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A Research Study on Comparison of Prevalence and Outcome of Maxillofacial Odontogenic Space Infection between Diabetic and Non-Diabetic Patients

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Background: *Orofacial space infections are commonly encountered problems in dental practice. The highest prevalence is seen among South Asian population because of their negligence in seeking dental treatment. Diabetes is one of the most common systemic illnesses suppressing the immunity of individual and increasing their susceptibility to infections. Currently, immunocompromised situation (Diabetes mellitus) and space infection together leads to complexity to evaluate the overall outcome of the patients.* ***Objective****: Aim of this study is to compare the prevalence and outcome of maxillofacial odontogenic space infection between diabetic and non-diabetic patients.* ***Materials and Methods:*** *This cross sectional study was conducted in the Department of Oral and Maxillofacial Surgery, BSMMU and DMCH over a period of 15 Months, from June 2020 to August 2021.The selection of the patients was as per the inclusion and exclusion criteria. The study commenced after IRB clearance. All the patients enrolled in this study after proper counseling and informed written consent. A total of 63 patients were taken and divided in to two groups on the basis of presence or absence of diabetes mellitus, Group A (diabetic): N1 number of patients and Group B (non-diabetic): N2 number of patients.* ***Results:*** *Majority of the patients were from BSMMU (58.73%) followed by DMCH (41.26%). Male were more commonly affected than females. Submandibular space was most commonly involved. Streptococcus was the most commonly isolated organism in non-diabetics while Klebsiella in diabetic patients. Meropenem was the most sensitive antibiotic while Amoxicillin was least sensitive antibiotic against the organisms found. This data will be helpful for future research and that will be considered baseline information for public health department.* ***Conclusion:*** *Prevalence of MSI was 4.33 (per thousand) in the study centers of Dhaka. Submandibular space was most common involved space in both diabetic and non-diabetic patients. Streptococcus was the most commonly isolated organism in non-diabetics while Klebsiellain diabetic patients. Meropenam was the most sensitive antibiotic in both group while Amoxicillin was not found sensitive on any patient in group A while least sensitive in group B.*

Keywords: *odontogenic infection, fascial spaces, culture and antibiotic sensitivity*

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Introduction

Head and neck tissues commonly represent the site of several non-specific infections with various degrees of severity. This localization is favored by the presence of oral cavity and of pharyngeal structure, which, because of exposure of high level of bacterial flora, are frequently the starting point of these conditions (Fragiskos 2007).

Among them spreading odontogenic infections are the most common type of serious oral and maxillofacial infections and range from the periapical abscess to superficial and deep neck abscess. Maxillofacial spaces have been defined and described by Urns in 1811 as potential spaces between the layers of fascia. These spaces are filled with loose connective tissues and numerous anatomical structures like veins, arteries, glands, lymph nodes (Holkom 2020).

Odontogenic infections contribute to Maxillofacial Space Infection (*MSI*) in the range of 50–89% in reports from different parts of the world (George et al. 2012). There were 50% odontogenic infections in 185 cases of deep neck infections in Taiwan and diabetic have increased range of MSI that was 88.9% (Huang et al. 2005), 56.1% among 212 cases of *MSI* in China (Zheng et al. 2012), 89% in their 121 cases of Ludwig's angina, Mexico, (Bross-Soriano et al. 2004), 2.85% cases with Ludwig's angina in 210 cases of maxillofacial infections in Brazil (Sato et al. 2009) and 6.25% in 48 cases of severe space infections (Uluibau et al. 2000). An increasing proportion of odontogenic cause among deep neck abscesses over the years has been reported and range of *MSI* increased by 50% among diabetic patients (Parhiscar and Har-El 2001).

MSI are caused by the sequela of dental caries, periodontal disease and even by trauma. Periapical lesion and periodontal lesions are considered as the foremost causes of facial infection which may arise as iotrogenic complications of tooth extraction or local anesthesia (Holkom et al. 2020). Odontogenic infections are typically polymicrobial in nature. It may be due to the fact that the oral cavity contains a complex population of microorganisms. However, the anaerobes generally outnumber the aerobic bacteria by a factor of three to four folds (Sands and Markus 1995). The etiology is usually a presence of decayed or contiguous non-vital teeth, postoperative infections, periodontal disease andpericoronitis. If dismissed, they generally spread into fascial spaces and may lead to adverse life-threatening consequences (Shakya et al. 2017).

Diagnostic work-up includes proper history taking, close clinical examination certain investigations like OPG, contrast CT, USG, MRI, Culture and Sensitivity. Diagnosis should include the spaces involved, severity of infections, virulence of microorganisms.USG is quick, inexpensive, painless and is valuable diagnostic aid to the oral and maxillofacial surgeon for early and accurate diagnosis of facial space infection, their appropriate treatment and to limit their further spread (Bali et al. 2015). Enhanced contrast CT is valuable for detecting either the infection is odontogenic or non odontogenic (Kim et al. 1997). However MRI is considered to be more superior to CT in regard to lesion conspicuity, extension, number of anatomic spaces involved and source on infection (Ikkurthi et al. 2018).

Different strategies have been adopted for the management of odontogenic space infections. Some of these infections resolve with little consequences, while some may spread to facial spaces adjacent to the oral cavity and spread aggressively leading to more severe infections (Chunduri et al. 2012).

Several antibiotics are indicated for odontiogenic infections. Proper understanding of disease process, treatment plan, mode of action of antibiotics, patient's health status, pharmacokinetics and dose of the antibiotics is essential for a successful treatment outcome. The orally administered antibiotics are effective against odontogenic infections. They include amoxicillin, metronidazole, clindamycin etc. (FC 2016). However, if these infections are ignored or not treated properly, complications such as airway obstructions, infection of carotid sheath, meningitis, septicemia, cavernous sinus thrombosis, mediastinitis and distant metastatic foci have been reported.

Some reports reveal Streptococcusas the major causative organism for infection, whereas a few have *Klebsiella Pneumonia*thepredominate causative organisms.

Odontogenic infections most of the times seems to be associated with co-morbid conditions like diabetes mellitus, hypertension and renal disease. Among them diabetes mellitus is recognized as the most common associated systemic disease in deep neck infections (Parhiscar and Har-El 2001). The clinical studies performed so far have emphasized a frequent association between diabetes and the occurrence of severe head and neck infections such as necrotizing fasciitis (Flynn et al. 2006).

The patients with deep neck infection who have diabetes mellitus usually display a unique clinical picture in comparison with those without diabetes mellitus (Chen et al. 2000).

The prevalence of diabetes is increasing worldwide with diabetic individuals usually having higher predisposition to infections. Infections represent a frequent and severe systemic complication of diabetes mellitus and are said to be associated with sustained hyperglycemia (Pozzilli and Leslie 1994). In addition to impaired host defense mechanism, other factors may also increase the susceptibility of diabetic patients to infection. In odontogenic infections it has been documented that the organisms that affect diabetic individuals might be different from those in individuals who are not diabetic (Huang et al. 2005).

There are certain pathogenic mechanisms that make diabetic patients more susceptible to infection. It includes hyperglycemic environment increasing the virulence of some pathogens; lower production of interleukins in response to infection; reduced chemotaxis and phagocytic activity; immobilization of polymorph nuclear leukocytes; glycosuria, gastrointestinal and urinary dysmotility (Alves et al. 2012).

In short all these effects are caused by hyperglycemia. Hyperglycemia causes proteinglycation and formation of advanced glycation end products, which can have a diverse impact on host cell function (Sathasivam 2018). It can cause impairment of host proteins involved in complement activation, bacterial uptake, phagocytic killing and scavenging of bio limiting nutrients and change the binding of host surface receptors for pathogens (Gan 2013).

The aim of the study will be to highlight the comparison of frequency and outcome of maxillofacial space infections in diabetic and non-diabetic patients. The corner stone of management of infections in the oral and maxillofacial region remains the same in diabetic and non-diabetic patients i.e., source, infection control, drainage and adjunctive antimicrobial therapy. In light of this, a study will be conducted to compare the prevalence, odontogenic spaces involved, microorganism involvement and antibiotic susceptibility between diabetic and non-diabetic.

Rationale

Maxillofacial infections are most frequently occurring infectious processes known to both antiquity and present-day health practice which ranges from periapical abscess to superficial and deep neck abscess. The annual estimated prevalence of MSI is 50-89% from different part of the world. There are wide geographical variations in the prevalence of MSI and is more commonly seen in developing countries.

This study was design to see the prevalence of MSI in both Diabetic and non-diabetic patients. The spaces commonly involved in MSI. The most common organisms involved and the sensitive antibiotics against those organisms.

Globally, the burden of diabetes is increasing very rapidly as its related complications. Infections in diabetes mellitus are relatively more common and serious. There is no previous study of maxillofacial space infections comparing between diabetic and non-diabetic patients in Bangladesh. This study will give a new insight of maxillofacial space infection originating from dental origin comparing the outcome between diabetic and non-diabetic patients.

Research Question

Are there any differences on prevalence and outcome of maxillofacial odontogenic space infections between diabetic and non-diabetic patients?

Objectives

<u>General Objective</u>

To compare the prevalence and outcome of maxillofacial odontogenic space infection between diabetic and non-diabetic patients.

<u>Specific Objectives</u>

- To determine the prevalence of space infection in both diabetic and non-diabetic patients.
- To determine the maxillofacial spaces involved in both diabetic and non-diabetic patients.
- To assess the microorganisms involved in maxillofacial space infections in both diabetic and non-diabetic patients

- To evaluate the antibiotic sensitivity profile of both diabetic and non-diabetic patients having maxillofacial space infection.

Literature Review

A retrospective study among 131 patients was conducted by Lin et al. (2006) on influence of diabetes mellitus on deep neck infection. Prevalence rate of infection was greater in diabetes mellitus. Klebsiella was most common isolated organism and more than 2 spaces involvement was common among diabetic patients.

Rao et al. (2010) conducted a 4 years retrospective study of comparison of Maxillofacial space infection in diabetic and non-diabetic patients among the 111 patients. Among them they found 31 patients were diabetic and 80 were non-diabetic. The organism most commonly isolated were streptococcus species with submandibular space being the most common space in both groups.

George et al. (2012) conducted a 5 years retrospective study of odontogenic maxillofacial space infection at a tertiary center in North India among 137 patients. Among them 24.1% were diabetic. Submandibular space was commonly involved.

A 10 years retrospective study on prevalence of odontogenic deep head and neck space infection and its correlation with length of hospital stay by Zamiri et al. (2012). Among total of 297 patients, 34.3% (n=102) were odontogenic origin. Middle class families were more commonly affected. Sub-mandibular space was most commonly involved (32%). Non-hemolytic streptococcus was most common isolated organism.

A two year retrospective study was conducted by Chang et al. (2013) among fifty-one (51) patients to evaluate the clinical impacts of diabetes mellitus on prognosis in comparing non-diabetic patients. In the study twenty-five (25) patients were diabetic and twenty-six (26) were non-diabetic. In diabetic patients more space were involved, being the masseteric, pterygomandibular and temporal spaces were the secondary spaces were mainly involved.

A case control study by Juncar et al. (2014) a retrospective study over a period of 10 years in 899 patients with 79 patients in diabetic group and 826 patients in non-diabetic group. In the study old aged patients were more commonly affected in both groups. There were 34% cases involving single space only in diabetic groups and 86.8% in non-diabetic groups. The most common isolated organism was staphylococcus aureus, followed by streptococcus and E.coli in both the groups.

A comparative analysis of odontogenic maxillofacial infections in diabetic and non-diabetic patients, an institutional study was evaluated by Rahul et al. (2015) among 188 patients for 2 years and concluded that 61 patients were diabetic and 127 patients were non-diabetic with MSI. The submandibular space was the most commonly involved space, and the most common organism was Klebsiella in diabetic and streptococcus in non-diabetic group.

A retrospective study of 270 cases of deep neck space infection at tertiary care center by Gujrathi et al. (2016) where males were commonly affected. Streptococcus and Staphylococcus species were most commonly isolated organism.

Sultana et al. (2017) conducted study on etiology of deep neck infection and determination of their predisposition factors and microbial pattern. The study concluded Streptococcal species was most common isolated organism followed by *Klebseilla*and *Staphylococcus.*

In a study conducted by Shah et al. (2016), among 100 patients on aerobic microbiology and culture of head and neck space infection of odontogenic origin. aerobic gram positive was isolated among 73% and aerobic gram negative among 18% patients while no growth was detected among 9% patients. *Streptococcus* was most common involved organism in gram positive cases while *Kleibsella* was found maximum in overall patients. Amoxicillin was most resistance (48.4%) comparing ceftriaxone, carbenicillin and amikacin.

Shakya et al. (2017) conducted study on epidemiology, microbiology, antibitotic sensitivity of odontogenic space infection in central India among 100 cases. Male were more commonly affected. Sub mandibular space was most common involved (44.26%) followed by buccal space (27%). Streptococcus was most common isolated organism (47.05) followed by staphylococcus. Amoxicillin with clavunate and clindamycin was the most effective antibiotic against those organisms.

An study on analysis of maxillofacial and neck spaces infection by Holkom et al. (2020) in diabetic and non-diabetic patients was conducted for 4 years in 120 cases where 47 patients found to be diabetic and 73 patients were non-diabetic, Among the study population it was concluded that 53% were female and 45% were male. Multiple spaces were more common in diabetic groups comparing to non-diabetic groups. Submandibular space was most common space in both the groups followed by buccal and masseteric space. Streptococcus species was the most common isolated organism in both the groups.

Materials and Methods

Type of Study

Observational analytical study

Place of Study

Department of Oral and Maxillofacial Surgery
Bangabandhu Sheikh Mujib Medical University (BSMMU) and
Dhaka Medical College and Hospital (DMCH)

Period of Study

June 2020 to August 2021 (15 Months)

Study Population

The study population comprised of patients having maxillofacial space infections associated with other conditions.

Study Sample

Patients having Maxillofacial space infections with or without diabetes mellitus presenting to the department of oral and maxillofacial surgery, Bangabandhu Sheikh Mujib Medical University and Dhaka Medical College and Hospital, Dhaka.

Sampling Technique

Consecutive sampling: Total 63 patients assigned by consecutive sampling technique patients and divided in to 2 groups.

Sample Size

According to the **Morgan's table** for sample size, if the population size is 70 then by considering **5%** of margin of error, sample size will be **63**.

Grouping of the Sample

Total sample size of the study as per calculation was 63 which was divided in to following 2 groups.

Group A - This group consists of N1 number of Maxillofacial space infection patients with diabetes mellitus.

Group B - This group consists of N2 number of Maxillofacial space infection patients without diabetes mellitus.

Selection Criteria

Inclusion Criteria

- Patient with MSI either diabetic or non-diabetic.
- Patient who has given consent will be included in this study
- Both gender
- Any age patients

Exclusion Criteria

- Patient with other pathological findings in maxillofacial region rather than space infections.
- Patients with head and neck space infection of non-odontogenic origin.
- Patients with antibiotic intake before reporting.

Immuno-compromised patient other than diabetes mellitus

Patents who refuse to give written consent

Variables of the Study

Demographic Variables

- Age
- Gender
- Educational status
- Socio-economic status

Outcome Variables

- Prevalence
- Spaces involved
- Causative organism
- Antibiotic sensitivity

Operational Definitions

Orofacial Space Infection

Space infections are potential spaces between the fascias. The clinical spectrum of orofacial infections affecting the skin or mucous membrane of the face and oral cavity is quite diverse. Such infections may be localized and indolent, or invasive and life-threatening. These infections may be conveniently categorized as odontogenic and non-odontogenic.

Odontogenic Infection

An odontogenic infection is an infection that originates within a tooth or in the closely surrounding tissues. The term is derived from odonto- (from ancient Greek odontos - "tooth") and -genic (from Greek genos - "birth").

Diabetes Mellitus

Diabetes mellitus (DM), commonly known as diabetes, a chronic disease associated with abnormally high level of sugar glucose in the blood due to inadequate production of insulin (which is made by the pancreas and lowers blood glucose) or inadequate sensitivity of cells to the action of insulin and is a group of metabolic disorders characterized by high blood sugar levels over a prolonged period.

Antibiotic Sensitivity Test

An antibiotic sensitivity (or susceptibility) test is done to help chose the antibiotic that will most effective against the specific type of bacteria infecting an individual person that is because by resistant bacteria are not cured by treatment with those antibiotics. This method is also called the agar diffusion method or the disk diffusion method. The procedure followed is simply that a filter disk impregnated with an antibiotic is applied to the surface of an agar plate containing the organism to be tested and the plate is incubated at 37°C for 24-48 hours.

Pus Culture

A sample of pus is added to a substance which promotes the growth of microorganisms. If no microorganisms grow, the culture is said to be negative. On the other hand, if the microorganisms that can cause infection to grow, the culture is said to be positive.

Wound infections may be caused by one to many organisms depending on the site of the infection

Gram positive	Gram negative
Staphylococcus aureus	*Pseudomonas aeruginosa*
Streptococcus pyogenes	*Escherichia coli*
Enterococcus species	*Proteus* species
Anaerobic streptococci	Klebseillaspecies
Other streptococci	Bacteriodes species

Deep Neck Infection

A deep neck infection (neck abscess) is a collection of pus from an infection in spaces between the structures of the neck. Deep neck infections (DNI) can originate from infection in the potential spaces and fascial planes.

Incision and Drainage

It can be defined as process to release pus or pressure built up under the skin, such as from an abscess, boil or infected paranasal sinus.

Socio-economic condition:
According to Asian Development Bank
Less than 2$ per day = poor family
2$ to 20$ per day= middle class family
More than 20$ per day= high class family

Study Procedure

Detailed history was taken, and clinical examinations were done for each patient and recorded in pre-designed data entry sheet. Study data (Demographic characteristics, Space infection characteristics, radiological examinations) were recorded.

Specimen was collected before antimicrobial therapy and/or before application of antiseptic dressing. Minimum volume of 1ml (up to 5 ml) of pus was collected in a sterile syringe – any air bubble was expelled. Syringe safely and tightly capped (needle was not sent).

The specimen was labeled and deliver to the laboratory as soon as possible with a completed request form.

Data Collection

The study subjects were selected on the basis of selection criteria from the patients presenting at Department of Oral and Maxillofacial Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU) and Dhaka Medical College and Hospital (DMCH). The demographic information, relevant history, examination findings and investigation reports of all the study subjects was recorded in the pre-designed data collection sheet.

Data Collection Tools

Pre-determined data collection sheet, filled up by the investigator himself through interview, supplemented by documentary evidence (imaging).

Data Analysis

The data were analyzed using the Statistical Package for the Socials Sciences (SPSS) version 24 (IBM Corporation, Armonk, NY, USA). Demographic variables were presented by means of frequency and percentages. Categorical variables were analyzed between 2 groups by Chi-square test and Fisher's exact test whereas continuous variables between 2 groups were measured by Student's *t* test (unpaired). Level of significance was considered as $p<0.05$.

Ethical Consideration

Ethical clearance for the study was taken and obtained from the Institutional Review Board (I.R.B) of BSMMU prior to the commencement of this study. After the research protocol is approved by the committee, permission for the study was taken from the Department of Oral and Maxillofacial Surgery, Bangabandhu Sheikh Mujib Medical University and Department of Pathology, Bangabandhu Sheikh Mujib Medical University. (**Ethical IRB Number: BSMMU-2020/10144**) held in the 209th meeting on 17th October 2020.

The aims and objectives of the study along with its procedure, risks, Stages and benefits of this study was explained to the study subjects in an easily understandable local language. A written informed consent was taken from all the study subjects without exploiting any of their weakness.

All the study subjects were assured about their confidentiality and freedom to withdraw themselves from the study at any time.

Results

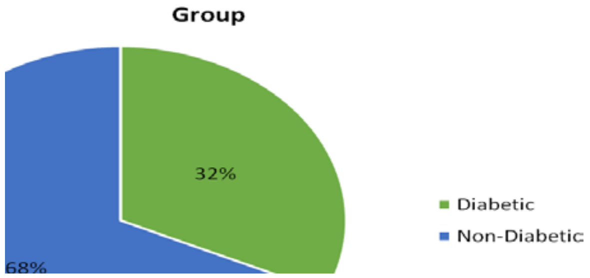
Prevalence of Maxillofacial Space Infection

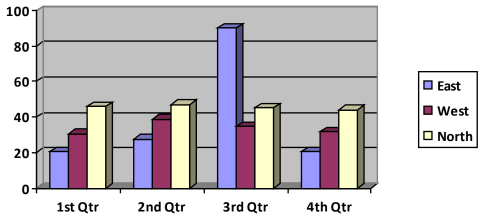
Table 1 and Figure 1 show the total cases presented at department of OMFS were 14877. Among those, 63 were cases of MSI. Current prevalence of MSI at study centers of Dhaka is 4.23 (Per thousand).

Table 1. *Prevalence of Maxillofacial Space Infection*

Study Centers	Number of cases Presented at OPD	Diagnosed as Maxillofacial space Infection	Prevalence (per thousand)
BSMMU	8535	37	4.33
DMCH	6342	26	4.09
TOTAL	14877	63	4.23

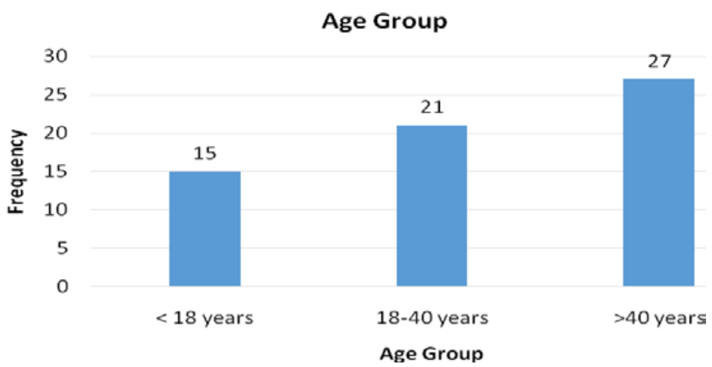
Figure 1. *Pie Chart Showing Distribution of Patients by Diabetic Status. Pie Chart Shows 32% Patients Were Diabetic while 68 % Patients Were Non-Diabetic in the Study Population*





Distribution of Patients by Age Group

Figure 2. *Bar Diagram Showing Distribution of Patients by Age Group (N=63)*



The above bar diagram shows>40 years of age group consists majority patients 27 (42%) while<18 years of age consists minimum patients 15 (34%).

Table 2 and Figure 2 show majority of the patients in group A were aged > 40 years 14 (70%) followed by (18-40) years of age 6 (30%). No patient in group A was below 18 years of age. In group B <18 years and (18-40) years of age consists equal number of patients 15 (34.88%) followed by 13 (30.2%) patients in > 40 years of age group. Patients distribution among both group by age was statistically highly significant (*p<0.001)*.

Table 2. *Distribution of Patients by Age Group (N=63)*

Age Group	Group A (n_1=20)		Group B (n_2=43)		*p**-value
	n_1	%	n_2	%	
< 18 years	0	0	15	34.88	
18-40 years	6	30	15	34.88	
>40 years	14	70	13	30.2	
Mean ± SD	53.43±12.17		49.31±9.39		0.001^{s}

s=significant
**p*-value reached by unpaired Student's *t*-test and considered significant *p*<0.05.

Gender

Figure 3. *Chart Showing Distribution of Patients by Gender (N=63)*

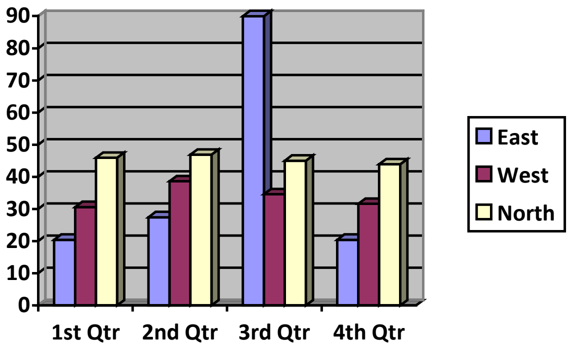


Table 3 and Figure 3 show pre-dominancy of the male patients 38 (60%) in comparison to the female patients 25 (39.6%) in the study population.

There were more male patients in both group A 11 (55%) and B 27 (62.8%) in comparison to female patients, A 9 (45%) and B 16 (37.2%). Patients distribution among both group by gender was statistically non- significant (*p=0.375)*.

Table 3. *Distribution of Patients by Gender (n=63)*

Gender	Group A (n_1=20)		Group B (n_2=43)		*p*-*value
	n_1	%	n_2	%	
Male	11	55	27	62.8	0.375^{ns}
Female	9	45	16	37.2	

ns=non-significant
**p*-value reached by Pearson Chi-Square test and considered significant when *p*<0.05.

Educational Status

Figure 4. *Pie Chart Showing Distribution of Patients by Educational Status (n=63)*

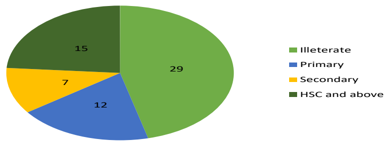


Table 4 and Figure 4 show majority of patients were illiterate 29 (46%) while minimum patients had primary level education 12 (19%) in the study population.

Table 4 also shows majority of the patients in group A were educated (HSC and above) followed by equal number of patients in Illiterate and primary level category 4 (20%). In group B illiteracy rate was found in majority of patients 25 (58.1%) followed by primary level education 8 (18.6%). Minimum number of patients from both group A 3 (15%) and group B 4 (9.3%) were from secondary level education. Patients distribution among both group by educational status was statistically significant (*p=0.017).*

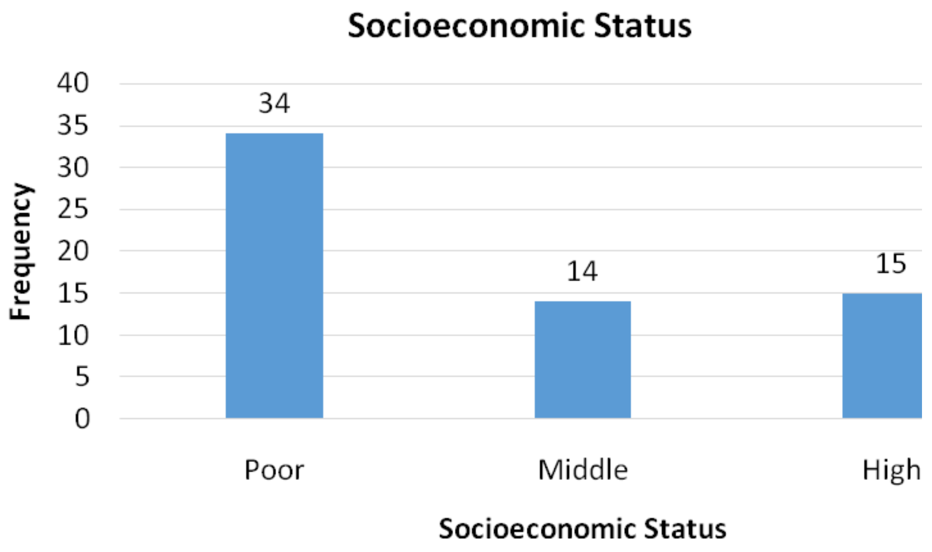
Table 4. *Distribution of Patients by Educational Status (n=63)*

Educational Status	**Group A (n_1=20)**		**Group B (n_2=43)**		***p**-value**
	n_1	**%**	**n_2**	**%**	
Illiterate	4	20.0	25	58.1	0.017^{s}
Primary	4	20.0	8	18.6	
Secondary	3	15	4	9.3	
HSC and above	9	45	6	14	

S=significant
**p*-value reached by Pearson Chi-Square test and considered significant when $p<0.05$.

Socio-Economic Condition

Figure 5. *Bar Diagram Showing Distribution of Patients by Socio-Economic Condition (n=63)*



Majority of patients were from poor society 34 (53.96%) while middle- and high-class patients have almost equal incidence of involvement 14 (22.22%) and 15 (23.80%) respectively (Table 5, Figure 5).

Group A consists 10 (50%), 6 (30%) and 4 (20%) number of patients in high, middle and low-class society, respectively. In group B majority of patients belongs to low class society 30 (69.8%) followed by middle class 8 (18.6%) and then high class society 5 (11.6%).Patients distribution among both group by socio-economic condition was statistically highly significant (*$p<0.001$).*

Table 5. *Distribution of Patients by Their Socio-Economic Condition (n=63)*

Socio-economic condition	Group A (n_1=20)		Group B (n_2=43)		*p**-value
	n_1	%	n_2	%	
Low	4	20	30	69.8	0.001^s
Middle	6	30	8	18.6	
High	10	50	5	11.6	

s=significant

**p*-value reached by Pearson Chi-Square test and considered significant when $p<0.05$.

Space Involvement

Figure 6. *Distribution of Patients by Spaces Involvement (n=63)*

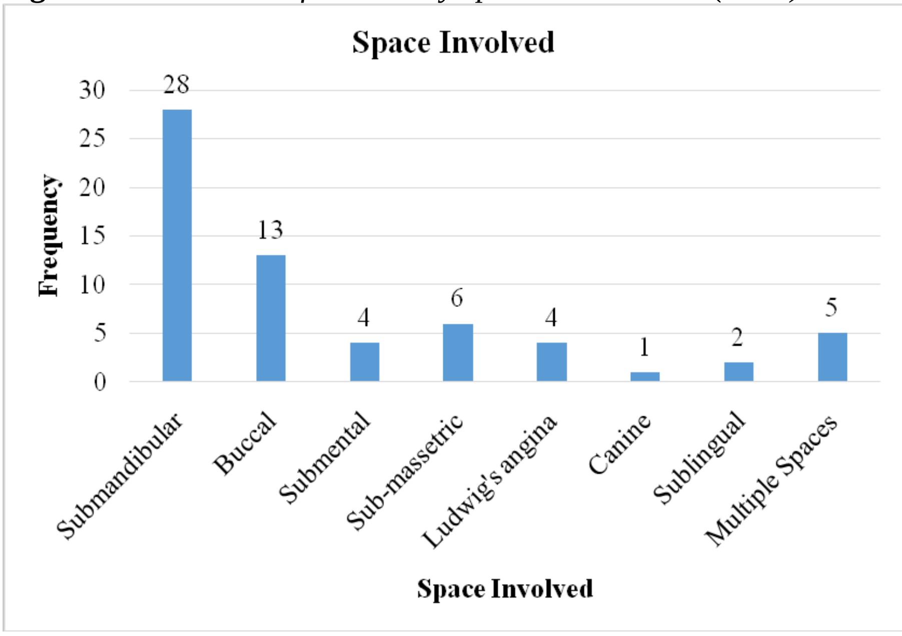


Table 6 and Figure 6 show submandibular space was most commonly involved 28 (44.44%) followed by buccal space 13 (20.63). Submental and Ludwig's angina has equal incidence of occurrence 4 (6.34%). Canine space was affected least 1 (1.58%).

Submandibular was most commonly involved space in both group A 8 (40%) and group B 20 (46.5%) which was followed by buccal space 4 (20%) and 9 (20.9%) in group A and B respectively). Sub-masseteric space, Ludwig's angina and multiple spaces has got equal incidence of involvement in group A 2 (10%). Submental and Sublingual space was involved in only 1 patient in group A. In group B, Sub-masseteric space, Ludwig's angina and multiple spaces involvement was among 4 (9.3%), 2 (4.7%) and 3 (7%) patients respectively. Least affected was canine space 1 (2.3%) in group B. Patients distribution among both group by the spaces involved was statistically non-significant (*p=0.971*).

Table 6. *Distribution of Patients by Spaces Involvement (n=63)*

Spaces involved	Group A (n_1=20)		Group B (n_2=43)		*P value*
	n_1	%	n_2	%	
Sub-mandibular	4	20	30	69.8	0.971^{ns}
Buccal	6	30	8	18.6	
Submental	10	50	5	11.6	
Sub-masseteric	2	10	4	9.3	
Ludwig' angina	2	10	2	4.7	
Canine	0	0	1	2.3	
Sublingual	1	5	1	2.3	
Multiple	2	10	3	7	

ns=non-significant
**p*-value reached by Pearson Chi-Square test and considered significant when p<0.05.

Micro-organisms

Figure 7. *Distribution of Patients by Growth on Culture (n=50)*

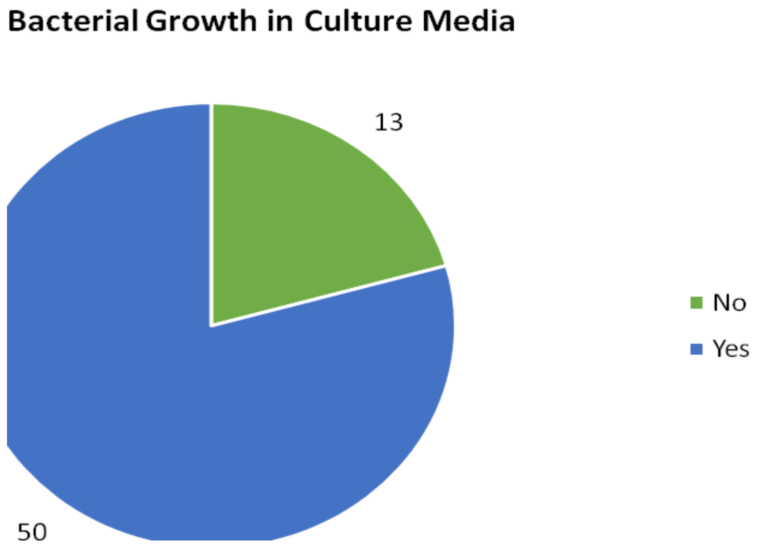


Table 7 and Figure 7 show among the study population of 63 patients, no growth was found in 13 (20.06%) patients while 50 (79.33%) patients show growth on culture media.

Most common isolated organism in group A was Klebsiella 6 (37.5%) followed by Streptococcus 5 (31.3%). E.coli and Staphylococcus were 3rd common isolated organism 2 (12.5%) in group A while Acinobacter was found in 1 culture only. In group B, Streptococcus was most common organism 17 (50%) followed by E.coli 9 (26.5%). Staphylococcus and Klebsiella were found in 6 (17.6%) and 2 (5.9%) patients culture respectively in group B. Patients distribution among both group by the organism was statistically significant (*p=<0.027*).

Table 7. *Distribution of Patients by Growth on Culture (n=50)*

Isolated organism	**Group A (n_1=16)**		**Group B (n_2=34)**		***p-value**
	n_1	**%**	**n_2**	**%**	
Streptococcus	5	31.3	17	50	0.027^{ns}
Staphylococcus	2	12.5	6	17.6	
Klebsiella	6	37.5	2	5.9	
E.coli	2	12.5	9	26.5	
Acinobacter	1	6.3	0	0	

s=significant
**p*-value reached by Pearson Chi-Square test and considered significant when $p<0.05$.

Antibiotic Sensitivity

Table 8 shows Meropenam was most sensitive organism in both group A 15 (93.75) and B 14 (100%) followed by Amikacin 14 (87.5%) and 33 (97.05%) in group A and B respectively. Tazobactam and Piperacillin. Cefotaxime and

Gentamicin were found sensitive among 13 (81.25%), 12 (75%), 11 (68.75%) patients respectively in group A, while 27 (79.41%), 16 (47.05%) 22 (64.70%) respectively in group B. In group A, Ceftriaxone and Ciprofloxacin were found sensitive among 6 (37.5%) patients while in group B Ceftriaxone and Ciprofloxacin were found sensitive among 20 (58.8%) and 14 (41.11%) patients respectively. Amoxicillin was not found sensitive among any patients in group A while least sensitive in group B 11 (32.35%). Patients distribution among both group by antibiotic sensitivity of Amoxicillin and Colistin Sulphate was statistically significant *(p<0.05)* (Table 7).

Table 8. *Distribution of Patients by Antibiotic Sensitivity (n=50)*

Name of Antibiotics	Group A (N=16)	%	Group B (N=34)	%	**p*-value
Amoxicillin	0	0	11	32.35	0.01^{S}
Cotrimoxazole	5	31.25	15	44.11	0.291^{ns}
Ciprofloxacin	6	37.5	14	41.11	0.582^{ns}
Ceftriaxone	6	37.5	20	58.8	0.135^{ns}
Gentamicin	11	68.75	22	64.70	0.520^{ns}
Cefotaxime	12	75	16	47.05	0.059^{ns}
Cefuroxime	10	62.5	18	52.94	0.373^{ns}
Amikacin	14	87.5	33	97.05	0.237^{ns}
Aztreoman	10	62.5	20	58.82	0.528^{ns}
Azithromycin	6	37.5	16	47.05	0.373^{ns}
Meropenam	15	93.75	34	100	0.542^{ns}
Tazobactam And Piperacillin	13	81.25	27	79.41	0.600^{ns}
ColistinSulphate	10	62.5	33	97.05	0.003^{S}

S=significant
Ns=non-significant
**p*-value reached by Pearson Chi-Square test (cell count >5) and Fisher's exact test (cell count <5) and considered significant when *p*<0.05.

Table 9 shows Meropenem was most sensitive organism in group A 11 (100%) followed by Amikacin 10 (90.9%). Cotrimoxazole and Ciprofloxacin were less sensitive among 4 (36.36%) patients. In group B, Meropenem, Tazobactam and Piperacillin, Amikacin, Atreoman and Gentamicin were found equally sensitive among 4 (80%) patients. Cotrimoxazole, Ceftriaxone, Cefuroxime and Azithromycin were least sensitive among 1 (20%) population. Patients distribution among both group by antibiotic sensitivity of Cefuroxime was statistically significant (p=0.036).

Table 9. *Distribution of Patients by Antibiotic Sensitivity among Controlled and Uncontrolled Diabetes Mellitus (n=16)*

Name of Antibiotics	Controlled DM (N=11)	%	Uncontrolled DM (N=5)	%	**p*-value
Amoxicillin	0	0	0	0	
Cotrimoxazole	4	36.36	1	20	0.484 ns
Ciprofloxacin	4	36.36	2	40	0.654 ns
Ceftriaxone	5	45.45	1	20	0.346 ns
Gentamycin	7	63.63	4	80	0.484 ns
Cefotaxime	9	81.81	3	60	0.365 ns
Cefuroxime	9	81.81	1	20	0.036 S
Amikacin	10	90.90	4	80	0.542 ns
Aztreoman	6	54.54	4	80	0.346 ns
Azithromycin	5	45.45	1	20	0.346 ns
Meropenam	11	100	4	80	0.313 ns
Tazobactam and piperacillin	9	81.81	4	80	0.705 ns
ColistinSulphate	7	63.63	3	60	0.654 ns

S=significant; ns=non-significant

**p*-value reached by Pearson Chi-Square test (cell count >5) and Fisher's exact test (cell count <5) and considered significant when $p<0.05$.

Discussion

This study was conducted at the Department of OMFS, BSMMU and DMCH over a period of 15 months, from June 2020 to August 2021. Total 63 patients were divided into 2 groups on the basis of presence or absence of diabetes mellitus. Group A consists of 20 patients of maxillofacial space infection with Diabetes Mellitus and Group B consists of 43 patients of maxillofacial space infection without Diabetes Mellitus.

In this study the total cases presented at department of OMFS were 14877. Among those, 63 were cases of MSI. Current prevalence of MSI at study centers of Dhaka is 4.23 (per thousand). 20(32%) patients were diabetic while 43(68%) patients were non-diabetic in the study population.

In our study, patients aged above 40 years were maximum in group A 14 (70%) while minimum in group B 13 (30.2%). Less than 18 years and (18-40) years of age group consists equal patients which were maximum in group B 15 (34.88%). No patients in group A were aged <18 years. The mean age of group A patients was 53.43±12.17 years and of group B patients was 49.31± 9.39. Patients distribution among both group by their age was statistically highly significant (*p=0.001*) (Table 1). The result is consistent with Holkom et al. (2018) where mean age in group A was 55±18.039 with minimum age 9 years and maximum 82 years while mean age in group B was 47.10±20.95 years with minimum as 4 years and maximum 92 years and age difference between the two age group was statistically significant. In a study by Rao et al. (2010) maximum percentage of patients included in the study were aged > 40 years where mean age group was 47.97 for group A and 43.70 for group B.

Current study shows Pre-dominancy of male patients 38 (60%) in comparison to female patients 25 (39.6%) in the study population (Table 2). Patients distribution among both group by gender was statistically non-significant (*p<0.375).* The incidence was higher in males conducted by Mihai et al. (2013). Similar results were obtained in the study conducted by Rahul et al. (2015) in which 108 patients were male and 80 patients were female in total of 188 patients. The result is not consistent with Holkom et al. (2018) where 55% were female and 45% were male.

In group A, maximum number of patients belongs to high class society 10 (50%) while minimum number of patients belongs to low class society 4 (20%). The situation is vice–versa in group B, where maximum number of patients belongs to low class 30 (69.8%) while minimum from high class society 5 (11.6%) (Table 3). Patients distribution among both group by socio-economic condition was statistically highly significant (*p<0.001*). Similar results were reported by Holkom et al. (2018) where majority of 72.5% patients had no occupation.

In current study, majority of the patients were illiterate in group A (58.1%) and of higher education in group B (50%) followed by primary level education (20% and 18.6% in group A and group B, respectively) (Table 4). Patients distribution among both group by educational status was statistically significant (*p<0.017).*

Submandibular was most commonly involved space in both group A 8 (40%) and group B 20 (46.5%) which was followed by Buccal space 4 (20%) and 9 (20.9%) in group A and B respectively). Sub-masseteric space, Ludwig's angina and multiple spaces has got equal incidence of involvement in group A 2(10%). Submental and Sublingual space was involved in only 1 patient in group A. In group B, Sub-masseteric space, Ludwig's angina and multiple spaces involvement was among 4 (9.3%), 2 (4.7%) and 3 (7%) patients respectively. Least affected was canine space 1 (2.3%) in group B. Submental and sublingual space was involved in only 1 patients in group A. Least affected was canine space 1 (2.3%) which was from group B. Patients distribution among both group by the spaces involved was statistically non-significant (*p=0.971*) (Table 5). In a Previous study by Rahul et al. (2015) similar reports were found where submandibular space was most commonly affected space in both group A 15 (24.9%) and group B 44 (34.69%) followed by the buccal space (11 18.03% in group A and 37, 29.13% in group B). Similar reports were also reported by Dipesh et al. (2010) where submandibular space was the most common involved space in both group A and B followed by buccal space.

In this study, Among study population of 63 patients, no growth was found in 13 (20.06%) patients while 50 (79.33%) patients shows growth on culture media which is similar to previous study by Holkom et al. (2018), in which 45% cases yielded no growth. This may be due to collection of sample after antibiotic therapy, poor handling of sample, poor transportation and poor processing. Streptococcal Species were most common isolated organism in group B 17(50%) and Kleibsella in group A 6 (37.5%). Streptococcus was 2nd common involved organism in group A 5 (31.3%) while *E.coli* in group B 9 (26.5%). Staphylococcus was 3rd common isolated organism in both groups A 2 (12.5%) and B 6 (17.6%). One patient in group A had *Acinobacter* growth in culture. Patients distribution among both group by involvement of organism was statistically significant (*p=<0.027*) (Table 6). In a study by Rahul et al. (2015), *Kleibsella*was most common isolated organism in group A (24.59%) and Streptococcus in group B (29.13%) which is similar to our study. In a Study by Holkom et al. (2018) Streptococcus was most common organism in both group A (16.13%) and group B (26.25%) while Klebsiella was 2nd common organism in group which is contrast to our study

Meropenam was most sensitive organism in both group A 15 (93.75) and B 14 (100%) followed by Amikacin 14 (87.5%) and 33 (97.05%) in group A and B respectively. Tozobactum and Piperacillin, Cefotaxime and Gentamicin were found sensitive among 13 (81.25%), 12 (75%), 11 (68.75%) patients respectively in group A while 27 (79.41%), 16 (47.05%), 22 (64.70%) respectively in group B. In group A, Ceftriaxone and Ciprofloxacin were found sensitive among 6 (37.5%) patients while in group B, Ceftriaxone and Ciprofloxacin were found sensitive among 20 (58.8%) and 14 (41.11%) patients respectively. Amoxicillin was not found sensitive among any patients in group A while least sensitive in group B 11(32.35%). Patients distribution among both group by antibiotic sensitivity of Amoxicillin and Colistinsulphate wasstatistically significant *($p<0.05$).*

Again we divided the diabetic patients in controlled and uncontrolled diabetic mellitus to see the status of antibiotic sensitivity where we found 11 cases of controlled diabetes mellitus and 5 cases of uncontrolled diabetic mellitus. Meropenam was most sensitive organism in controlled diabetic group 11 (100%) followed by Amikacin 10 (90.9%). Cotrimoxazole and Ciprofloxacin were less sensitive among 4 (36.36%) patients. In uncontrolled diabetic, Meropenam, Tozobactum and piperacillin, Amikacin, Atreoman and Gentamicin were found equally sensitive among 4 (80%) patients. Cotrimoxazole, Ceftriaxone, Cefuroxime and Azithromycin were least sensitive among 1 (20%) population. Patients distribution among both group by antibiotic sensitivity of Cefuroxime was statistically significant (p=0.036).

Conclusion

Prevalence of MSI was 4.33 (per thousand) in the study centers of Dhaka. Male were more affected comparing females. Maximum patients belongs to high class society in diabetic group while low class society in non-diabetic group. Submandibular was the most commonly involved space in both diabetic and non-diabetic patients followed by buccal space. Streptococcus was the most commonly isolated organism in non-diabetics while Klebsiella in diabetic patients. Meropenam was most sensitive organism in both groups. Amoxicillin was not found sensitive on any patient in group A while least sensitive in group B.

Limitations of the Study

- Small sample size
- Short study duration
- Only 2 centers included
- Observational study

Recommendations

- MSI patient with diabetes mellitus has got antibiotics less sensitive so proper selection of antibiotics by doing culture and sensitivity will be fruitful for better management of the disease.
- Further study incorporating other centers inside and outside of Dhaka
- Large sample size
- Experimental Studies

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