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Research Article

Analysis of orofacial infections in Johannesburg, South Africa

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ABSTRACT

Introduction: Orofacial infections remain a significant cause of morbidity, particularly in low- and middle-income countries. Limited data exist on factors influencing treatment outcomes and hospital stay in South Africa. This study aimed to assess the clinical presentation, management, outcomes, and predictors of hospital stay duration.

Patients and Methods: All patients aged 18 years or older diagnosed with orofacial infections at two academic hospitals over 1 year (2022) were included in the study. All patients had antibiotic therapy, and all but four had maxillofacial surgery involving tooth extraction, drainage of abscesses, and/or repair of fractures. The collected data included demographics, clinical presentation, infection microbiology, special investigations, comorbidities, and the extent of disease spread. Statistical analyses were performed to identify factors with a significant impact on the length of stay and patient outcomes.

Results: A total of 152 patients were included in the study. Dental caries was the most common cause, with trismus as the most common symptom. The majority had multi-space involvement, and 17 cases of Ludwig's Angina were recorded. Patients with diabetes had significantly longer hospital stays ($t = -1.806$; $df = 150$; $p = 0.036$). The median length of stay was five days. Infections originating from mandibular 3rd molars, multi-space involvement, and dysphagia were associated with prolonged hospital stay.

Conclusion: The study identifies key predictors of prolonged hospital stay, emphasising the importance of early risk stratification. Knowledge of these predictive factors not only enhances the ability to predict hospitalisation length but also lays the foundation for mobilising resources and integrating them into primary prevention programs.

Keywords: orofacial infections, dental caries, Ludwig's angina, maxillofacial surgery

INTRODUCTION

Orofacial infections remain a significant cause of morbidity, particularly in resource-limited settings where timely access to dental care is often restricted. These infections can range from localised abscesses to life-threatening conditions such as Ludwig's Angina and mediastinitis. The anatomical definition of the orofacial region remains variably applied. Upper jaw infections may manifest as sinusitis or orbital cellulitis, whereas lower jaw infections often affect the floor of the mouth and upper cervical regions, with potential airway compromise.

The burden of orofacial infections in South Africa is exacerbated by the high prevalence of untreated dental caries, trauma-related sepsis, and systemic conditions such as HIV and diabetes that predispose individuals to severe infections. Despite well-documented risks associated with these infections, there is scant data on infection epidemiology and management of orofacial infections in South Africa.(1)

Internationally, studies have reported that odontogenic infections account for a significant proportion of hospital admissions in maxillofacial units. Studies from Malaysia (2) and Iran (3) have identified factors such as delayed presentation, immunosuppression, and multi-space involvement as key predictors of prolonged hospitalisation.(2,3) However, there is a lack of data specific to South Africa, where socio-economic factors, healthcare access disparities, and a high burden of communicable and non-communicable diseases influence patient outcomes.

Thus, this study aimed to evaluate the clinical presentation, management, and outcomes of orofacial infections in two major academic hospitals in Johannesburg, South Africa. Additionally, we sought to analyse predictors of length of hospital stay, providing insights that could

enhance early risk stratification and optimise healthcare resource allocation in South African settings.

PATIENTS AND METHODS

Patients aged 18 years or older admitted to the Chris Hani Baragwanath Academic Hospital and the Charlotte Maxeke Johannesburg Academic Hospital between January and December 2022 with a diagnosis of orofacial sepsis were included in this study.

Data were categorised as demographic (age and gender), health status (morbidities), clinical presentation (symptoms of trismus, stertor, dysphagia), findings on examination (routine, fascial spaces involved by cellulitis, abscess), and results of special investigations (white blood cell count and C-reactive protein). The data sheet recorded the probable cause of infection, such as dental caries, 3rd molar involvement, pericoronitis, or retained roots.

The types of treatment listed on the datasheet included non-surgical (medications, dose, route of administration) and surgical (tooth extraction, drainage of fascial spaces, fracture repair). For the purposes of this study, the interval from admission to discharge was defined as the length of hospital stay**.**

Statistical analyses

Data were entered into Microsoft Excel and analysed using R (R Core Team, 2025). Continuous variables were summarised as means and standard deviations (SD) or medians and interquartile ranges (IQR), depending on distribution. Categorical variables were summarised as frequencies and percentages. One-tailed two-sample t-tests were conducted to assess associations between potential predictors (e.g., aetiological factors, clinical signs, laboratory markers, comorbidities) and increased length of stay (LOS). LOS was skewed, so a logarithmic transformation was applied so that the variable met the assumption of normality. Homogeneity of variance was checked using Levene's test, and a Welch Two Sample t-test was used if the assumption of homogeneity of variance was not met. Predictors were then entered into a multivariable linear regression model to identify the independent effects of the predictors on LOS. B-coefficients, 95% confidence intervals (CIs), and p-values are reported.

Ethical clearance for the study was obtained from the Human Research Ethics Committee (medical) of the University of the Witwatersrand (M201039).

RESULTS

During the study period, 152 patients met the inclusion criteria.

Clinical Presentation

A variety of symptoms were noted in the study (Table 1). Trismus was the presenting symptom in 123 patients, followed by dysphagia (31 patients) and stertor in 23 patients. Only dysphagia on admission was associated with an extended hospital stay ($t = -4.1962$; $df = 150$; $p < 0.0001$).

Table 1: Clinical presentation

Symptom	Number of patients
Trismus	123 (80.9%)
Dysphagia	31 (20.4%)
Stertor	23 (15.1%)
Odynophagia	21 (13.8%)
Others (dysphonia, periorbital oedema, rhinorrhoea, unstable fractures)	8 (5.3%)

Aetiology

The most common cause of odontogenic infection was dental decay (69.7%). Within this group, in 44 (28.9%) patients, it involved the lower 3rd molars. Other odontogenic causes included retained roots (2.0%), acute alveolitis (3.9%), and periodontitis (1.3%). Non-odontogenic sources of sepsis were identified in 35 patients, most commonly septic fractures (11.2%), septic hardware (4.6%), and soft tissue infections (7.2%) (Table 2). A univariate analysis using one-tailed two-sample t-tests was performed to assess the association between each aetiological factor and increased hospital stay. Only the 3rd molar involvement was a significant predictor of prolonged hospital stay ($t = -3.0825$; $df = 150$; $p = 0.001$).

Location and Spread of Infection (Table 3)

Most patients (75.5%) had multi-space spread, with the submandibular space involved in 56.6% of cases, followed by the buccal (36.2%) and submental (35.5%) spaces. Ludwig`s Angina (submental plus sublingual plus submandibular orofacial space infection) was diagnosed in 17 patients with mediastinal sepsis in three cases.

Biological Markers

One hundred and thirty-three patients had white blood cell (WBC) levels measured on admission, and 119 had C-reactive protein (CRP) levels measured on admission. Upon admission, the mean CRP was 142.6 ± 101.3 mg/dL, and the mean WBC count was 14.01 ± 6.56 x 10μL.

Co-Morbidities

The study population had a low morbidity profile, with 53.9% of patients in good health and 16.4% with a single comorbidity. The most common morbidity was HIV infection in 21 patients (13.8% of cases), all of whom were on antiretroviral therapy. Forty-four patients (28.9%) were

Table 2: Aetiology of orofacial infection and association with length of hospital stay using one-tailed two-sample t-tests

Odontogenic	Number of patients (n=117)*	P-value	Non-odontogenic	Number of patients (n=35)*	P-value
Dental caries	106 (69.7%)	t = -0.670; df = 150; p = 0.252	Septic fracture	17 (11.2%)	t = 1.268; df = 150; p = 0.897
Lower 3rd molar infections	44 (28.9%)	t = -3.083; df = 150; p = 0.001	Septic 'hardware'	7 (4.6%)	t = 0.897; df = 150; p = 0.820
Retained roots	3 (2.0%)	t = -0.757; df = 150; p = 0.225	Soft tissue infections (post-operative, human bite, sinusitis, foreign body)	11 (7.2%)	t = -0.782; df = 150; p = 0.218
Acute Alveolitis	6 (3.9%)	t = 0.447; df = 150; p = 0.672			
Periodontitis	2 (1.3%)	t = 0.719; df = 150; p = 0.764			

* Some patients presented with more than one odontogenic cause at admission

Table 3: Location and spread of infection

Orofacial spaces	Number of spaces involved n=301	Extra-orofacial spaces	Number of spaces involved n=37
Submandibular	99 (65.1%)	Infra-orbital	9 (5.9%)
Buccal	57 (37.5%)	Temporal	7 (4.6%)
Submental	54 (35.5%)	Cervical	6 (3.9%)
Sub-masseteric	45 (29.6%)	Infra-temporal	6 (3.9%)
Sublingual	44 (28.9%)	Periosteal	4 (2.6%)
Masseteric	26 (17.1%)	Thoracic	3 (2.0%)
Ludwig's angina	17 (11.2%)	Frontal	2 (1.3%)
Ludwig's angina with mediastinal sepsis	3 (2.0%)		
Canine space	4 (2.6%)		

cigarette smokers. Diabetes accounted for 9.9% (15 cases) and hypertension for 7.9% (12 cases).

Special investigations

Cross-sectional imaging, particularly CT scans, is instrumental in defining the extent of abscess formation, anatomical space involvement, and airway compression. Although not systematically recorded for all patients, imaging was used in several complex cases to guide surgical intervention.

Management

It is essential that the successful management of orofacial sepsis relies heavily on source control through incision and drainage, debridement, and extraction, rather than relying solely on antibiotics. Most patients underwent incision and drainage of orofacial abscesses under general anaesthesia, combined with dental extraction (120 cases), fracture repair (18 cases), debridement (8 cases), and hardware removal (7 cases). Ten patients only required antibiotic therapy.

Bacteria

The microbial species identified were principally *Streptococcal* (36 cases), *Staphylococcal* (10 cases), *Enterococcal* (4 cases), and *Klebsiella* (3 cases). *Acinetobacter baumannii* and *Clostridium* were cultured from two patients, respectively. Pus swabs were taken from 96 patients.

Antibiotics

The infections were managed with intravenous amoxicillin-clavulanate in 134 patients, to which metronidazole (3 patients) and cefazolin (2 patients) were added. The current guidelines (4) suggest amoxicillin as the first-line antibiotic for odontogenic abscesses. All patients received chlorhexidine digluconate during hospitalisation. Antibiotics may be combined with metronidazole for more widespread infections.

Multivariate analysis

Only variables that reached statistical significance at the univariate level were subsequently entered into the multivariate regression model.

A multivariate regression analysis (Table 4) demonstrated that both systemic and local factors significantly influenced the length of hospital stay in patients with orofacial sepsis. A logarithmic transformation was used for the length of stay to satisfy the assumption of normality of the response variable. Residuals vs fitted and QQ-plot of residuals were used to check that the assumptions of normality and homogeneity of variance of the residuals were met. Multicollinearity was assessed using Variance Inflation Factors (all < 1.5). Among systemic conditions, diabetes mellitus was moderately associated with length of hospitalisation ($t = 1.923$, $p = 0.057$). Hypertension was not statistically significant.

Key local disease factors were also predictive of hospitalisation length. Third molar involvement ($t = 2.175$, $p = 0.032$) and dysphagia on admission ($t = 2.434$, $p = 0.017$) were significant predictors of length of hospital stay.

The biological markers, elevated CRP at admission, and WBC count were not statistically significant.

Other factors, such as HIV infection, dental caries, retained roots, and smoking, were not significantly associated with hospital stay.

DISCUSSION

This study assessed the clinical presentation, management, and predictors of length of stay in patients with orofacial infections. The mean length of stay in our study was 8 days, which is comparable to findings from developed countries, where the length of stay ranges from 7 to 10 days for similar conditions.(5,6)

Several key findings emerged from this study, including the predominance of odontogenic infections, the association of diabetes with prolonged hospitalisation, and the significant role of mandibular third molar infections in increasing disease severity. Hypertension, however, was not associated with a prolonged stay; in fact, the regression model showed a negative coefficient, indicating that it was linked with a slightly shorter length of stay. Regarding comorbidities, an Iranian study also found that multiple comorbidities extended hospitalisation beyond the average length of stay.(3)

C-reactive protein increases significantly in severe inflammatory states and bacterial sepsis and has been shown to predict a prolonged hospital stay.(7) An elevated WBC count is associated with multiple space infections.(7,8) In our cohort, neither CRP nor WBC was a statistically significant predictor of length of stay. Unlike previous studies in developed countries, where antibiotic resistance plays a major role in prolonged hospitalisation,(4) our study found that multi-space infections and 3rd molar involvement were stronger predictors of extended length of stay. This finding is consistent with a Korean study, which also identified anatomical space involvement as a major determinant of hospitalisation duration.(6) Our findings also corroborate a study from Malaysia, which observed that dysphagia and multiple-space infections were key contributors to prolonged hospital stay.(2)

Internationally, similar trends have been observed. Studies from Malaysia and Iran have reported that the

Table 4: Multivariate analysis of factors associated with length of stay in patients with orofacial sepsis

	B-Coefficient	SE	CI_low	CI_high	t	p
Diabetes Mellitus	0.523	0.272	–0.016	1.062	1.923	0.057
Hypertension	–0.355	0.344	–1.037	0.327	–1.032	0.305
3rd molar involvement	0.454	0.209	0.040	0.867	2.175	0.032
Dysphagia	0.567	0.233	0.105	1.029	2.434	0.017
Multiple facial space involvement	0.388	0.225	–0.058	0.833	1.726	0.087
C.reactive.protein	0.149	0.094	–0.036	0.334	1.592	0.114
WBC	–0.017	0.097	–0.210	0.177	–0.170	0.865
HIV	0.050	0.268	–0.481	0.581	0.185	0.853
Dental caries	–0.091	0.212	–0.510	0.329	–0.428	0.669
Retained root	0.633	0.775	–0.904	2.169	0.816	0.416
Smoking	–0.173	0.195	–0.559	0.213	–0.890	0.375

majority of orofacial infections originate from dental caries, with trismus and dysphagia being common presenting symptoms.(2,3) Our findings align with these reports, reinforcing that untreated dental disease remains a major contributor to hospital admissions for orofacial infections. However, while previous studies have shown an association between cigarette smoking and increased length of stay,(9–11) our study did not. This discrepancy may be due to differences in sample size, smoking habits, or regional variations in oral health behaviours.

Our study highlights the role of Ludwig's Angina, with 17 cases (11.2%) diagnosed. Research from Nigeria (12) and South Africa has shown that Ludwig's Angina remains a significant clinical challenge in low- and middle-income countries due to delays in seeking care and the limited availability of surgical services in rural areas.(12,13) Despite the severity of the condition, all patients in our study survived, underscoring the importance of timely surgical intervention and antibiotic therapy in managing these infections.

The pathogenesis of the presenting symptomatology is primarily related to the extensive inflammatory oedema of the floor of the mouth and adjacent soft tissues.(1,4,7) Dysphagia in this context typically results from elevation and posterior displacement of the tongue, secondary to involvement of the sublingual and submandibular spaces. This impaired swallowing mechanism can lead to pooling of saliva and drooling, both of which are important clinical markers of disease severity.(2,5)

The patient frequently presents with partial airway obstruction due to marked swelling of the floor of the mouth, elevating the tongue and restricting airflow. This obstruction is clinically characterised by stertor, a low-pitched, snoring-like respiratory sound. Given the risk of airway compromise, monitoring is mandatory. Proactive airway management, including early consideration of tracheostomy, may be required to establish a definitive airway and prevent acute respiratory distress.(3,6,8) Odynophagia is attributed to both the pressure effect of the oedematous tissues and the associated inflammatory pain involving the oral and pharyngeal mucosa.(4,7)

Trismus, documented in over 80.9% of patients, is primarily due to inflammatory involvement of the masticator spaces, particularly the medial and lateral pterygoid muscles.(5,6) This condition is further characterised by restricted mouth opening caused by the involvement of both the sensory and motor components of a reflex arc mediated by the superior and inferior alveolar branches of the maxillary (V^2) and mandibular (V^3) divisions of the trigeminal nerve. Trismus complicates airway management, potentially precluding conventional orotracheal intubation in cases requiring general anaesthesia. Alternative strategies, such as awake fibre-optic intubation or surgical airway access, should therefore be anticipated and planned in advance.(4,5)

Infections originating in the upper jaw often extend into the paranasal sinuses and, in severe cases, may involve the orbit, resulting in periorbital swelling, cellulitis, or even cavernous sinus thrombosis.(4,7) Conversely, infections of the lower jaw are more frequently associated with spread to the floor of the mouth and upper neck spaces, which may lead to airway compromise, dysphagia, drooling, and deep neck space infections such as Ludwig's angina.(12,13) Recognition of these anatomical distinctions is essential, as they determine not only the presenting symptoms but also the surgical approach required for effective drainage of purulent collections, whether *via* intraoral or extraoral access.

The mylohyoid muscle serves as a critical structural barrier between the oral cavity and the submandibular space. Infections breaching this muscular diaphragm risk progression to Ludwig's angina.(12,13) Deep fascial plane involvement further enables rapid caudal spread of infection into the mediastinum *via* the retropharyngeal and "danger space," which may result in potentially fatal necrotising fasciitis. In this study, three such cases were documented, underscoring the importance of early recognition and aggressive management.(12,13)

The findings of our study emphasise the need for early intervention and targeted management strategies for high-risk patients. Implementing structured risk stratification models, such as those used in North America,(14) could help hospitals in South Africa allocate resources efficiently. Additionally, increasing public awareness of early dental treatment may prevent severe infections that require prolonged hospitalisation.

LIMITATIONS

This study has several limitations. Firstly, this study was limited to two large public hospitals over a relatively short one-year period, resulting in a small sample size. The study also focused on a relatively young and otherwise healthy population, which, while helpful in establishing treatment trends, may limit the generalisability of the findings to broader patient cohorts with higher comorbidity burdens. Furthermore, the study did not address all the causes of dental caries in young, otherwise healthy Africans, and it lacked data on longer-term follow-up.

CONCLUSIONS

Although our findings align with global studies, they also highlight specific regional differences, such as a younger affected population and a lower overall morbidity burden. Importantly, this study of orofacial sepsis highlights the critical predictors of prolonged hospital stay. Knowledge of these predictive factors not only enhances the ability to predict hospitalisation length but also lays the foundation for mobilising resources and integrating them into a primary prevention programme. Prompt management of co-morbidities such as diabetes, together with early recognition of high-risk local disease factors such as multi-space involvement, dysphagia and third molar infections, may improve outcomes and reduce hospital stay.

Author Contribution Statement

Dr Ruan Scheepers collected and collated the data, interpreted the data, and drafted the initial version of the manuscript.

Prof Ephraim Rikhotso conceptualised the study and contributed to the writing and critical revision of the manuscript.

Dr Marietha Nel provided critical input into the writing, structuring, and intellectual content of the manuscript.

All authors reviewed and approved the final version of the manuscript

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