necessary treatment through careful assessment of local and systemic clinical signs and symptoms while maintaining vital patient functions.

## PRACTICAL RECOMMENDATIONS

1. Patients and their relatives must be informed about the severity of the condition, treatment methods, and the recovery process.
2. The method of surgical processing of the buccal floor phlegmon needs to be selected individually for each case.
3. Patients with buccal floor phlegmon require increased monitoring at all stages of treatment.
4. Patients with buccal floor phlegmon who present preoperative or intraoperative signs of anaerobic infection require surgical processing through a wide incision.
5. Patients with buccal floor phlegmon who present reactive cervical edema or obesity require surgical processing through a wide incision.
6. Minimally invasive surgical processing is confidently recommended for normal-weight patients where the boundaries of the phlegmon do not exceed the buccal floor, in the absence of septic conditions and without clinical signs of anaerobic infections.

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**LIST OF PUBLICATIONS AND SCIENTIFIC EVENTS**

**where the research results were presented for the Ph.D. thesis in Medical Sciences on the topic „Optimizing the Diagnosis and Treatment of Patients with Oral Floor Phlegmon"**, conducted within the „Arsenie Guțan„ Department of Oro-Maxillofacial Surgery and Oral Implantology, by Mr. Levco Simion, the Ph. D graduate from the Doctoral School in Medical Sciences, at Nicolae Testemițanu State University of Medicine and Pharmacy in the Republic of Moldova, 323 – Dentistry

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✓ **Articles in ISI, SCOPUS, and other international databases.**

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