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Original Article

Potential predictors contributing to an increased hospital stay in odontogenic maxillofacial space infections: a retrospective study

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Abstract

Aim: Maxillofacial space infection refers to infections in the potential spaces and fascial planes of the maxillofacial region. The primary objective was identifying predictive variables associated with increased hospital stay in patients with odontogenic maxillofacial space infections.

Materials and methods: A retrospective chart review of all patients treated for odontogenic maxillofacial space infections from January 2001 to December 2012 at the P.M.N.M. Dental College and Hospital, Bagalkot, was conducted.

Results: Out of 141 patients identified, 59.6% were females, and the mean age of our study group subjects was 36.81±15.76 years. 9.93% of the patients had diabetes, and the most common space involved was the buccal space. The mean white blood cell (WBC) count was 12329.93 cells/mm^3, and the most common bacteria isolated were *Staphylococcus aureus*. The average length of hospital stay was 6.06±2.96 days. Space involvement, severity of infection (presenting WBC count in the CBC), and pre-morbid medical status increased the length of in-patient stay post-operatively with a statistical significance.

Conclusion: The results of our retrospective study noted a higher prevalence of maxillofacial space infections due to odontogenic etiology in the age group of 31-50 years with the buccal space being implicated the most. The predictors associated with an increased length of hospital stay were spaces involved, treatment regimen, severity of infection (indicated by presenting WBC count in the CBC), and pre-morbid medical status.

Keywords

odontogenic infection, space infection, incision and drainage

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PENSOFT.

Introduction

Maxillofacial space infection (MSI) refers to infections in the potential spaces and fascial planes of the maxillofacial region. The leading causes of these infections are odontogenic infection, lymphadenitis, and trauma.[1] Maxillofacial infections of odontogenic origin are among the most incident infections and assume significance due to their high rate of mortality and morbidity.[2-4]

These infections generally respond to antimicrobial therapy and surgical intervention. However, if not diagnosed and treated appropriately, they progress rapidly and are associated with high morbidity and mortality. Despite improved socioeconomic status in developing countries and a renaissance in antibiotic therapy, there are still numerous cases of odontogenic MSI referred to hospitals. This subset of patients presents with ignored tooth-related infections requiring urgent medical and surgical intervention with subsequent hospital admission to resolve the infection.[5]

Odontogenic infections can be related to anatomical variations, immunosuppression due to any etiology, limited access to care, neglect, or pre-morbid medical conditions like diabetes mellitus. Literature is sparse regarding predictive variable affecting the length of hospital stay for patients admitted to hospitals to manage odontogenic infections.[6]

A comprehensive review of literature yielded a few studies regarding the length of hospital stay in patients with odontogenic infections. Flynn et al.[7] showed a mean hospital stay of 5.1 days, while Sato et al.[2] showed a mean hospital stay of 3.69 days. A retrospective review by Storoe et al.[8] covering two decades showed a mean length of stay of 6.66 days during the 1980s and a mean length of stay of 8.27 during the 1990s.

As there are differences between institutions, our study is limited to one hospital, with a specific etiology (odontogenic).

Aim

The aim of our study was to identify potential predictors associated with increased hospital stay in patients with odontogenic MSI. Our study attempts to map the characteristics and length of hospital stay for MSI and reveal the regional scenario regarding severe odontogenic infections. Attention to the variables that lead to a more extended hospital stay could be pertinent in framing guidelines and reducing subsequent complications in patients presenting with MSI.

Materials and methods

A retrospective medical chart review was conducted and patients with a diagnosis of odontogenic MSI were included in the study. Clinical charts and investigations were reviewed. The variables recorded were demographic data (age, sex), pathogenesis (spaces involved, medical conditions), results of investigations (WBC count on admission, blood sugar levels, pus culture), treatment regimen (antibiotics and drainage) and outcomes (length of hospital stay [LOS] and complications). Inclusion criteria included all patients admitted for treatment of an odontogenic MSI only. Exclusion criteria for the study were patients with localized dental abscesses without space involvement, non-odontogenic space infections and those with incomplete data or unwilling to give informed written consent for participation in the study.

Descriptive statistics were given in the form of a frequency table. A normality test was performed using Shapiro-Wilk test significance value fixed at 0.05. Karl Pearson's correlation coefficient test for statistical analysis was employed to analyze the number of admitted days in the hospital with different parameters. Multiple linear regression analysis of the number of days patients were admitted to the hospital with different parameters was carried out. All analyses were performed using SPSS (version 27).

Results

A total of one hundred and forty-one patients met the inclusion criteria. The mean age of the subjects was 36.81±15.76 years. **Table 1** elaborates descriptive statistics of the selected variables.

Fig. 1 illustrates percentage distribution of MSI cases by age groups. It shows that most of the cases belonged to age group in the range of 31 to 50 years.

Of the 141 patients, 116 (82.7%) had no co-morbidities. Predisposing medical conditions were reported in the remaining 17.73% of included patients **(Fig. 2)**. 46.81% of the patients had infections limited to a single space, while the remaining 53.19% had multiple space infections. The most common space involved was buccal (19.86%) followed by submandibular (16.31%). **Fig. 3** depicts the percentage distribution of each single space involved in our study. WBC count was recorded for 141 patients. The count ranged from 2100 cells/mm^3 to 37600 cells/mm^3. The percentage of patients with a documented count of above 15,000 cells/mm^3 was 19.15% **(Fig. 4)**. The presenting WBC count was employed by us as an objective marker to indicate the severity of infection at the time of presentation at our tertiary center.

Culture after collecting pus swabs was carried out in 24.82% of the patients enrolled in the study. Negative cultures were recorded in 9.22%. The most involved species was *Staphylococcus aureus* (7.80%) followed by *Klebsiella species* (3.55%) and *Escherichia coli* (1.42%) **(Fig. 5)**. All the enrolled patients underwent the same protocol for treatment. Extraction of the offending tooth was followed by empirical antibiotic therapy. However, 19.86% of the cases resolved with antibiotic therapy without surgical decompression. Intraoral surgical drainage was performed under local anesthesia in 36.88% cases while extra-oral incision and drainage were carried out in 43.26% of the cases **(Fig. 6)**. The mean LOS was 6.06±2.96 days. Of the 141 cas-

Table 1. Results from descriptive statistics of the selected variables

Characteristics	Frequency	Mean±SD
Age		
0-12 years	3	
13-17 years	6	
18-30 years	51	2.17±0.960
31-50 years	54	
More than 50 years	23	
	4	
Sex		
Male	57	0.60±0.492
Female	84	
Space involved		
Buccal		
Canine		
Submandibular		
Submassetric		
Submental		
Temporal		1.52±0.742
Parotid		
Ludwig angina		
Sublingual		
Parapharyngeal		
Pterygomandibular		
Others		
Medical conditions		
Diabetes	16	
HBsAg positive	6	
Hypertension	1	0.260±0.680
Pregnancy	1	
HIV positive, diabetes	1	
Nil	116	
WBC		
<10,000	42	1.89±0.694
10,000–15,000	72	
>15,000	27	
RBS		
70–140 mg/dL	119	
141–200 mg/dL	12	1.18±0.484
More than 200 mg/dL	6	
Missing	4	
Treatment regimen		
Antibiotics only	28	0.74±1.986
Extraoral	61	
Intraoral	52	
Bacteriological findings		
No culture	106	
No growth	52	
Citrobacter freundi	61	
Escherichia coli	28	1.83±0.736
Gram positive bacilli	1	
Kleibsella	5	
Staphylococcus aureus	11	
Others	2	
Length of stay		
1-3 days	22	
4-5 days	41	2.64±1.016
6-7 days	44	
More than 7 days	34	

es, 31.21% were discharged in 6-7 days while 24.11% had an in-patient hospital stay of more than 7 days **(Fig. 7)**.

Linear regression techniques were used to explain the relationship between patient characteristics and LOS. Spaces involved and severity of disease at the time of admission (indicated by presenting WBC count) were found to significantly increase the LOS. Medical conditions had a positive correlation with the LOS. **Tables 2** and **3** represent findings from correlational and regression analysis.

Table 2 illustrates correlation analysis indicating that strong positive and statistically significant correlation was found for space involved and treatment regimen with length of stay in hospitals. However, for severity of infection and bacterial findings, negative correlation was found with no statistical significance with length of stay in hospital.

Table 3 shows that the strongest predictors is treatment regimen among all others (r^2=0.247). The most significant predictors among patient variables were treatment regimen, medical conditions, severity of infection (WBC), and spaces involved. However, it was found that bacterial culture was not statistically significant with length of stay in hospital.

Discussion

Odontogenic infections contribute to MSI in the range of 50%-89% in reports from different parts of the world. They remain one of the most encountered head and neck infections among adults. Zhang et al.[4] reported odontogenic infections as the cause of 56.1% of 212 cases of MSI in China. Parker et al.[9] reported odontogenic infections as the etiology in 83.1% of the 373 cases included in his study in Saudi Arabia while an Iranian study[10] reported 49% among 314 cases. This data indicates that the prevention and treatment of odontogenic infections have not been on par with

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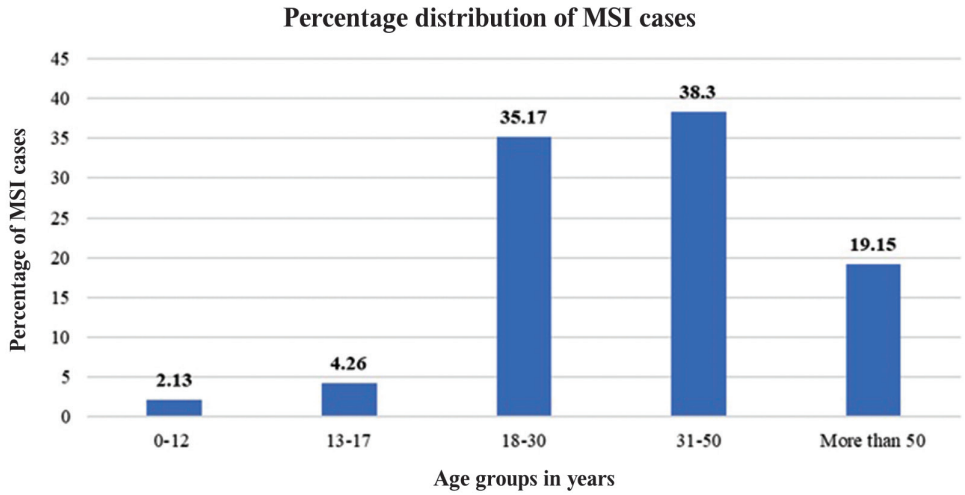

Figure 1. Distribution of cases by age group.

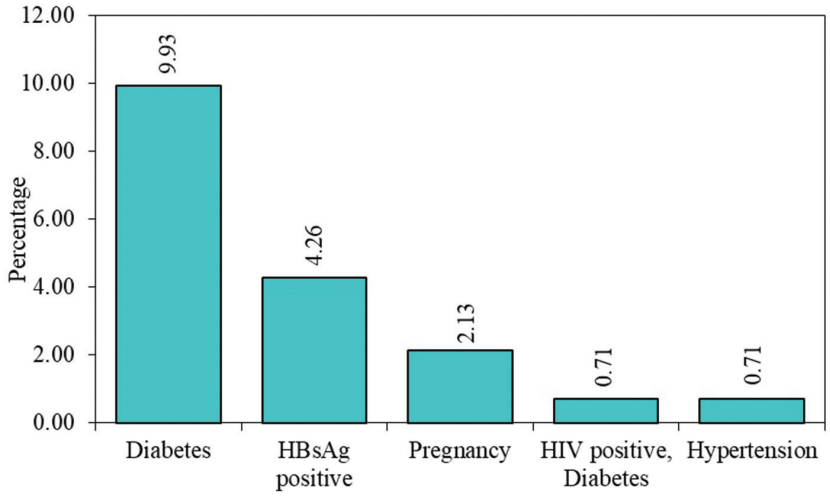

Figure 2. Distribution of cases by medical history.

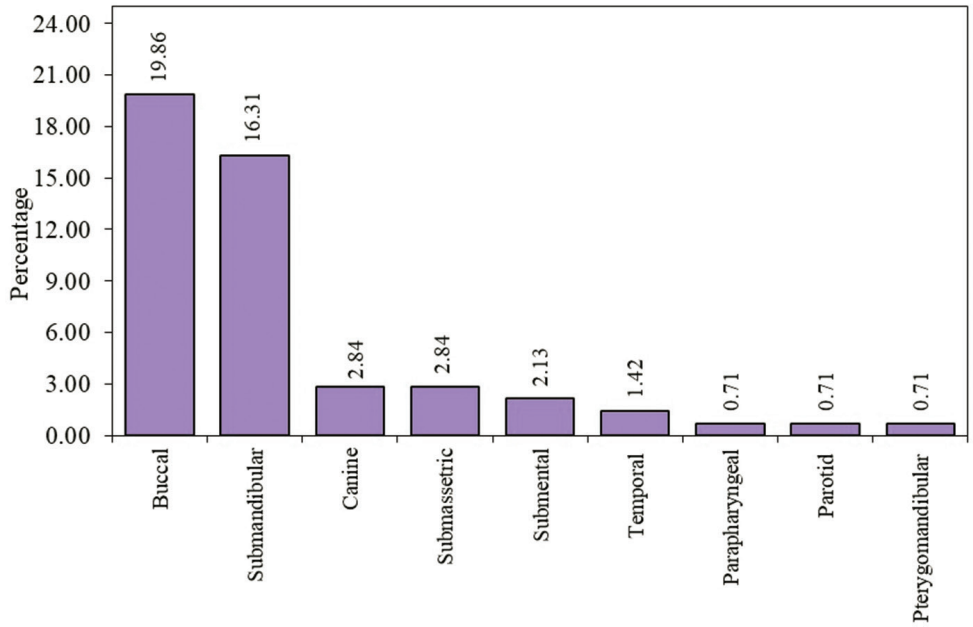

Figure 3. Distribution of single spaces involved.

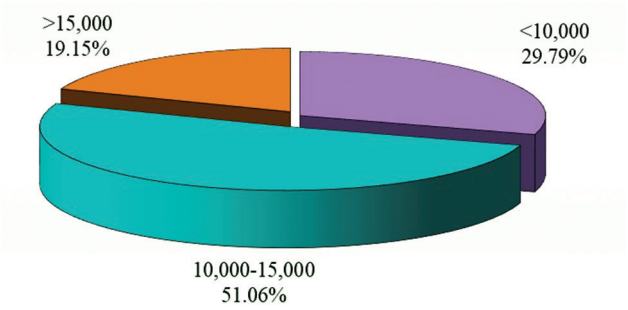

Figure 4. Distribution of cases by WBC counts.

the control of other causes of MSI like lymphadenitis and tonsillopharyngitis. Self-medication and non-provision of definitive management by the primary practitioner put the patient at serious risk for the progression of infection.[11] A call for public health measures to control odontogenic infections is warranted.

Most of the patients in our study were adults in the age group of 31-50 years. The probable reason for adults being at a higher risk is the higher prevalence of systemic diseases that compromise immunity. Children were found to have less incidence of infection probably because the erupting permanent teeth resorb their roots making their length

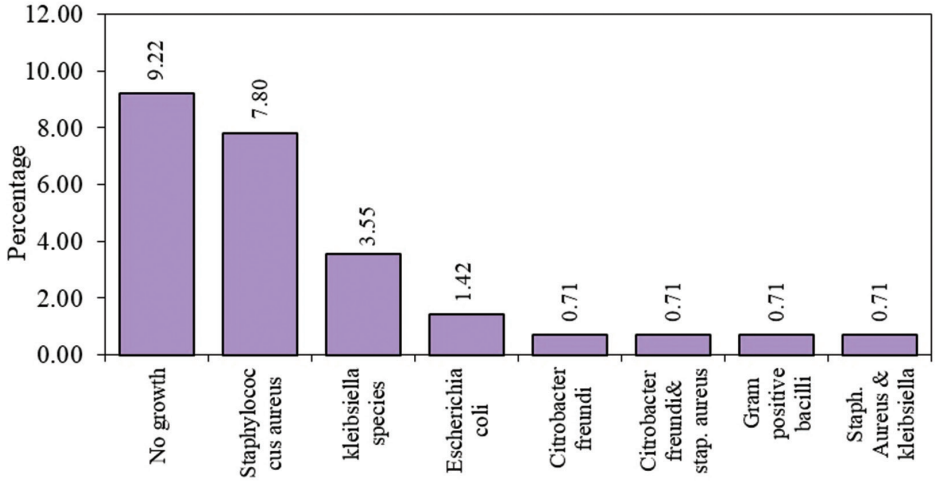

Figure 5. Distribution of cases by bacteria isolated.

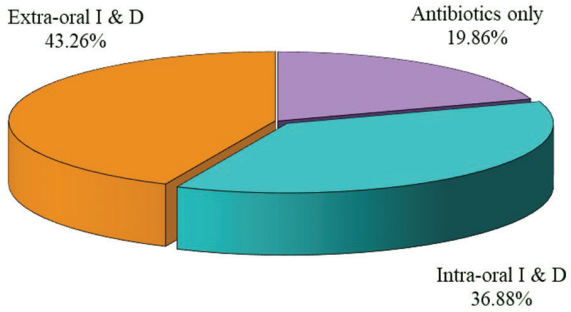

Figure 6. Distribution of cases by treatment.

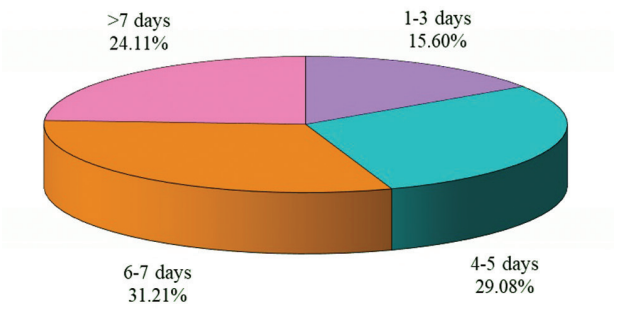

Figure 7. Distribution of cases by length of hospital stay.

Table 2. Correlation analysis for space involved and treatment regimen with length of stay in hospitals

Variables	Correlation coefficient (r)	P-value	Confidence interval (95%)	
			Lower	Upper
Spaces involved	0.253	0.002	0.92	0.402
Severity of infection (WBC)	−0.060	0.481	−0.224	0.107
Medical conditions	0.178	0.035	0.013	0.334
Treatment regimen	0.247	0.004	0.081	0.401
Bacterial findings	−0.112	0.188	−0.272	0.055

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Table 3. Analysis between patient characteristics and length of study described below using multiple linear regression model

Predictors	Beta coefficient (β)	r^2	Standard error	P-value
Spaces involved	0.253	0.064	0.986	<0.001
Severity of infection (WBC)	0.178	0.032	1.003	0.035
Medical conditions	−0.062	0.004	1.018	<0.001
Treatment regimen	0.061	0.247	0.981	0.004
Bacterial findings	−0.112	0.012	1.013	0.188

short. Such infections usually present as a gum boil rather than spreading to spaces.[3,12]

Our study showed a female predilection. A hypothesis to explain this is likely due to a complex interplay of biological, social, and cultural factors. While hormonal differences play a role, factors such as delayed healthcare seeking behavior and limited access to dental care are crucial contributors. In many South Indian households, women may be more involved in the caregiving roles and may prioritize the health of family members over their own. As a result, they might neglect their own oral health, leading to a higher risk of dental infections. MSI occur as an outcome of a prolonged disease process. Most patients have had recurring symptoms much before the onset of the space infection.[11] The most common complaint of patients was that of swelling associated with pain. Swelling was a ubiquitous complaint as the cases studied were space infections that had advanced beyond the confines of the jaw.

We recorded a relatively low prevalence of systemic diseases (17.73%) in the overall sample. The most common predisposing condition noted was diabetes (14 cases). The prevalence of diabetes among the urban population of India is 12.1%.[11] Polymorphonuclear leukocytes exhibit impaired migration, phagocytosis, intracellular killing, and chemotaxis. This is coupled with vascular abnormalities like microangiopathy and macroangiopathy which favor infection by compromising local circulation, leading to delayed response to infection.[13,14]

Literature describes that fascial spaces are affected by infection in the same proportion as their proximity to the roots of the teeth. Infections that originate in lower molars mainly affect submandibular, sublingual, and buccal spaces, justifying the fact that these spaces presented a higher incidence of infections.[3,11] Literature suggests submandibular space to be the most common.[4,11,13] A pattern was observed by Bridgeman et al.[15] where buccal space (52.6%) was the most common space followed by submandibular space (24%). MSIs usually involve more than one anatomic space. In our study 46.81% of cases had single space involvement while 53.19% had multiple space involvement, indicating that most anatomic spaces in the head and neck are interconnected, with odontogenic infections spreading rapidly.[11,13] The latency in presentation to the treatment facility may also be the probable reason behind the higher proportion of multiple space infections.

Acute bacterial infections trigger a neutrophil release from the bone marrow; an increase in these cells in peripheral blood is a useful indicator of infection.[16] In our study, the mean WBC count was 12329.93 cells/mm^3. The WBC count which is an indicator of the severity of presenting disease correlated positively to the LOS.[2]

Treatment for MSI suggested by Fabio et al.[3] follows a classic protocol which comprised removal of teeth, antibiotic therapy, and abscess drainage. Empirical intravenous antibiotic therapy with amoxicillin with clavulanate potassium, or cephalosporins and metronidazole were prescribed for the vast majority of cases. Negative cultures may be due to the administration of pre-admission antibiotics. In patients with severe infections and refractory to antibiotics, amikacin was added. Management included analgesics, fluid therapy and mouth-opening exercises. In our study, all the suspected teeth were extracted and surgical drains in the form of corrugated rubber sheets were placed for 48 hours after stab incision. Surgical drainage was performed in cases of cellulitis.[11] All procedures were done under local anesthesia except one case of Ludwig's angina, performed under general anesthesia. The management of MSI under local anesthesia has the advantages of safety and economy when compared to general anesthesia, especially in developing countries where resources may be limited and in rural setups where competent anesthetists may be few.[14]

LOS has become an important variable in reducing the cost of healthcare.[13] Reducing the LOS contributes to the economical utilization of resources. It becomes of even greater interest in patients with odontogenic infections, as the etiology is potentially a preventable problem. In a recent study reviewed by Augusto et al.[17], the average hospital stay was 7.3 days with a SD of 6.3 days, Otasowie et al.[18] reported a mean hospital stay of 10.7 days with a SD of 8.6 days, Dodson et al.[6] in pediatric maxillofacial infections reported average hospital stay of 3.5 days with a SD of 0.19 days. In accordance with the literature, our study reported mean hospital stay of 6.06 days with a SD of 2.96 days.

The severity of infection (WBC count) correlated positively to the LOS and may be useful as a predictor of the LOS.[2] Peters et al.'s study on the association of WBC count with the LOS was not significant. However, our study found that WBC count was a significant predictor (p=0.0124) showing its positive correlation with LOS. Mathew et al. found that patients with a total WBC count ≥15×10^9 tend to develop complications during treatment.[11] Storoe et

al.[16] suggested that WBC count is useful in assessing improvement or regression to patients' therapy.

Conclusion

Our study maps the regional scenario of MSI due to odontogenic infections. The results of our retrospective study noted a higher prevalence of maxillofacial space infections due to odontogenic etiology in the age group of 31-50 years with the buccal space being implicated the most. The predictors associated with an increased length of hospital stay were spaces involved, treatment regimen, severity of infection (indicated by presenting WBC count in the CBC), and pre-morbid medical status.

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Conflict of interest

All the authors above declare that there is no conflict of interest.

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