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**Original Article**

# The clinico-microbiological pattern of orofacial space infections in patients attending a tertiary hospital in Tanzania

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Abstract

Background: Fascial space infections in the orofacial region have plagued humans for centuries. The majority of these infections are of odontogenic origin and are polymicrobial in nature. This study aimed at determining the clinical and microbiological pattern of orofacial space infections in patients attending a tertiary hospital in Tanzania.

Methods: This was a cross-sectional hospital-based study that included patients with pyogenic orofacial space infections. Data on the demographic pattern of the patients, clinical presentations of the disease, and results of culture and sensitivity tests were collected. For analysis, when more than two spaces were involved, the case was classified as multiple space infection. The number of microbial isolates was grouped into no isolate, monomicrobial, and polymicrobial. The significance level was set at $p < 0.05$.

Results: The study consisted of 60 patients of whom 51.7% were males. The mean age was 33 ± 17.3 years. A painful swelling was the chief complaint of the majority of patients. Odontogenic causes of fascial space infection accounted for the majority (81.7%) of the cases. In most (66.7%) patients, multiple fascial spaces were involved, and the submandibular space was the frequently affected space. The most frequently isolated microbes were *Streptococcus viridans* and coagulase-negative *Staphylococcus*. The drug susceptibility test of different isolates to antibiotic agents revealed that clindamycin and amoxicillin + clavulanate were effective against both aerobes and anaerobes.

Conclusions: The young individuals and males were more affected. Most of the fascial space infections affect multiple spaces, commonly submandibular space. *Streptococcus viridans* and coagulase-negative *Staphylococcus* have frequently encountered isolates. Clindamycin was the most effective drug with a wide spectrum of activity against both aerobes and anaerobes.

Keywords: abscess; antimicrobial; orofacial; Tanzania

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## 1. Introduction

The muscles, visceral organs, vessels, and nerves are enclosed by a membrane of connective tissue called the fascia, which subdivides the human body into several compartments [1]. A pathologically potential space can occur between the fasciae and the underlying organs or tissues and as such, it is termed as fascial space [1,2]. In the head and neck region, the description of fascial spaces is complex, however, these spaces can be superficial and deep (which is further subdivided into superficial, pretracheal, and prevertebral fascial spaces) [1,3].

Fascial space infections in the orofacial region have plagued humans for centuries [4]. The majority of these infections are of odontogenic origin arising from dental caries, pericoronitis, periodontitis, or trauma to the dentition and the supporting structures [2,5]. Generally, these infections are polymicrobial in nature, caused by bacteria (aerobic and non-aerobic) as a result of either disturbance of the normal microflora or displacement of normal organisms from one side of the body to another [6,7]. The common bacterial isolates include *Streptococcus, Staphylococcus, Peptostreptococcus, Eubacterium, Escherichia coli, Klebsiella, Porphyromonus, Prevotella, Bacteroides*, and *Fusobacterium species* [5,8].

Once the infection sets in, its pathophysiology and clinical presentation will depend on the anatomical factors and virulence of the microorganisms [8,9]. Anatomical factors such as the bone, periosteum, muscles, and fascia dictate the lines of least resistance through which the infection spreads [9]. The virulence of microorganisms depends on the species of bacteria. For example, some streptococci produce hyaluronidase and fibrinolysin, whereas, some staphylococci produce a substance called coagulase [8]. The clinical presentations of the fascial space infection are vast depending on the affected fascial space, however, the commonly encountered presentations include fever, trismus, marked pain, swelling, discharge, dyspnea, and dysphagia [2,10].

The principle of management of fascial space infections entails the removal of the cause (e.g. extraction of carious tooth) and draining the pus, augmented by the use of antibiotics, intravenous fluids to rehydrate the patient and appropriate pain management [9]. It has been reported that antibiotic prescriptions in odontogenic infections (which are mostly broad-spectrum) account for about 7 to 12% of prescribed antibiotics for all infections [5,11]. Due to the use of broad-spectrum antibiotics, there is a growing number of resistant strains of bacteria [5,8,12].

Orofacial space infections contribute to a substantial number of hospital admissions, morbidity and mortality in Tanzania. Yet still, there is a paucity of information regarding orofacial fascial space infections in our setting. Considering the seriousness of the disease and the antimicrobial resistance, a clearer understanding of the pattern of presentation, bacteriology, and antimicrobial resistance in fascial space infections in Tanzania is necessary. This study aimed at determining the clinical and microbiological pattern of orofacial fascial space infection in patients attending a tertiary hospital in Tanzania.

## 2. Methods

This was a cross-sectional hospital-based study that took place at the Oral and Maxillofacial Department of Muhimbili National Hospital (MNH) between July 2017 and January 2018. All patients with pyogenic orofacial space infections attended for treatment at the MNH were recruited after voluntarily consenting to participate in this study.

Participants were interviewed using a prepared questionnaire whereby data on the demographic pattern, chief complaints, duration of chief complaints, and clinical presentations were collected. Confidentiality was maintained and identification numbers instead of patients, names were used in the questionnaires and clinical examination forms.

A thorough general, extraoral and intraoral examination was carried out using natural light. An abscess was confirmed through a combination of clinical features including a well-circumscribed warm and tender swelling with positive fluctuation test and presence of pus upon aspiration. The involved fascial spaces were identified during a clinical examination.

For bacteriological examination, the pus sample was collected from the abscess site by aspiration using a disposable 16-gauge needle and syringe. The collected sample was immediately transferred into a pre-reduced thioglycolate broth prepared and sterilized in a bijou bottle. The sample was immediately transported to the microbiology laboratory for gram staining, bacterial culture, and antimicrobial sensitivity. Specimens were inoculated on both differential and enriched media (MacConkey agar, chocolate agar, and blood agar) and incubated aerobically at 37°C for 24-48 hrs. Isolated colonies were sub-cultured in nutrient agar for biochemical testing.

Preliminary identification of bacteria was based on the colony characteristics of the organism i.e. colonial morphology, hemolysis on blood agar, changes in the physical appearance of the differential media, enzyme activities of the organisms and Gram staining.

Antimicrobial susceptibility pattern of isolated bacterial pathogens was performed by Kirby Bauer's disc diffusion method. Sensitivity discs for appropriate drugs were placed onto the media and incubated at 37°C for 24 hrs. After 24 hours each plate was examined and growth zones were measured to the nearest millimeter.

Susceptibility was tested against penicillin (10 units), ampicillin (10µg), amoxicillin/clavulanate (20/10µg), ceftriaxone (30µg), vancomycin (30µg), gentamycin (10µg), erythromycin (15µg), tetracycline (30µg), ciprofloxacin (5µg), clindamycin (2µg), trimethoprim/sulfamethoxazole (1.25/23.75µg), chloramphenicol (30µg), and imipenem (10µg). Qualities of media, antibiotic disc as well as the performance of a person carrying the tests were controlled by reference strains: *Escherichia coli* ATCC 25922, *Klebsiella pneumoniae* ATCC 700603 for Extended-spectrum beta-lactamases (ESBL), *S.aureus* ATCC 25923, and *S.aureus* ATCC 29213 for Methicillin-resistant *Staphylococcus aureus* (MRSA).

All the patients started treatment on the day of reporting to the hospital. Incision and drainage were done under local anesthesia. For patients who presented with an offending tooth, extraction was performed on the same day when the incision and drainage were done. This, however, was not possible in a few patients who presented with severe trismus. After surgery, a combination of broad-spectrum antibiotics which included ceftriaxone 1g intravenously (I.V) once daily and metronidazole 500 mg I.V after every 8 hours were prescribed while waiting for results of culture and sensitivity tests (C&S). Upon receiving the C&S results, the prescribed antibiotics were either maintained or changed. I.V fluids were given to hydrate the patients. Wound dressing was done twice daily. For the patients who had an underlying medical condition, physicians were consulted for optimizing their condition.

For analysis, the age was categorized into groups with a range of 40 years. When more than two spaces were involved, the case was classified as multiple space infection. The number of microbial isolates was grouped into no isolate, monomicrobial and polymicrobial (when two or more types of organisms were isolated).

Statistical Package for Social Sciences software (SPSS) for Windows (version 23, IBM Corporation Chicago, IL, USA) was used. Selected variables were represented as frequencies and percentages. Fisher's t-test of the association was used and associations were considered significant when $p < 0.05$. Uncontrolled multivariate logistic regression analysis was used to estimate the risk of independent variables in causing fascial space infection and length of hospital stay. The results were reported as odds ratio and 95% confidence interval.

The study was approved by the Institution Review Board (MU/PGS/SAEC/Vol.X) of the Muhimbili University of Health and Allied Sciences (MUHAS) and permission was granted by the Muhimbili National Hospital. Participation was voluntary and refusal to participate or withdraw from the study did not compromise the management of the patient. For each participant, a signed informed consent form was obtained before data collection. No names were used to avoid identification and the participants were assured of confidentiality and their right to participate or withdraw without any conditions. All patients were treated according to the established protocol at MNH.

## 3. Results

The study population consisted of 31 (51.7%) males and 29 (48.3%) females with a male to female ratio of 1.1: 1. The mean age was 33 ± 17.3 years. The youngest patient was two years and the oldest was 70 years old. Most of the patients had a primary level of education (34, 56.7%) and were petty traders (16, 26.7%). The majority (41, 68.3%) were residing in Dar es Salaam. About one third (18, 30%) of the patients had an underlying medical condition [Table 1].

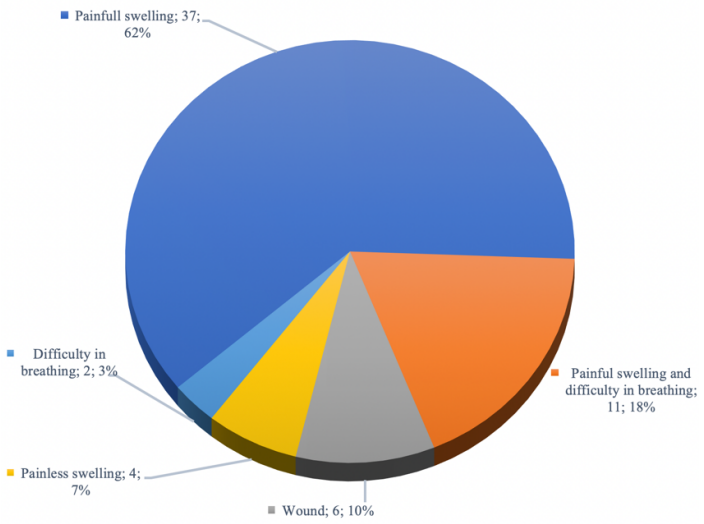



**Figure 1.** Distribution of patients according to their chief complaint on presentation.

**Table 1.** Distribution of study participants according to socio-demographic characteristics

| Socio-demographic characteristics | Patients | | |
|---|---|---|---|
| | Without underlying medical condition (n=42) | With underlying medical condition (n=18) | All (n=60) |
| **Age groups (years)** | | | |
| <20 | 12 (28.6%) | 1 (5.6%) | 13 (21.7%) |
| 20-39 | 16 (38.1%) | 9 (50.0%) | 25 (41.7%) |
| 40-59 | 11 (26.2%) | 7 (38.9%) | 18 (30.0%) |
| 60+ | 3 (7.1%) | 1 (5.6%) | 4 (6.7%) |
| **Sex** | | | |
| Male | 19 (45.2%) | 12 (66.7%) | 31 (51.7%) |
| Female | 23 (54.8%) | 6 (33.3%) | 29 (48.3%) |
| **Education** | | | |
| Non-formal | 13 (30.9%) | 2 (11.1%) | 15 (25.0%) |
| Primary | 24 (57.1%) | 10 (55.6%) | 34 (56.7%) |
| Secondary | 5 (11.9%) | 4 (22.2%) | 9 (15.0%) |
| College and above | - | 2 (11.1%) | 2 (3.3%) |
| **Occupation** | | | |
| Student | 11 (26.2%) | 2 (11.1%) | 13 (21.7%) |
| Peasant | 7 (16.7%) | 4 (22.2%) | 11 (18.3%) |
| Petty trader | 11 (26.2%) | 5 (27.8%) | 16 (26.7%) |
| Civil servant | 1 (2.4%) | - | 1 (1.7%) |
| Private sector employee | 12 (28.6%) | 7 (38.9%) | 19 (31.7%) |
| **Marital Status** | | | |
| Married | 18 (42.9%) | 8 (44.4%) | 26 (43.3%) |
| Single | 19 (45.2%) | 7 (38.9%) | 26 (43.3%) |
| Cohabiting | 3 (7.1%) | 1 (5.6%) | 4 (6.7%) |
| Widow/widower | 2 (4.8%) | 2 (11.1%) | 4 (6.7%) |
| **Residence** | | | |
| Dar es Salaam | 27 (64.3%) | 14 (77.8%) | 41 (68.3%) |
| Up-countries | 15 (35.7%) | 4 (22.2%) | 19 (31.7%) |

A painful swelling was the chief complaint of the majority of patients. Other complaints were difficulty in breathing, wound and painless swelling [Figure 1]. The time a patient took to seek medical care after the problem started ranged between one day to two weeks, with most (39, 65%) reporting within a week. In 47 (78.3%) patients the chief complaint was preceded by a toothache. Only 17 (36.2%) patients whose condition was preceded by toothache had the offending tooth extracted in the health facility they attended before referral to MNH, while the remaining ones were prescribed given medications. Reasons given to patients for not performing extraction of the offending tooth included: wait for the swelling to subside (14, 46.7%), patient's inability to open the mouth (9, 30%), and lack of trained personnel (7, 23.3%).

Odontogenic causes of fascial space infection accounted for the majority (49, 81.7%) of cases. Dental caries were the most (41, 68.3%) frequent cause of fascial space infections followed by periodontal conditions (8, 13.3%) and trauma (5, 8.3%). Others were skin infections (3, 5%), tonsillitis (2, 3.3%), and submandibular gland sialadenitis (1, 1.7%). Generally, the sex and age group of patients were not statistically associated with the causes of orofacial fascial space infection, except for the age group and dental caries [Table 2]. The odds of suffering from orofacial space infection due to dental were four folds higher in individuals aged less than 41 years when compared to those aged 41 years and above (OR 4.6; 95% CI 1.4 – 15, p = 0.015).

**Table 2.** Etiology of orofacial space infections against sex and age group of patients

| Etiology of orofacial space infections | Socio-demographic characteristics | | | | | |
|---|---|---|---|---|---|---|
| | Sex | | p-value | Age group | | p-value |
| | Male (n=31) | Female (n=29) | | ≤ 40 years (n=42) | 41+ years (n=18) | |
| **Odontogenic** | | | | | | |
| Dental caries | 58.1% | 79.3% | 0.1 | 78.6% | 44.4% | 0.015 |
| Periodontal | 22.6% | 3.4% | 0.053 | 2.4% | 38.9% | 0.001 |
| **Non-odontogenic** | | | | | | |
| Trauma | 16.1% | - | 0.053 | 7.1% | 11.1% | 0.631 |
| Sialadenitis | - | 3.4% | 0.483 | 2.4% | - | 1 |
| Skin infection | 3.2% | 6.9% | 0.606 | 4.8% | 5.6% | 1 |
| Tonsillitis | - | 6.9% | 0.229 | 4.8% | - | 0.573 |

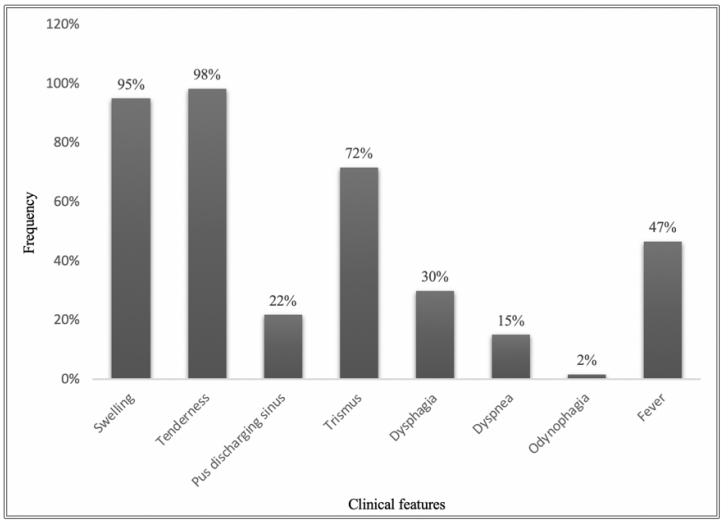



**Figure 2.** Percentage distribution of clinical features of orofacial space infections.

On examining the patients, the most frequently encountered clinical features were tenderness (59, 98.3%) and swelling (57, 95%) and the least common were dyspnea (9, 15%) and painful swallowing (1, 1.7%) [Figure 2].

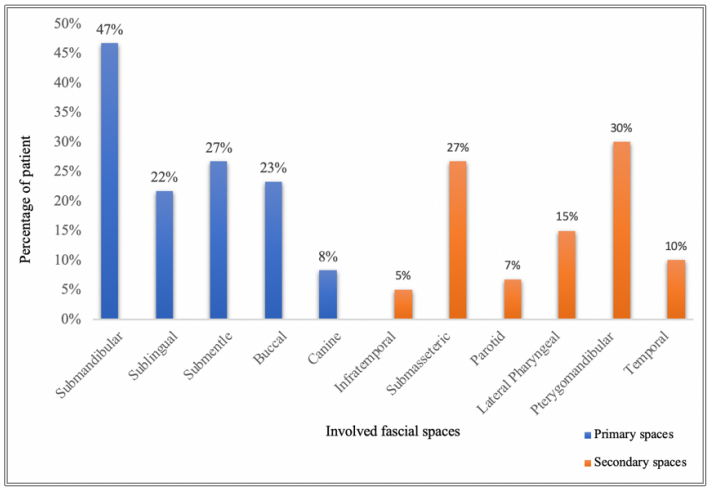



**Figure 3.** Percentage distribution of different fascial space involvement in orofacial infections.

A total of 11 different fascial spaces were noted to be involved. The number of fascial spaces that were involved ranged from one to six per person. In most (40, 66.7%) patients there was the involvement of multiple fascial spaces. Involvement of only primary spaces was observed in 18 (30%) patients, 14 (23.3%) had direct involvement of secondary spaces without the involvement of primary spaces and the remaining 28 (46.7%) had both primary and secondary spaces involved. Generally, the submandibular space was the frequently involved space with 28 (46.7%) patients while infratemporal space was involved in only 3 (5%) patients [Figure 3]. There was no statistically significant association between the total fascial space involved and factors such as patient's age and sex, presence of underlying medical condition ($p > 0.05$).

**Table 3.** Susceptibility pattern of isolated organisms to different antimicrobials

| | Susceptibility (%) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cef | Gen | Amk | Ery | Van | Amp | Lin | Tet | Cot | Aug | Clin | Chl | PeG | Cip | Met | Pene |
| **Aerobic/facultative anaerobe** | | | | | | | | | | | | | | | | |
| S. Viridans | 98 | 89 | 98 | 35 | 100 | -- | -- | 27 | 18 | 98 | 100 | 45 | 52 | 100 | -- | -- |
| Coag -ve staph. | 73 | 91 | -- | 73 | -- | -- | 100 | 18 | -- | 100 | 100 | -- | -- | 100 | -- | -- |
| S. pyogenes | 100 | 83 | 100 | 50 | 100 | -- | -- | 17 | 12 | 100 | 100 | 100 | 33 | 100 | -- | -- |
| S. pneumon | -- | 100 | 100 | 50 | -- | -- | -- | -- | 25 | 100 | 100 | 100 | 50 | -- | -- | -- |
| Klebsiella | 73 | 100 | 36 | 82 | -- | 43 | 54.5 | 27 | 36 | 50 | 82 | 54.5 | 25 | 100 | -- | 100 |
| Pseudom. | 75 | 88 | 38 | 12 | -- | | -- | 12 | 41.2 | 75 | 100 | -- | -- | 100 | -- | -- |
| Proteus | -- | 100 | 25 | 50 | -- | 50 | -- | 25 | 38 | 100 | 75 | 50 | 12 | 75 | -- | 100 |
| E. coli | -- | 100 | 50 | 86 | -- | -- | -- | 14 | 57 | 57 | 86 | 42.9 | 29 | 86 | -- | 100 |
| **Obligate anaerobe** | | | | | | | | | | | | | | | | |
| Prevotella | -- | -- | -- | 92 | -- | -- | -- | -- | -- | 92 | 100 | -- | 81 | -- | 85 | 92 |
| Bacteroides | -- | -- | -- | 63 | -- | -- | -- | -- | -- | 100 | 100 | -- | 80 | -- | 88 | 75 |
| Porphylomonas | -- | -- | -- | 33.3 | -- | -- | -- | -- | -- | 100 | 100 | -- | 67 | -- | 83 | 100 |
| Fusobacterium | -- | -- | -- | 50 | -- | -- | -- | -- | -- | 100 | 100 | -- | 100 | -- | 75 | 100 |
| Peptostrep | -- | -- | -- | 67 | -- | -- | -- | -- | -- | 78 | 89 | -- | 89 | -- | 78 | 89 |

Cef: Ceftriaxone; Gen: Gentamycin; Amk: Amikacin; Ery: Erythromycin; Tet: Tetracycline; Cot: Cotrimoxazole; Aug: Amoxicillin/Clavulanate, Clin: Clindamycin; Chl: Chlorophenical; Pe: Penicillin; Cip: Ciprofloxacin; Met: Metronidazole; Pene: Imipenem; Van: Vancomycin; Amp: Ampicillin; Lin: Linezolid.

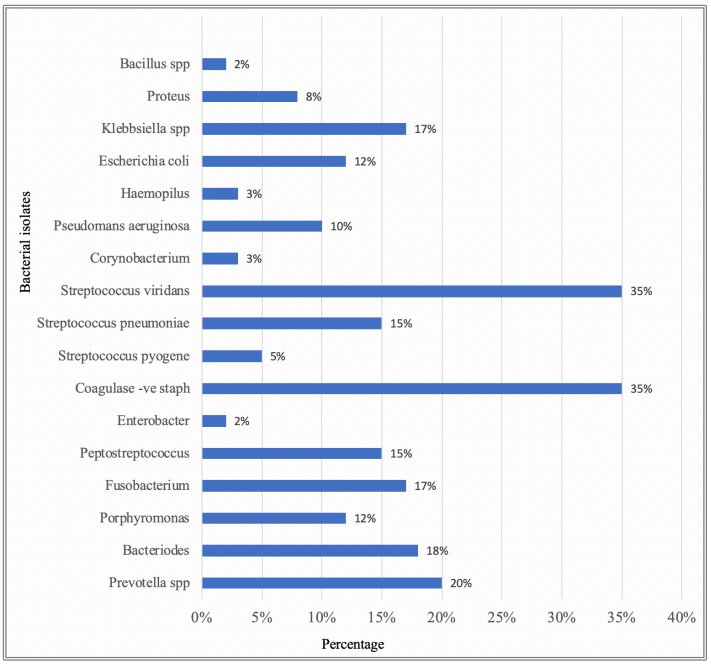



**Figure 4.** Percentage distribution of different isolated microorganisms from patients with fascial space involvement in orofacial infections.

On performing culture of the pus samples from the patients, 54 (90%) samples processed had microbial growth and six (10%) samples had negative growth of microbes. Of the samples with positive growth, the majority (48, 88.9%) were polymicrobial. For the polymicrobial samples, the number of isolates per sample ranged from two to five. The most frequently isolated microbes were *Streptococcus viridans* and coagulase-negative *Staphylococcus* while *Enterobacter spp*. were the least isolated organisms [Figure 4].

The drug susceptibility test of different isolates to antibiotic agents revealed that clindamycin and amoxicillin + clavulanate were effective against both aerobes and anaerobes. Ceftriaxone did not affect the obligate anaerobes and metronidazole had no action against the aerobes and facultative anaerobes [Table 3].

**Table 4.** Factors associated with and duration of hospital stay among patients with fascial space infections involving the orofacial region

| Factors associated with the hospital stay | Duration of hospital stay | | p-value |
|---|---|---|---|
| | Less than a month | More than a month | |
| **Sex** | | | |
| Male | 22 (71%) | 9 (29%) | 0.067 |
| Female | 26 (89.7%) | 3 (10%) | |
| **Age group** | | | |
| ≤ 40 years | 33 (88.1%) | 5 (11.1%) | 0.022 |
| > 40 years | 11 (61.1%) | 7 (38.9%) | |
| **An underlying medical condition** | | | |
| No | 36 (85.7%) | 6 (14.3%) | 0.093 |
| Yes | 12 (66.7%) | 6 (33.3%) | |
| **Fascial space involved** | | | |
| Single | 14 (70%) | 6 (30%) | 0.152 |
| Multiple | 34 (85%) | 6 (15%) | |
| **Types of microbes isolated** | | | |
| No isolate | 6 (100%) | - | 0.221 |
| Monomicrobial | 6 (100%) | - | |
| Polymicrobial | 36 (75%) | 12 (25%) | |

The majority (48, 80%) of the patients stayed in the hospital for less than a month. There was a statistically significant association between the duration of hospital stay and the age of the patients ($p < 0.05$). Other factors had no significant association with the duration of hospital stay [Table 4]. A prolonged hospital stay beyond one month was almost five times higher in those aged above 40 years compared to those aged less than 40 years (OR 4.7; 95% CI 1.2 – 17.8, $p = 0.022$). A total of three patients succumbed to infection in the course of this study, of which one patient has Ludwig's angina, one had parapharyngeal space abscess and one had necrotizing fasciitis.

## 4. Discussion

Orofacial infections have been recognized as an important cause of morbidity and mortality for centuries, and its pathophysiology has been well documented in the literature [4,9,13]. With developments of a range of antibiotics and improved healthcare systems, these infections have become considered as easily managed and thus their incidence is declining not only in developed countries but also in some parts of the developing world [14]. However, since the findings from this study indicate that on average 10 patients are managed for orofacial fascial space infection in our setting, the incidence may still be high.

The results of this study show that males were more affected than females which were in accordance with the findings in the literature [4,9,13,15,16]. Although the reason more males being affected is not known, it has been suggested that it may be attributed to poor oral hygiene condition in men compared to women. Other reasons include negligence of light infections in the mouth and face and increased risk of facial and neck traumas among men [15].

Sixty-five percent of the patients in this study sought medical care within a week after the problem started, similar findings were obtained in Nigeria [16]. The relatively early reporting time among patients with orofacial space infections can be influenced by the fact that this pathological condition often has alarming signs and symptoms such as painful swelling accompanied by dyspnea and/or dysphagia, as it was seen in this study and from elsewhere [5,17,18]. These signs and symptoms which are acute, do force an individual to seek treatment at the earliest time possible.

In a significant number of patients, the orofacial space infection was preceded by a toothache, yet only 36.2% of them had the offending tooth extracted in the health facility they attended before referral to our center, and the main reason for not extracting the tooth was the presence of swelling. Similar findings were reported by Mtenga et al. [19]. These findings reveal that the myth of avoiding tooth extraction in the presence of swelling resulting from infection persists among the health professionals in Tanzania. These health care providers tend to have the sentiments that extraction in the presence of swelling may disseminate infection [20] and thus they prescribe antibiotics. Though initially, the antibiotics appear to work, if the patient does not receive definitive management the problem recurs with greater severity [9].

The presence of swelling and tenderness were the most frequent clinical findings in almost all the patients. Similar findings have been reported in the literature [9,16,17]. Swelling and tenderness can be attributed to the inflammatory response of the body in an attempt to clear, contain and/or slow down the infection caused by microbial invasion [21]. Trismus, dysphagia, and dyspnea usually signify that the infection may have involved the masticatory spaces and the deep cervical spaces especially the parapharyngeal space [17,22] and these are among the important indicators of higher severity of the infection that necessitates the patient to be hospitalized.

Most cases of fascial space infections in the present study had an odontogenic origin, commonly dental caries. These results agree with what has been reported in the literature [5,8,10,23]. Results from the current study also revealed that the odds of suffering from orofacial space infections due to dental caries were four times higher in younger individuals. Our finding may be explained by the fact that dental caries is a slow disease that usually starts during childhood and often becomes symptomatic in early adulthood. Therefore, the sequela of caries and its subsequent management happens in the early years of life.

Concurring to the findings from various studies [10,16,18,24], the submandibular space was the commonly involved site in this study. However, our findings were contrary to the findings from Uganda [5] and Brazil [15] which reported that the buccal space was the most involved site, and from Nigeria [14] where submasseteric space was mostly involved. It has been also documented that the submandibular spaces play an important role as a relay station conveying the infections into the deep portion of the fascial spaces [1]. In our study, most of the patients had multiple fascial spaces involvement, similar to findings from elsewhere [10,16,17]. The reason for this finding is attributed to the rapid spread of infection between spaces that are interconnected and communicate freely with each other.

The prevalence of positive pus culture was 90% in the current study, these findings were higher than what was reported in China [17] and Uganda [5], but lower than findings from India [4]. The reasons for negative growth in pus culture could be related to antibiotic use before the patient was referred to us for management. Commonly, the cultures were polymicrobial and the number of isolates per sample ranged from two to five concurring with the findings in the literature [9,19,25]. Orofacial space infections are polymicrobial because of the interdependent and synergistic metabolism of a variety of microorganisms whereby individual members of the group produce metabolites that are essential for the growth of the other [4].

In the present study, *Streptococcus viridans* was the frequently isolated microorganism, which is in agreement with the findings from South Africa [26] and Malaysia [27], but contrary to findings from Nigeria [25] and India [24] where *Streptococcus aureus* was the commonly isolated organism. The isolation of *Streptococcus spp* is not surprising since they are the predominant bacterial species in the oral cavity [28]. Although clinical studies have emphasized the importance of anaerobic bacteria in orofacial infections, the bacteria responsible for most orofacial infections are *Streptococcus spp* and *Staphylococcus spp* [27].

In this study, penicillin showed a wide spectrum of activity against both aerobes and anaerobes with varying effectiveness, however, semisynthetic penicillin such as “amoxicillin with clavulanic acid” has proved to be better, with a high level of effectiveness. Generally, penicillin's effectiveness, minimal side effects, low cost, patient tolerability, and ready availability [24] makes it remains the treatment of choice for orofacial infections in our settings, and this corresponds to reports from elsewhere [24,26]. Ampicillins displayed an overall poor antimicrobial activity against almost all the species of bacteria, the findings which corresponding to the previous report from our setting [19], and these findings call for abandoning the use of ampicillin in orofacial fascial space infection in our local context.

Basing on the findings of the current study, it was noted that metronidazole had no activity against aerobes and facultative anaerobes. This drug was effective against obligate anaerobes with a spectrum of activity ranging from 75% to 89%. Due to the polymicrobial nature of orofacial fascial space infections, metronidazole is usually used in our setting aiming to target the anaerobes. However, it is only used when there are indications in clinical presentation in the form of a chronic abscess, massive cellulitis, presence of crepitus, evidence of tissue necrosis, and presence of thick foul-smelling pus [24].

In this study, clindamycin was found to be the most effective drug, with a wide spectrum of activity against both aerobes and anaerobes. The isolates were susceptible to this drug by 75 to 100%. This may be attributed to the fact that this drug is fairly expensive in our locality, hence a majority of individuals cannot afford to buy it over the counter, thus the chances of developing resistance against it are low.

The duration of hospital stay for most of the patients was less than a month. There was a statistically significant association between the duration of hospital stay and the age of the patients, with univariate analysis results indicating the odds of prolonged hospital stay were

almost 5 times higher in those aged above 40 years. Based on this, individuals aged more than 40 years require a high index of suspicion for potential complications that may entail longer hospital stays. A total of three patients succumbed to infection in the course of this study. The patient who had necrotizing fasciitis developed septicemia and the remaining two died because of airway obstruction.

### 4.1. Limitations

There were some inherent limitations in this study including that the study was conducted in a single institute and its short duration. As such, the results cannot be generalized. Moreover, the majority of the patient had received antibiotics before attending treatment in our center, and this may have affected culture and sensitivity results. Despite these limitations, the findings of this study cast light on the pattern, bacteriology and outcome of orofacial fascial space infection in our locality. It provides evidence-based support to the current clinical practice in our institute, which emphasizes that antibiotics on their own cannot satisfactorily resolve fascial space infections but rather an early incision and drainage/decompression of the infection.

### 4.2. Conclusion

Orofacial fascial space infections affect all age groups, but commonly young individuals. Males are slightly more affected than females. Most of the fascial space infections are of odontogenic origin and are mostly polymicrobial. In most cases, multiple fascial spaces are affected and the submandibular space is frequently involved. The majority of processed samples had a positive growth of microbes. Clindamycin was found to be the most effective drug, with a wide spectrum of activity against both aerobes and anaerobes. A combination of antibiotics, surgical measures and management of co-existing systemic conditions is mandatory for the management of the condition.

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### Conflict of interest

The authors declare that they have no competing interests with regards to authorship and/or publication of this paper.

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