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Original Article

Correlation of Odontogenic Infections in the Etiology of Submandibular Space Infections: A Prospective Observational Study

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Abstract *- The Submandibular space infections are deep neck infections, with their etiology often being odontogenic sources. Thorough knowledge of their clinical profile, predisposing factors, and outcomes is important for an effective treatment plan. Hence, diagnosis at the very early stage of infection and timely management are crucial for a good prognosis of the infection. Analyze the clinical, Demographic Profile, Predisposing Factors, and presentation of patients with submandibular space infections. A prospective observational study conducted in the ENT department, Assam Medical College, from November 2023 to November 2024. Twenty-five patients with submandibular space infections were included. Data on age, gender, residence, predisposing factors, symptoms, and infection characteristics were collected and analyzed. Most patients were aged 21–30 years (32%), with male predominance (60%). Rural residents comprised 72% of cases (p=0.028). Poor oral hygiene was the most common risk factor (48%, p=0.012). All patients presented with neck swelling and pain; fever and dysphagia were present in 72%. Abscess formation was seen in 88% of cases (p<0.001). Surgical intervention, along with intravenous antibiotics, was required in 88% of cases. Mean hospital stay was 7.2days with complete recovery in 92%. Odontogenic infections remain a significant cause of submandibular space infections, with poor oral hygiene as a major modifiable risk factor. Early diagnosis of the infections with targeted management is crucial to avoid complications.*

Keywords *- Abscess, Deep Neck Infections, Oral Hygiene, Odontogenic Infections, Submandibular Space Infection.*

1. Introduction

Submandibular space infections represent a clinically significant deep neck infection, accounting for a significant proportion of ENT diseases worldwide. Anatomically, the submandibular space is a horseshoe- shaped compartment situated below the mandible, where the mylohyoid muscle divides the spaces into the sublingual and submaxillary spaces[1]. Due to its anatomical continuity with the dental apices of the mandibular molars and premolars, this region is particularly vulnerable to odontogenic infections, which can rapidly spread along fascial planes and lead to complications [2]. The odontogenic infections are among the most common causes of submandibular space infections, with studies reporting that 50–80% of deep neck space infections originate from dental sources [3]. The polymicrobial nature of oral flora, comprising both aerobic and anaerobic organisms, contributes to the aggressive course of these infections. If early recognition and adequate management are not done, submandibular space infections can progress to Ludwig's angina, descending mediastinitis, airway compromise, sepsis, and even death [4]. Several systemic and local factors predispose individuals to submandibular space infections. Poor oral hygiene remains the most important modifiable risk factor, while comorbid conditions such as diabetes mellitus, immunocompromised states, tobacco use, and alcohol consumption further increase susceptibility and severity [5]. Additionally, socioeconomic factors, including limited access to dental care and rural residence, significantly influence the incidence and outcomes of these infections [6]. Despite the well-established association between odontogenic infections and submandibular space involvement, there is a paucity of prospective data from Northeast India characterizing the clinical profile, predisposing factors, and management outcomes of these infections. Most existing studies are retrospective in design, originate from urban tertiary centers, or focus primarily on surgical techniques rather than a comprehensive clinical and microbiological profile.[7,8] Besides, there are certain variations in different regions with respect to etiology, antimicrobial susceptibility, and healthcare availability, which remain unnoticed. Prospective data on the demographic characteristics of the patients, modifiable risk factors in rural populations, and microbiological data to guide empirical antibiotic selection

are essential for developing specific management protocols that can improve patient outcomes and reduce complications. Hence, this will enable clinicians to tailor interventions, optimize resource utilization, and implement preventive strategies targeting high-risk populations. This prospective observational study aims to contribute to the existing body of knowledge and guide clinical practice in similar settings by evaluating the clinical and demographic profile, predisposing factors, management approaches, and outcomes of patients presenting with odontogenic submandibular space infections.

2. Materials and Methods

Study Design: Prospective observational study

Place of study: Department of Otorhinolaryngology, Assam Medical College and Hospital, from November 2023 to November 2024.

Inclusion Criteria :

- Patients aged 11–70 years with clinical and radiological evidence of submandibular space infection
- Both sexes included
- Patients giving informed consent

Exclusion Criteria

- Age <11 years or >70 years
- Head and neck malignancy
- Post-traumatic submandibular infection
- Patients with prior surgical intervention elsewhere
- Unwilling to participate

Sample Size: Calculated with the formula $n = Z^2 \times P \times (1\text{-}P) / d^2$ with expected prevalence of 68% [6] 95% confidence level (Z = 1.96) with a margin of error of 15%, the calculated sample size was 37 patients.

Applying the finite population correction for an estimated 50 patients during the study period yielded an adjusted sample size of 22 patients. Considering practical feasibility and similar published studies, a final sample size of 25 patients was determined.

Ethical Considerations: Informed written consent was obtained from all the participants. Ethical clearance was waived off as the study was observational, and all management was performed according to standard institutional protocols.

Data Collection and Analysis: Data collected using a pre-designed proforma and tabulated in Microsoft Excel 2010, analyzed using SPSS version 20.0. Descriptive statistics were used for categorical variables and presented as frequencies and percentages.

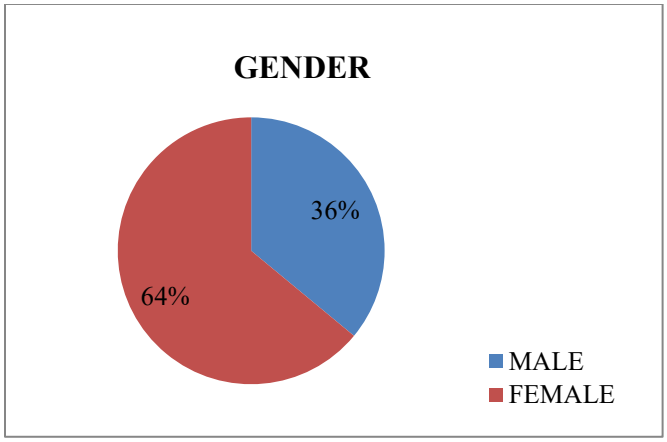
3. Results and Discussion

In the 21–30 years age group (32%), the highest incidence was observed, followed by 11–20 years (28%). Chi-square goodness-of-fit test showed no significant difference across age groups ($\chi^2 = 7.76$, $p = 0.172$), indicating that submandibular space infections affect a wide age range without significant age predilection.

Table 1. Age of the patients

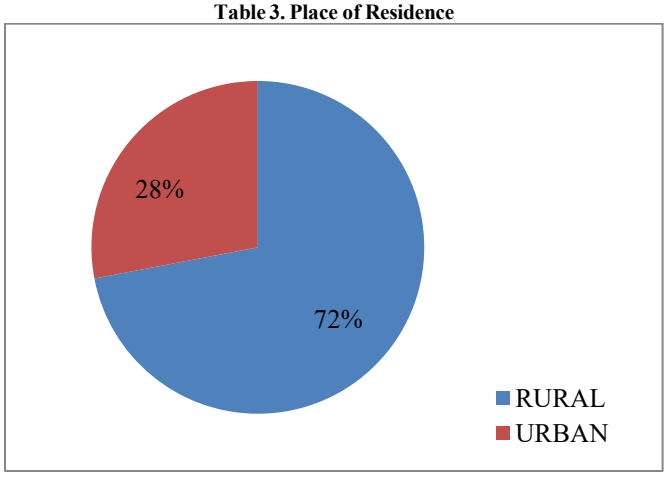
AGE LIMIT (YR)	Number of cases	Percentage
11-20	7	28%
21-30	8	12%
31-40	2	32%
41-50	3	12%
51-60	2	8%
60-70	3	12%
Total	25	100%

Table 2. Gender



A male-to-female ratio of 1.78:1was noted, where the male population is seen as predominant. Chi-square test revealed no statistically significant difference from an expected 1:1 ratio ($\chi^2 = 1.96$, $p = 0.162$), suggesting that while male predominance exists, it did not reach statistical significance in this sample size.

Table 3. Place of Residence



72%, that is, the majority of the patients hailed from rural areas. Chi-square test demonstrated a statistically significant rural predominance ($\chi^2 = 4.84$, $p = 0.028$), indicating that submandibular space infections are significantly more common in rural populations, which is probably due to limited access to dental healthcare services and less awareness of oral hygiene.

Table 4. Predisposing factors

Risk factor	No. of patients	Percentage
Poor oral hygiene	12	48
Diabetes Mellitus	4	16
Smoking	2	8
Alcohol + Smoking	2	8%
Unknown	5	17%
Total	25	100%

The most common predisposing factor identified in 48% of patients was poor oral hygiene. Chi-square test showed a statistically significant difference among the distribution of risk factors ($\chi^2 = 15.60$, $p = 0.012$), confirming that poor oral hygiene is the predominant modifiable risk factor for submandibular space infections in this population.

Table 5. Presenting complaints

Presenting Complaints	No of patients	Percentage
Neck Swelling	25	100%
Neck Pain	25	100%
Fever	18	72%
Dysphagia	18	72%
Dyspnoea	1	4%
Change of voice	1	4%
Otalgia	2	8%

Binomial test comparing observed proportion to 50% expected.' All patients presented with neck swelling and pain, which was highly significant ($p < 0.001$). Fever and dysphagia were present in 72% of cases, significantly higher than 50% ($p = 0.036$). Dyspnoea, change of voice, and otalgia were rare and not statistically significant, indicating that these symptoms are less commonly associated with isolated submandibular space infections.

Table 6. Presenting Site of Infection

Side of Submandibular Infections	Number of patients	Percentage
Right	12	48%
Left	9	36%
Both	4	16%
Total	25	100%

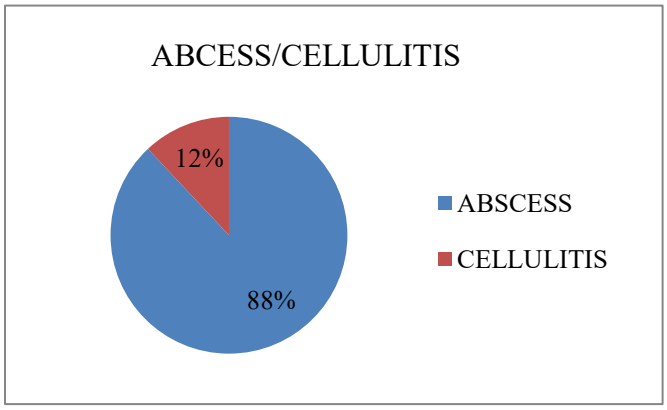
Right-sided involvement was most common (48%), followed by left-sided (36%). Chi- square test revealed no significant difference in the side distribution ($\chi^2 = 3.92$, $p = 0.141$), indicating that submandibular space infections occur with equal frequency on both sides, with bilateral involvement being less common.

Table 7. Multiple Space Involvement

Multiple Space Involvement	No of patients	Percentage
Yes	3	12%
No	22	88%
Total	25	100%

Fisher's exact test indicated no significant association of multiple space involvement and abscess formation ($p = 0.502$). This suggests that abscess formation is common regardless of whether the infection remains isolated to the submandibular space or involves adjacent spaces.

Table 8. Character of infections



Abscess formation was noted in 88% of patients, which was highly significant ($\chi^2 = 14.44$, $p < 0.001$). This overwhelming predominance of abscess over cellulitis confirms that most odontogenic submandibular space infections progress to suppuration, necessitating prompt surgical drainage as a primary management strategy.

Table 9. Management and Outcomes of Patients with Submandibular Space Infections (N=25)

Management Parameters	Category	Number of patients	Percentage
Antibiotic Therapy	Iv antibiotics	25	100%
	Amoxicillin clavulanate	16	64%
	Metronidazole	18	72%
	3rd gen cephalosporins	7	28%
	Culture-based antibiotics	12	48%
Surgical	I&D	22	88%

intervention	No surgical cellulitis only	3	12%
Dental Management	Dental extraction required	12	48%
	No extraction needed	13	52%
Airway Management	Close monitoring only	25	100%
	Tracheostomy	None	
Hospital Stay	Mean duration 7.2 days	Range 3-5days	
Outcome	Complete recovery	24	96%
	Recurrence	1	4%
	Mortality	0	
	Sepsis	0	

Comparison between surgical (n=22) and non-surgical (n=3) groups showed no significant difference in complete recovery rates (95.5% vs. 100%, Fisher's exact test $p = 0.734$). The mean hospital stay was much longer in the surgical group (7.5 ± 2.1 days vs. 5.0 ± 1.0 days, $t = 2.34$, $p = 0.028$), indicating the expected longer recovery following surgical intervention. The 0% tracheostomy rate and 0% mortality mark proper management and outcome.

Table 10 Antibiotic regimen details

Antibiotic combination	Number of patients	Percentage
Amoxicillin-clavulanate + metronidazole	14	56%
Ceftriaxone +metronidazole	5	20%
Amoxicillin-clavulanate alone	2	8%
Ceftriaxone + Amikacin +metronidazole	2	8%
Other combination	2	8%
Total	25	100%

Amoxicillin-clavulanate with metronidazole (56%, 95% CI: 34.9-75.6%) was commonly used, providing broad-spectrum coverage against oral flora, including both aerobes and anaerobes.

Table 11. Surgical Intervention Outcomes

Outcome	Surgical intervention (n=22)	Conservative treatment(n=3)	p-value
Complete recovery	21(95.5%)	3 (100%)	0.734
Recurrence	1 (4.5%)	0 (0%)	
Complication rate	1%	0 (0%)	0.73

Fisher's exact test showed no statistically significant difference in outcomes among patients who underwent incision and drainage, and those managed conservatively ($p = 0.734$). The single recurrence (4.5%) occurred in a patient who did not undergo dental extraction, highlighting the importance of eliminating the odontogenic source.

Table 12. Microbiology Abscess vs Cellulitis

Organisms isolated	Abscess (n=19)	Cellulitis (n=3)	p-value
Streptococcus viridans	5 (26.3%)	1 (33.3%)	0.786
Staphylococcus aureus	4 (21.1%)	0 (0%)	0.364
Mixed anaerobic flora	3 (15.8%)	0 (0%)	0.462
Klebsiella pneumoniae	1 (5.3%)	0 (0%)	0.697
E. coli	1 (5.3%)	0 (0%)	0.697
No growth	5 (26.3%)	2(66.7%)	0.189

Streptococcus viridans was the most common isolate (40% of positive cultures), followed by Staphylococcus aureus (26.7%). 20% of positive cultures showed mixed anaerobic flora, indicating the polymicrobial nature of odontogenic infections. Fisher's exact test showed no significant differences in microbiological profiles of abscess and cellulitis (all $p > 0.05$). The high rate of no growth (46.7% of cultured samples) may be due to prior antibiotic use.

Table 13. Comparison of Findings with Previous Studies

Parameter	Present study	Patil Et al (2020) [6]	Kim Et al (2019) [7]	Huang Et al(2004) [6]
Location	Northeast India	Rural india	South korea	Taiwan
Sample size	25	50	112	185
Odontogenic etiology	100%	68%	72%	35%
Male: Female ratio	1.78:1	1.5:1	1.6:1	2.1:1
Peak age Group	21-30yrs	31-40years	40-50years	51-60years
Rural population	72%	68%	Not specified	Not specified
Poor oral hygiene	48%	52%	45%	38%
Diabetes mellitus	16%	20%	28%	32%

Abscess formation	88%	82%	85%	79%
Surgical intervention	88%	84%	86%	81%
Dental extraction	48%	52%	44%	30%
Tracheostomy rate	0%	8%	12%	15%
Mean hospital stay	7.2days	8.1days	9.3days	10.5days
Mortality	0%	2%	3.6%	4.3%

Our study population had a significantly higher proportion of odontogenic etiology (100%) compared to other Asian studies ($p < 0.05$), reflecting the study design focusing on odontogenic causes.

4. Discussions

Submandibular space infections continue to cause diagnostic and therapeutic challenges, hence they represent a significant cause of deep neck infections. Our study did a specific evaluation of the association of odontogenic causes with submandibular space infections and analyzed their clinical presentation and management outcomes. With respect to epidemiological profile and risk factors, our findings align with a study done by Balakrishnan K et al., indicating that odontogenic infections are a primary cause of submandibular space infections [4].

Poor oral hygiene was seen as the most common modifiable risk factor (48%, $p = 0.012$), hence showing the importance of preventive dental care, which is similar to studies by Wang et al., who reported poor oral hygiene as a risk factor in 52% of cases[5]. The high prevalence in rural populations (72%, $p = 0.028$) in our study, probably due to limited access to dental services, is similar to findings in a study by Patil et al. in rural India, where 68% of deep neck infections were of odontogenic origin[6]. The predominance of abscess formation (88%, $p < 0.001$) indicates the necessity of prompt surgical drainage in addition to antibiotic therapy, which is comparable to Kim et al., who reported abscess formation in 85% of submandibular infections requiring drainage [7].

In our study, the low rate of multispace involvement (12%), possibly due to earlier presentation in our cohort, is in contrast with the study done by Candamourty et al., who reported 28% multispace involvement [8]. The male predominance (64%) and peak age group (21–30 years) in our study are consistent with global demographic trends in odontogenic infections, as noted in a systematic review by Pasternak-Junior et al.[9]. Diabetes mellitus as a comorbidity (16%) aligns with a study done by Flynn et al, who highlighted impaired immunity and microvascular changes as contributing factors in diabetic patients with odontogenic infections [10].

Our management protocol followed standard guidelines for deep neck space infections [11]. All patients received empirical broad-spectrum antibiotics covering aerobic and anaerobic oral flora, which is similar to recommendations by Brook et al [12]. The most commonly used combination was amoxicillin- clavulanate with metronidazole (56%, 95% CI: 34.9-75.6%), providing coverage against streptococci, staphylococci, and anaerobes. Third-generation cephalosporins were added in 28% of cases, particularly in patients with severe infection or comorbidities. In our study, the high rate of surgical intervention (88%) reflects the predominance of abscess formation, which is consistent with a study done by Kataria et al, who reported surgical drainage in 84% of their deep neck infection cases [13]. The primary indications for surgery were abscess on imaging (86.4%) and clinical fluctuance (72.7%). However, 27.3% of patients required surgical drainage due to failure to improve after 48-72 hours of antibiotic therapy, highlighting the importance of timely surgical assessment. Dental extraction in 48% of cases emphasizes the importance of eliminating the odontogenic focus to prevent recurrence. Similar observations were made by Heim et al., who found that definitive dental management is essential for successful outcomes [14]. In our study, no patient required tracheostomy, possibly due to early presentation and effective airway monitoring, which is in contrast with the study done by Saifeldeen et al., where airway intervention rates range from 10-30% [15].

Streptococcus viridans (40% of positive cultures) and Staphylococcus aureus (26.7%)were seen as the predominant organisms, with mixed anaerobic flora in 20% of cases, which is typical of odontogenic infections and supports the use of broad-spectrum antibiotic coverage [10]. The high rate of no growth (46.7% of cultured samples) may be due to prior antibiotic use before presentation. Fisher's exact test showed no significant difference in microbiological profiles between abscess and cellulitis groups (all $p > 0.05$), suggesting that the microbiological characteristics do not predict the stage of infection.

A study done by Huang et al. in an urban setting showed only 35% of cases were odontogenic, whereas our study's higher proportion (100% odontogenic) highlights regional disparities in etiology and healthcare access [16]. The lower rate of diabetes in our study (16%) compared to the study done by Western et al (up to 30%) suggests different comorbidity profiles in our population [17]. The mean hospital stay of 7.2 days in our study is shorter than the 10.5 days reported by Huang et al.[16] and 9.3 days by Kim et al [7], possibly due to differences in disease severity, healthcare delivery systems, or patient demographics. In our study, a good outcome was seen (96% complete recovery), which shows the effectiveness of prompt, comprehensive

management, including appropriate antibiotics, surgical drainage, and elimination of the odontogenic source.

Our study is a prospective observational study evaluating the clinical profile, management, and outcomes of odontogenic submandibular space infections. Unlike most previous studies that report aggregate demographic data, our study provides a detailed rural-urban stratification (72% rural, 28% urban) with statistical confirmation ($p = 0.028$), offering valuable insights into healthcare access. This study uniquely documents the entire management spectrum from presentation to definitive treatment, including: Empirical and culture-guided antibiotic therapy with detailed regimen analysis, Indication-based surgical intervention rates with dental extraction rates, and their impact on recurrence. Also provides contemporary, region-specific microbiological data from Northeast India, which is currently scarce in the literature. Our findings on Streptococcus viridans (40%) and Staphylococcus aureus (26.7%) as predominant pathogens offer valuable guidance for empirical antibiotic selection in this geographic region. This study also provides a comparative analysis among regional studies done by Patil et al.[6] Asian studies done by Kim et al [7] and Huang et al. [16] and international studies, enabling readers to identify region-specific variations in etiology, management, and outcomes. Identification of poor oral hygiene as the predominant modifiable risk factor (48%, $p = 0.012$) and rural residence as a key demographic determinant ($p = 0.028$), in our study, provides statistically validated data necessary for an appropriate action plan for public health interventions. The 96% complete recovery rate, 4% recurrence rate, and 0% mortality in our study demonstrate that an early and appropriate interdisciplinary approach leads to good outcomes for patients with submandibular neck infection

5. Conclusion

In the etiology of submandibular space infections, odontogenic causes stand as an important cause. Hence, improvement of oral hygiene and early dental intervention is essential to reduce the incidence of submandibular neck infections. Early presentation of the disease in a healthcare setting aids in timely management, including appropriate antibiotic therapy, surgical drainage when indicated, and elimination of the odontogenic focus, which is essential to prevent complications and ensure favorable outcomes with an interdisciplinary approach in the form of dental intervention.

Limitation

Single-center design and small sample size (n=25) limit generalizability and statistical power. Patients were included in the study from a tertiary care setting, which potentially represents more severe cases of submandibular neck space infections; hence, there is a possibility of selection bias in the study. Prior antibiotic use in most patients affected the microbiological study. Hence, multicenter studies with larger cohorts are recommended to validate these findings across diverse populations.

Conflicts of Interest

No conflict of Interest.

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