DEEP NECK INFECTIONS OF ODONTOGENIC ORIGIN: SURGICAL MANAGEMENT AND MULTIDISCIPLINARY CONSIDERATIONS

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ABSTRACT

Background: Deep neck infections of odontogenic origin may progress rapidly and cause airway compromise, sepsis, or descending necrotizing mediastinitis. Early source control and multidisciplinary management are essential in severe cases.

Methods: This retrospective observational study included 74 adult patients treated for odontogenic deep neck infections at the Department of Surgery, Clinical Emergency Hospital of Bucharest. Demographic, clinical, laboratory, imaging, microbiological, therapeutic, and outcome-related variables were analyzed. Factors associated with a complicated clinical course were assessed using multivariable logistic regression.

Results: Twenty-eight patients (37.8%) developed a complicated course. Mandibular molars were the most frequent odontogenic source (73.0%), while the submandibular space was most commonly involved. Complicated cases showed higher leukocyte counts and C-reactive protein levels and more frequent multispace and bilateral involvement. ICU admission was required in 24.3%, repeat surgery in 10.8%, advanced airway intervention in 9.5%, and descending necrotizing mediastinitis occurred in 6.8%. In-hospital mortality was 2.7%. Multispace involvement (OR 8.73; 95% CI 1.87–40.64; $p = 0.006$) and increasing CRP (OR 3.99 per 50 mg/L; 95% CI 1.84–8.68; $p < 0.001$) independently predicted complicated evolution.

Conclusions: Multispace extension and elevated CRP identify patients at increased risk and may support early escalation of surgical and multidisciplinary management.

Keywords: odontogenic infection, deep neck infection, surgical drainage, airway management, multispace infection, descending necrotizing mediastinitis

1. INTRODUCTION

Deep neck infections of odontogenic origin represent severe infectious conditions characterized by the spread of dental and periodontal pathogens beyond the alveolar process into the potential spaces of the head and neck. Although advances in dental care, antimicrobial therapy, cross-sectional imaging, and perioperative support have reduced their overall frequency, these infections remain clinically important because progression may be rapid and can result in airway obstruction, sepsis, vascular complications, or descending necrotizing mediastinitis [1,2]. Odontogenic foci continue to account for a substantial proportion of deep cervical infections, particularly when infection originating from mandibular molars extends into the submandibular, sublingual, masticator, or parapharyngeal spaces [2,3].

Once the infection crosses fascial boundaries, anatomical continuity between cervical compartments facilitates extension toward the retropharyngeal space and mediastinum. Descending necrotizing mediastinitis is among the most severe

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consequences of this process and remains associated with considerable morbidity despite modern surgical and intensive care management [4-7]. Early recognition of mediastinal extension is therefore essential, and contrast-enhanced computed tomography plays a central role in defining the extent of disease and guiding the operative approach [8,9]. Advanced cases frequently require coordinated management involving oral and maxillofacial or head and neck surgeons, anesthesiologists, intensive care specialists, radiologists, and, when thoracic spread is present, thoracic surgeons [10-12].

Successful treatment depends on three interrelated principles: prompt control of the odontogenic source, adequate drainage of infected cervical spaces, and appropriate antimicrobial therapy. Large clinical series have shown that delayed diagnosis, extensive multispace involvement, systemic comorbidities, and advanced inflammatory response are associated with a more complicated course and increased resource utilization [13-17]. Microbiologically, deep neck infections are typically polymicrobial, with streptococcal species and anaerobic organisms frequently identified, supporting the need for broad empirical antimicrobial coverage until culture-directed treatment becomes available [18,19].

Airway assessment represents an additional priority because edema, trismus, distorted anatomy, and displacement of the pharyngeal or laryngeal structures may render conventional intubation difficult. In selected patients, awake fiberoptic techniques or a surgical airway may therefore be required [20].

Against this background, the present study aimed to evaluate the clinical characteristics, anatomical distribution, surgical management, and outcomes of odontogenic deep neck infections and to identify factors associated with a complicated clinical course in patients treated at a tertiary emergency center.

2. MATERIALS AND METHODS

2.1. Study Design and Patient Selection

This retrospective observational study included 74 consecutive adult patients diagnosed and treated for deep neck infections of odontogenic origin at the Department of Surgery, Clinical Emergency Hospital of Bucharest, Bucharest, Romania, between January 2020 and December 2025 and patients were eligible for inclusion if they were ≥18 years of age and presented with a deep neck space infection confirmed by clinical examination and contrast-enhanced computed tomography (CT), with a clearly identified odontogenic source. Odontogenic origin was established based on clinical and imaging evidence of dental or periodontal infection, including periapical infection, periodontal abscess, pericoronitis, or complications following a recent dental procedure.

Patients with non-odontogenic infections, infections confined to superficial facial or dentoalveolar tissues without deep cervical extension, postoperative cervical infections unrelated to dental pathology, or incomplete clinical or radiological records were excluded.

2.2. Data Collection and Clinical Assessment

Demographic, clinical, laboratory, imaging, microbiological, and therapeutic data were retrospectively collected from medical records. Variables included age, sex, relevant comorbidities, suspected causative tooth, anatomical spaces involved, unilateral or bilateral extension, admission leukocyte count and C-reactive protein level, microbiological findings, antimicrobial therapy, airway management, intensive care unit admission, and length of hospital stay and contrast-enhanced CT was used to determine the anatomical extent of infection, the presence of abscess formation, involvement of multiple

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cervical spaces, airway deviation or compression, and possible extension into the mediastinum.

2.3. Surgical and Multidisciplinary Management

Surgical treatment consisted of elimination of the odontogenic source, incision and drainage of involved deep cervical spaces, debridement when required, and placement of drainage systems. The timing and extent of surgery were individualized according to the clinical condition and radiological extent of infection. Repeat surgical exploration was performed when persistent or progressive infection was suspected.

Airway management was determined according to the degree of upper airway compromise and anticipated difficulty of intubation. Patients with severe systemic involvement or respiratory compromise were managed in collaboration with anesthesiology and intensive care specialists. Otorhinolaryngology, radiology, infectious disease, and thoracic surgery teams were involved when dictated by the anatomical extent and clinical severity of infection, particularly in cases with descending mediastinal spread.

2.4. Outcomes and Statistical Analysis

The primary endpoint was the occurrence of a complicated clinical course, defined by at least one of the following: advanced airway intervention, intensive care unit admission, sepsis or septic shock, descending necrotizing mediastinitis, repeat surgical intervention, or in-hospital death. Secondary outcomes included duration of hospitalization and number of surgical procedures. Continuous variables were expressed as mean ± standard deviation or median and interquartile range according to data distribution. Categorical variables were reported as absolute numbers and percentages. Patients with uncomplicated and complicated clinical courses were compared using the Student's *t*-test or Mann–Whitney *U* test for continuous variables and the chi-square or Fisher's exact test for categorical variables. Variables associated with complicated evolution in univariate analysis were considered for multivariable logistic regression when the number of outcome events permitted reliable modeling. A two-sided p value < 0.05 was considered statistically significant.

3. RESULTS

3.1. Patient Characteristics and Initial Clinical Presentation

A total of 74 patients with deep neck infections of odontogenic origin fulfilled the inclusion criteria. The mean age of the study population was 54.7 ± 14.5 years, and 43 patients (58.1%) were male. Overall, 28 patients (37.8%) developed a complicated clinical course according to the predefined composite endpoint, whereas 46 patients (62.2%) had an uncomplicated evolution. Patients who developed complications were significantly older than those with an uncomplicated course (60.4 ± 12.0 vs. 51.3 ± 15.0 years; $p = 0.005$). They also presented with significantly higher admission leukocyte counts (20.6 ± 5.9 vs. 13.7 ± 4.7 $\times 10^9$/L; $p < 0.001$) and C-reactive protein levels (median 197.7 vs. 92.3 mg/L; $p < 0.001$). Diabetes mellitus was more frequent among patients with complicated evolution, although this difference did not reach conventional statistical significance (28.6% vs. 10.9%; $p = 0.065$). Baseline characteristics and comparison according to clinical course are summarized in Table 1.

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Table 1. Demographic and clinical characteristics according to clinical course.

Variable	Overall (n = 74)	Uncomplicated (n = 46)	Complicated (n = 28)	p value
Age, years	54.7 ± 14.5	51.3 ± 15.0	60.4 ± 12.0	0.005
Male sex, n (%)	43 (58.1)	25 (54.3)	18 (64.3)	0.471
Diabetes mellitus, n (%)	13 (17.6)	5 (10.9)	8 (28.6)	0.065
Multispace involvement, n (%)	34 (45.9)	12 (26.1)	22 (78.6)	<0.001
Bilateral extension, n (%)	16 (21.6)	4 (8.7)	12 (42.9)	0.001
WBC, ×10⁹/L	16.3 ± 6.2	13.7 ± 4.7	20.6 ± 5.9	<0.001
CRP, mg/L	131.7 (87.5–193.8)	92.3 (75.7–139.6)	197.7 (155.5–274.9)	<0.001

Continuous normally distributed data are presented as mean ± standard deviation; non-normally distributed data as median (interquartile range).

3.2. Odontogenic Source and Anatomical Extension

Mandibular molars represented the predominant odontogenic source, accounting for 54 cases (73.0%), followed by maxillary molars in 9 cases (12.2%), premolars in 7 cases (9.5%), and other dental sites in 4 cases (5.4%). The submandibular space was the most frequently affected anatomical compartment, followed by the parapharyngeal, sublingual, masticator, retropharyngeal, and carotid spaces. Because several patients had simultaneous involvement of more than one compartment, anatomical frequencies exceeded the total number of patients. The distribution of involved spaces is illustrated in Figure 1.

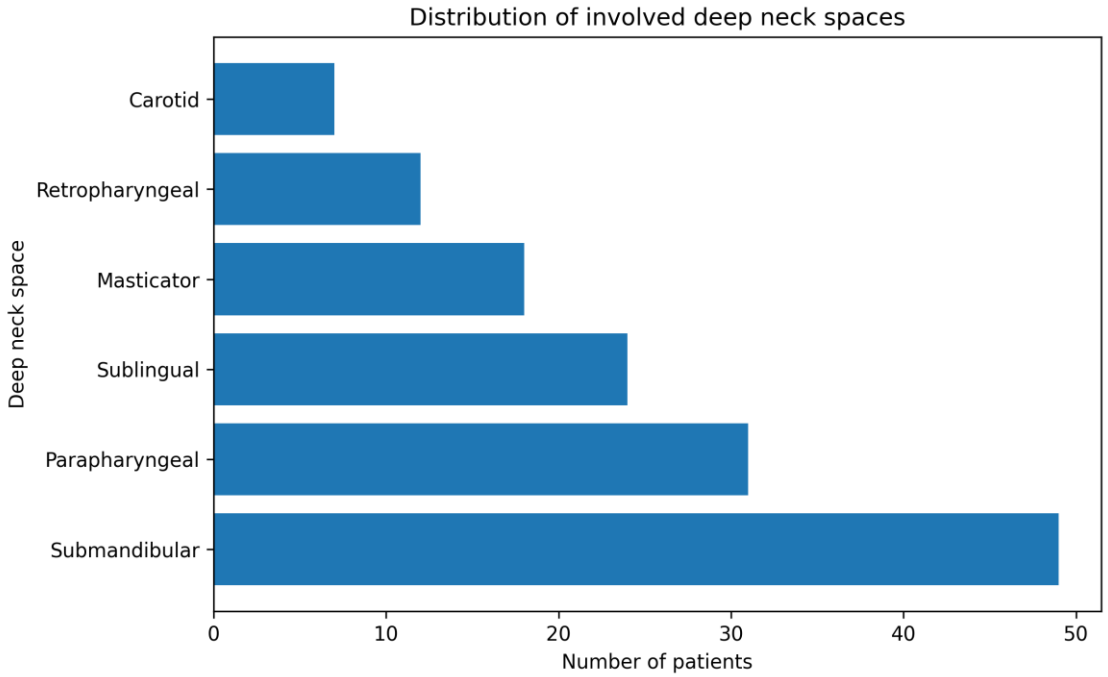


Figure 1. Distribution of involved deep neck spaces.

Multispace infection was identified in 34 patients (45.9%) and was substantially more frequent in patients with complicated evolution (78.6% vs. 26.1%; $p < 0.001$). Bilateral cervical extension was documented in 16 patients (21.6%) and was likewise associated with complicated evolution (42.9% vs. 8.7%; $p = 0.001$). Microbiological

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specimens were available in 51 patients (68.9%). The most frequently identified pattern involved streptococcal species, particularly organisms belonging to the Streptococcus anginosus group, followed by mixed aerobic–anaerobic infections. The anatomical and microbiological characteristics are presented in Table 2.

Table 2. Odontogenic source, anatomical extension, and microbiological findings.

Characteristic	n (%)
Odontogenic source	
Mandibular molars	54 (73.0)
Maxillary molars	9 (12.2)
Premolars	7 (9.5)
Other dental sites	4 (5.4)
Deep neck spaces involved*	
Submandibular	49 (66.2)
Parapharyngeal	31 (41.9)
Sublingual	24 (32.4)
Masticator	18 (24.3)
Retropharyngeal	12 (16.2)
Carotid	7 (9.5)
Multispace involvement	34 (45.9)
Bilateral extension	16 (21.6)
Microbiology, among 51 sampled patients	
Streptococcus anginosus group	21 (41.2)
Mixed aerobic–anaerobic flora	14 (27.5)
Staphylococcus aureus	6 (11.8)
Klebsiella spp.	4 (7.8)
Other microorganisms	6 (11.8)

*Multiple anatomical spaces could be involved in the same patient.

3.3. Surgical Management and Clinical Outcomes

All patients underwent definitive odontogenic source control combined with drainage according to the anatomical distribution of infection. Extraction of the causative tooth was performed during the initial surgical procedure in 69 patients (93.2%), whereas five patients underwent delayed dental source control because of clinical or anesthetic considerations.

Cervical drainage was performed whenever imaging demonstrated deep cervical collections not amenable to limited intraoral drainage. Repeat surgical exploration was required in 8 patients (10.8%) because of persistent or progressive infection.

Advanced airway intervention was required in 7 patients (9.5%), and 18 patients (24.3%) required intensive care management. Sepsis or septic shock developed in 6 patients (8.1%), whereas descending necrotizing mediastinitis occurred in 5 patients (6.8%). Two patients

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died during hospitalization, corresponding to an overall in-hospital mortality of 2.7%. Major outcomes are summarized in Table 3 and graphically represented in Figure 2.

Table 3. Surgical management and major clinical outcomes.

Outcome	n (%)
Immediate odontogenic source control	69 (93.2)
Delayed odontogenic source control	5 (6.8)
Repeat surgical intervention	8 (10.8)
Advanced airway intervention	7 (9.5)
ICU admission	18 (24.3)
Sepsis/septic shock	6 (8.1)
Descending necrotizing mediastinitis	5 (6.8)
In-hospital mortality	2 (2.7)

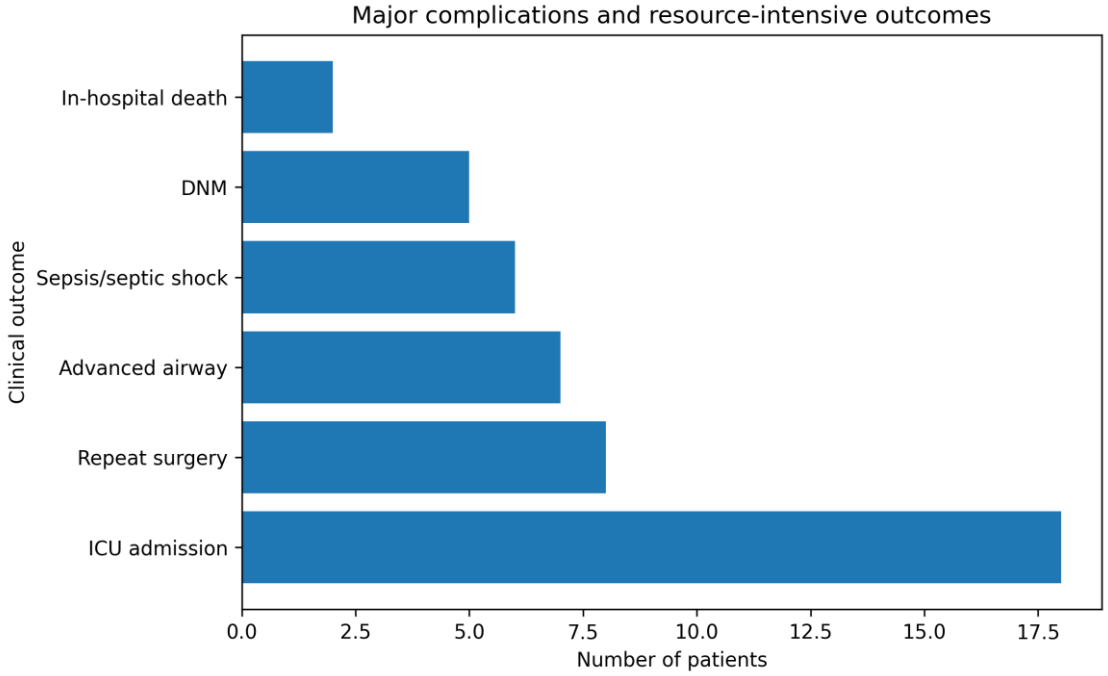


Figure 2. Major complications and resource-intensive outcomes.

Length of hospital stay differed markedly according to clinical course. Patients with complications had a median hospitalization of 15.0 days (IQR 13.5–19.1) compared with 6.7 days (IQR 5.7–8.3) among patients without complications ($p < 0.001$).

3.4. Factors Associated with a Complicated Clinical Course

Univariate analysis demonstrated significant associations between complicated evolution and older age, higher leukocyte count, elevated CRP, multispace involvement, and bilateral cervical extension. Given the number of outcome events, a parsimonious multivariable logistic regression model was constructed to reduce the risk of model overfitting.

In multivariable analysis, multispace involvement remained independently associated with complicated evolution (OR 8.73; 95% CI 1.87–40.64; $p = 0.006$). Increasing CRP also remained an independent predictor, with each 50 mg/L increase associated with approximately a fourfold

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increase in the odds of complicated evolution (OR 3.99; 95% CI 1.84–8.68; p < 0.001). Age and diabetes mellitus did not retain independent statistical significance after adjustment.

The multivariable model is presented in Table 4, while adjusted odds ratios and their 95% confidence intervals are shown in Figure 3.

Table 4. Multivariable logistic regression for predictors of complicated clinical course.

Predictor	Adjusted OR	95% CI	p value
Age, per 10-year increase	1.63	0.92–2.89	0.097
Diabetes mellitus	1.99	0.16–25.04	0.594
Multispace involvement	8.73	1.87–40.64	0.006
CRP, per 50 mg/L increase	3.99	1.84–8.68	<0.001

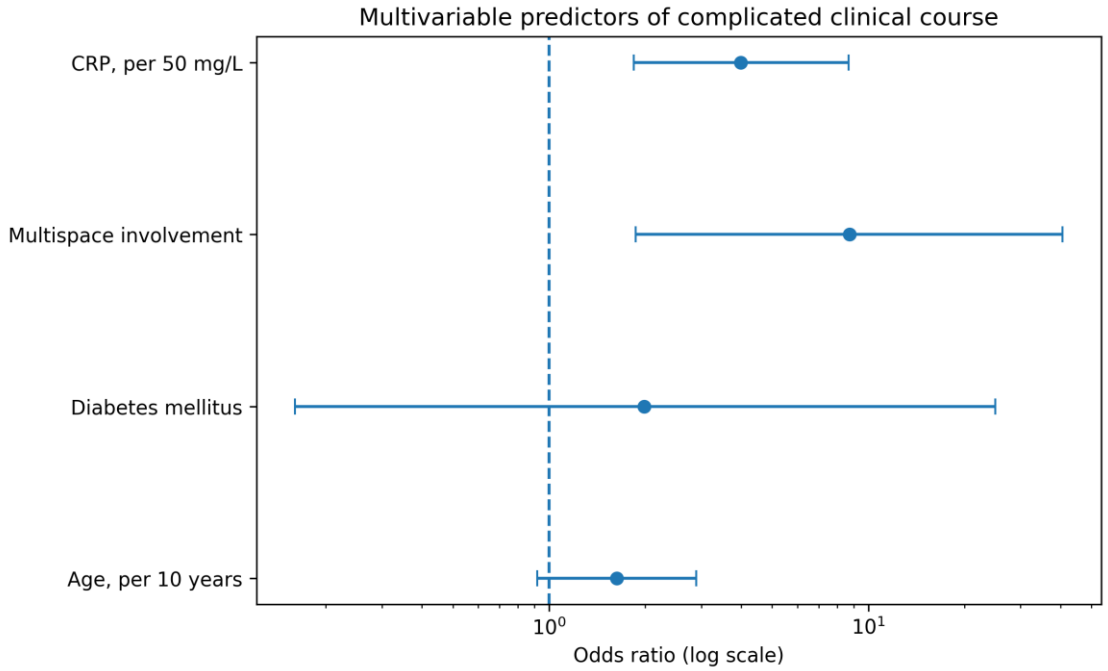


Figure 3. Multivariable predictors of complicated clinical course.

4. DISCUSSION

The present study highlights the clinical heterogeneity and potentially severe evolution of deep neck infections of odontogenic origin, emphasizing the importance of early source control, accurate assessment of anatomical extension, and coordinated multidisciplinary management. In our cohort of 74 patients, more than one-third developed a complicated clinical course, while multispace involvement and elevated C-reactive protein levels emerged as independent predictors of adverse evolution. These findings reinforce the concept that the severity of odontogenic deep neck infection is determined not only by the primary dental focus but particularly by the extent of spread through the interconnected cervical fascial spaces and by the magnitude of the systemic inflammatory response.

Odontogenic infections remain among the most important causes of deep neck infections, with mandibular molars representing a particularly relevant source because of their anatomical relationship with the submandibular and sublingual spaces. In the present series, mandibular molars accounted for nearly three-quarters of the identified odontogenic foci, while the submandibular

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space was the most frequently involved cervical compartment. Similar anatomical patterns have been reported in previous clinical series of odontogenic deep neck infections [2,3,13,15]. Once infection extends beyond the primary compartment, communication between cervical fascial planes facilitates rapid progression toward the parapharyngeal, retropharyngeal, and carotid spaces, with subsequent risk of airway compromise or descending mediastinal spread. This anatomical behavior provides a plausible explanation for the strong association observed between multispace disease and complicated clinical evolution.

The inflammatory profile at admission also appeared to have substantial prognostic value. Patients with complicated disease presented with markedly higher leukocyte counts and CRP concentrations, and CRP remained independently associated with adverse outcomes after multivariable adjustment. Although inflammatory markers should not be interpreted independently of clinical and imaging findings, they may provide an objective indication of systemic disease burden and can support early risk stratification. Conversely, diabetes mellitus was more prevalent among patients with complications but did not remain independently significant after adjustment. Previous studies have nevertheless identified diabetes and other immunocompromising conditions as factors associated with more extensive infection, prolonged hospitalization, and increased complication rates [13,16,17]. The lack of independent association in our cohort may partly reflect the limited number of diabetic patients and the relationship between metabolic comorbidity, inflammatory response, and anatomical extent.

Definitive treatment of odontogenic deep neck infection requires both drainage of established deep collections and elimination of the dental source. In our cohort, the causative tooth was removed during the initial intervention in 93.2% of patients. This approach is supported by previous evidence suggesting that early elimination of the odontogenic focus may reduce the persistence of infection and facilitate clinical resolution [3]. Surgical strategy, however, should be tailored to the distribution and severity of infection. Localized collections may occasionally be accessible through an intraoral approach, whereas extensive submandibular, parapharyngeal, or multispace abscesses generally require external cervical drainage. Persistent inflammatory findings, residual collections on imaging, or continued clinical deterioration should prompt early reassessment and, when necessary, repeat surgical exploration rather than prolonged reliance on antimicrobial therapy alone.

Airway management remains one of the most critical components of treatment because edema, trismus, anatomical distortion, and displacement of the upper airway may make conventional intubation difficult or hazardous. In the present cohort, 9.5% of patients required an advanced airway intervention and almost one-quarter required intensive care admission. The airway should therefore be assessed early, ideally before progressive edema creates an emergency situation. Awake fiberoptic intubation and surgical airway techniques remain important options in selected patients, although the optimal strategy depends on airway anatomy, institutional expertise, and clinical urgency [20–22]. The need for close cooperation between surgeons, anesthesiologists, and intensive care specialists is particularly evident in patients with Ludwig's angina, extensive bilateral disease, or radiological evidence of airway narrowing.

Descending necrotizing mediastinitis represented one of the most severe

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complications in our series, occurring in 6.8% of patients. Although uncommon, mediastinal extension remains associated with substantial morbidity and mortality and requires prompt recognition. Contrast-enhanced CT should therefore include the thorax whenever clinical or cervical imaging findings raise suspicion of inferior spread. Once mediastinitis is established, treatment requires aggressive control of both cervical and mediastinal infection. Depending on the extent of disease, this may involve combined cervicotomy and thoracic drainage, including video-assisted thoracoscopic approaches, within a multidisciplinary team involving maxillofacial or head and neck surgery, thoracic surgery, anesthesiology, and intensive care [4,8–12]. The two deaths observed in the present cohort further illustrate that, despite modern imaging, antimicrobial therapy, and intensive care, advanced odontogenic deep neck infection remains a potentially lethal condition.

Several limitations should be acknowledged. The retrospective, single-center design inherently limits control over data completeness and may introduce selection bias. The sample size, although adequate for descriptive and comparative analyses, restricted the number of variables that could be reliably included in multivariable modeling. Microbiological cultures were not available for all patients, and previous antimicrobial exposure may have influenced culture results. Furthermore, management decisions were individualized according to clinical severity and anatomical involvement rather than governed by a uniform prospective protocol. Nevertheless, the inclusion of consecutive patients and the integration of anatomical, inflammatory, surgical, and outcome-related variables provide a clinically relevant representation of the management of odontogenic deep neck infections in a tertiary emergency setting.

Overall, our findings support an approach based on early identification of high-risk patients, prompt CT-based assessment of infection extent, definitive odontogenic source control, adequate surgical drainage, and timely escalation to multidisciplinary care. Multispace involvement and markedly elevated CRP appear particularly useful for recognizing patients who may require more aggressive surveillance and treatment.

5. CONCLUSIONS

Deep neck infections of odontogenic origin remain potentially life-threatening conditions that require rapid diagnosis and coordinated treatment. In the present cohort, mandibular molars were the predominant odontogenic source, while submandibular and multispace involvement characterized the most severe presentations. The substantial proportion of patients requiring intensive care, repeat surgery, advanced airway management, or treatment for descending necrotizing mediastinitis confirms the potential for rapid progression beyond the initial dental focus.

Multispace involvement and increasing C-reactive protein levels were independently associated with a complicated clinical course, suggesting that anatomical extension on contrast-enhanced CT and the magnitude of the inflammatory response may provide clinically useful early indicators of disease severity. These parameters should be interpreted together with airway status, comorbidities, and systemic signs when determining the intensity of monitoring and treatment.

Optimal management relies on early elimination of the odontogenic source, adequate drainage of involved cervical spaces, appropriate antimicrobial therapy, and timely protection of the airway. Patients with extensive or progressive disease benefit from early multidisciplinary involvement,

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particularly when intensive care or thoracic surgical management is required. Such an integrated approach may reduce treatment delays and limit progression toward severe septic or mediastinal complications.

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