

Orofacial space infections, etiology, microbiological susceptibility and surgical management.

Infecciones del espacio orofacial, etiología, susceptibilidad microbiológica y manejo quirúrgico.

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Abstract: Orofacial infections are considered as one of most common infections and need rapid and adequate treatment as they affect a very delicate region and are associated with serious life-threatening complications. Orofacial infections can be either odontogenic that is with an origin in teeth and associated structures or non-odontogenic, not associated with teeth, can affect facial spaces and spread from one space to another, so a good knowledge about diagnosis and treating these infections is of utmost importance, and can include both non-surgical and surgical treatment. The aim of our study was to determine the most common cause of orofacial infections, the most common bacterial microorganisms and their antibiotic susceptibility. **Materials and Methods:** A descriptive study was undertaken in the Department of Oral and Maxillofacial Surgery, Al-Shaheed Ghazi Al-Hariry Hospital, Baghdad, Iraq from 1st January to 30th September 2015. This study included 45 patients with different forms of orofacial infections; data regarding age, gender, underlying cause, facial space involvement, presenting signs were collected through history, clinical examination and radiographs, incision and drainage with swab sample for culture and sensitivity test was performed. **Results:** Patients with orofacial infections showed a female to male ratio of 1.25:1. The mean age was 32.8 years. Most of the patients were in their 4th decade of life (27%). Most infections were odontogenic in origin (62%), the most common facial space involved was submandibular (65%), the most common isolated microorganism was *Streptococcus pyogenes* (59%), and most patients were treated using an extra-oral surgical approach (78%). Antibiotics to which bacterial isolated showed the most sensitivity were netilmicin, cefoperazone and rifampicin (91%). Pain and limitation of mouth opening gradually decreased in most of patients during the two weeks follow up period. **Conclusion:** Orofacial infections were more common in females, in the third and fourth decade of life, were odontogenic in origin, were mostly caused by *Streptococcus pyogenes*, and most isolates were susceptible to netilmicin, cefoperazone and rifampicin. Pain and trismus decreased over two weeks post-treatment.

Keywords: Drug resistance, bacterial; bacterial infections; anti-bacterial agents; *Streptococcus pyogenes*; surgery, oral; mouth.

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Resumen: Las infecciones orofaciales se consideran una de las infecciones más comunes y necesitan un tratamiento rápido y adecuado, ya que afectan una región muy delicada y se asocian con complicaciones graves que amenazan la vida. Las infecciones orofaciales pueden ser odontogénicas que se originan en

los dientes y las estructuras asociadas, o no odontogénicas, no asociadas con los dientes, pueden afectar los espacios faciales y propagarse de un espacio a otro, por lo que un buen conocimiento sobre el diagnóstico y el tratamiento de estas infecciones es de suma importancia, y puede incluir tratamiento no quirúrgico y quirúrgico. El objetivo de nuestro estudio fue determinar la causa más común de infecciones orofaciales, los microorganismos bacterianos más comunes y su susceptibilidad a los antibióticos. **Material y Métodos:** se realizó un estudio descriptivo en el Departamento de Cirugía Oral y Maxilofacial, Hospital Al-Shaheed Ghazi Al-Hariry, Bagdad, Iraq del 1 de enero al 30 de septiembre de 2015. Este estudio incluyó a 45 pacientes con diferentes formas de infecciones orofaciales; Se recopilaron datos sobre edad, sexo, causa subyacente, afectación del espacio facial, signos de presentación a través de la historia, examen clínico y radiografías, incisión y drenaje con muestra de hisopo para cultivo y prueba de sensibilidad. **Resultado:** Los pacientes con infecciones orofaciales mostraron una relación mujer/hombre de 1.25: 1. La edad media fue de 32,8 años. La mayoría de los pacientes estaban en su cuarta década de

vida (27%). La mayoría de las infecciones fueron de origen odontogénico (62%), el espacio facial más común involucrado fue submandibular (65%), el microorganismo aislado más común fue *Streptococcus pyogenes* (59%), y la mayoría de los pacientes fueron tratados con un abordaje quirúrgico extraoral (78%). Los antibióticos a los que las bacterias aisladas mostraron mayor sensibilidad fueron netilmicina, cefoperazona y rifampicina (91%). El dolor y la limitación de la apertura de la boca disminuyeron gradualmente en la mayoría de los pacientes durante el período de seguimiento de dos semanas. **Conclusión:** Las infecciones orofaciales fueron más comunes en las mujeres, en la tercera y cuarta década de la vida, fueron de origen odontogénico, fueron causadas principalmente por *Streptococcus pyogenes* y la mayoría de los aislamientos fueron susceptibles a la netilmicina, cefoperazona y rifampicina. El dolor y el trismo disminuyeron durante las dos semanas posteriores al tratamiento.

Palabras Clave: Farmacorresistencia bacteriana; infecciones bacterianas; antibacterianos; *Streptococcus pyogenes*; cirugía bucal; boca.

INTRODUCTION.

Orofacial infections have occurred ever since humans have existed. Most of these infections are odontogenic in origin and are one of the most frequently occurring infectious processes known to both antiquity and present day health practice.^{1,2} Most of these infections can be managed without the use of antibiotics, for example, by tooth extraction, endodontic therapy, and surgical treatment, including drainage.^{3,4}

Surgical incision and drainage may also obviate the use of an antibiotic or may increase the effectiveness of an antibiotic as the vascular flow is restored. However, when an acute bacterial infection has progressed or antimicrobial therapy might be of benefit to patients, antibiotics are prescribed.^{3,4}

It is estimated that 90-95% of all orofacial infections originate from the teeth or their supporting structures.⁶ Furthermore, about 70% of odontogenic infections occur as periapical inflammation, *i.e.* acute periapical periodontitis or a periapical abscess.

The next most common form of odontogenic infection is the periodontal abscess.⁵ Microscopic examination to determine the presence of pathogens in patients with suspected wound infections, reveals that most often these infections are purulent.

Most organisms require approximately 24 hours to grow in the laboratory, but when antibiotic therapy

needs to be started before lab results are available, Gram stain of the specimen smeared on a slide can be reported in less than 10 minutes, and can help give clues to the possible identification of the microorganism, guiding appropriate antibiotic treatment. Also it can be combined with Giemsa's stain to better detect organisms.⁶ Antimicrobial susceptibility tests are used to determine to which antimicrobial agents bacteria or fungus are susceptible. Antimicrobial susceptibility tests can guide the physician in choosing antimicrobials and dosage for difficult-to-treat infections.⁷

In our study we randomly select cases of oro-facial bacterial infections of different etiology and sites, use culture and susceptibility testing to identify the most common bacterial microorganisms associated with these infections, the antibiotic of choice and the best surgical management for these infections, with a follow-up of 2 weeks in order to document evolution, such as pain and trismus.

MATERIALS AND METHODS.

A descriptive study was undertaken in the Department of Oral and Maxillofacial Surgery at AL-Shaheed Ghazi Al-Hariry Hospital, Baghdad, over a period of 9 months from 1st January 2015 to 30th September 2015. A total of 45 patients with orofacial infections, irrespective of the age and sex, were included in the study.

The data for this study was compiled from the admitted patients and consultation clinic patients visiting the Department of Oral and Maxillofacial Surgery at AL-Shaheed Ghazi Al-Hariry Hospital, Baghdad. Informed and written consent was obtained from all patients.

A thorough history was taken, followed by a detailed clinical examination and necessary investigations were carried out. The diagnosis was confirmed by extra-oral and intra-oral clinical examination.

For the identification of causal factors such as tooth involvement, sialadenitis, parotitis, foreign body, etc, all patients underwent periapical view and orthopantomogram (OPG) radiographs.

A specially designed case sheet was used for the collection of data; Incision and drainage of the abscess according to Hilton's method was done with 1 or more corrugated drains placed for 3 days according to the facial spaces involved and replaced if pus discharge was still present, and stick swab samples were collected. After empirical antibiotic were prescribed either parental as 500mg Ampiclox (250mg ampicillin and 250mg cloxacillin) every 6 hours for adults, or 250mg for children over 2 years, 125 mg for patients under 2 years.

In cases of allergy to penicillin erythromycin was prescribed for adults and pediatric patients, the recommended intravenous dose of erythromycin lactobionate was 15 to 20mg/kg/day every 6 hours. To ensure full coverage of anaerobic bacteria metronidazole (Flagyl) 7.5 mg/kg was infused over one hour every 6 hours (approximately 500mg for a 70-kg adult) was prescribed. Analgesics also were given as parenteral Acetaminophen (paracetamol) 500mg for adult, 15mg/kg for children, every 8 hours. Alternatively oral antibiotics for adult were prescribed: 625mg Augmentin (amoxicillin with Clavulanic acid) tablet for adults, 312mg/ 5ml oral suspension every 8 hours for children.

In cases of allergy to penicillin, 500 mg erythromycin tablets every 6 hours, erythromycin oral suspension 125mg/5ml for children every 6 hours. Metronidazole (Flagyl) 500mg tablets every 8 hours for adult or metronidazole 200mg/5ml oral suspension for children under 12 years. F

or analgesia, acetaminophen 500mg tablets every 8 hours for adults was prescribed, and acetaminophen (Antipyrol) oral suspension 160mg/5ml every 8 hours for children. After the results of antibiotic susceptibility testing were available, the antibiotic was changed accordingly, and administered for 5 days.

Follow-up for a 2 week period was implemented, pain was measured according to Wong-Baker Faces Pain Rating Scale by the patients, and trismus was assessed using fingers test in all patients; the collected data was analyzed by chi-square test.

RESULTS.

A total of 45 patients were recruited for this study. Some patients presented comorbidities such as diabetes mellitus and hypertension, especially among the oldest. There were 25 females (55.55%) and 20 males, with a male to female ratio of 1:1.25. The age of patients ranged from 4 to 80 years with the mean age of 32.84 years. The frequency of orofacial infections was the highest in the 4th decade (27%) followed by 3rd decade (24%), and 5th (16%) and 2nd decades (16%). Table 1

The most common cause of orofacial infections was odontogenic in origin (62%), while post filler-injection infection was the least common, present in one patient (2%) The details of the etiology of orofacial infections are given in Table 1.

Submandibular space was the most common single fascial space involved 65.21% of cases, followed by the canine space (22%); the least frequently involved single spaces were infratemporal, submental and buccal spaces, each representing 4% of cases. In multiple space involvement, submandibular and submental were involved in 40% of cases while Ludwig's angina occurred in 20%. The most common isolated microorganism was *Streptococcus pyogenes* (59%), which appeared in 30 out of 45 cases, followed by *Klebsiella* spp in 10% of cases, and *Haemophilus* spp and *Enterococcus faecalis* (8%); The least common were *Pseudomonas* spp. and *Escherichia coli* isolated only from one case each. Table 2.

At times more than one species of bacteria was isolated from each infection. The type of anesthesia used in surgical treatment was mostly local anesthesia (80%), with general anesthesia used in 20% of cases. Most patients were treated using an extra-oral surgical approach (78%) rather than intra-oral (22%).

This study showed almost all bacterial isolates were susceptible to netilmicin, cefoperazone and rifampicin (91%). (Table 3)

Table 4 shows the degree of pain reported by patients according to Wong-Baker Faces Pain Rating Scale.

Severe trismus (less than a finger's width) was present in 22% of cases at 24hrs post treatment and decreased gradually to 2.22% at two weeks. Table 5

Table 1. Etiology of orofacial infections.

Etiology	Number of patients	%
Odontogenic infection	28	62.2
Postoperative infection	11	24.4
Post trauma infection	2	4.4
Post filler injection infection	1	2.2
Skin infection	3	6.7
Total	45	100

Table 2. Distribution of isolated bacteria.

Bacteria	Number of cases	%
<i>Klebsiella</i> spp.	5	9.8
<i>Streptococcus pyogenes</i>	30	58.8
<i>Coagulase negative Staphylococcus</i> spp.	3	5.9
<i>Proteus</i> spp.	3	5.9
<i>Pseudomonas</i> spp.	1	2.0
<i>Hemophilus</i> spp.	4	7.8
<i>Escherichia coli</i>	1	2.0
<i>Enterococcus faecalis</i>	4	7.8
Total	51	100

Table 3. Antibiotic susceptibility of the bacterial isolates

Antibiotics	Resistance	%	Susceptibility	%
Gentamicin	15	33	30	67
Netilmicin	4	9	41	91
Azithromycin	12	27	33	73
Clarithromycin	11	24	34	76
Amoxicillin/Clavulanic acid	13	29	32	71
Ampicillin/Sulbactam	9	20	36	80
Piperacillin/Tazobactam	6	13	39	87
Ceftriaxone	12	27	33	73
Cefoperazone	4	9	41	91
Ceftazidime	21	23	24	47
Cefuroxime	5	11	40	89
Pefloxacin	5	11	40	89
Levofloxacin	5	11	40	89
Ofloxacin	6	13	39	87
Rifampicin	4	9	41	91
Meropenem	12	27	33	73
Co-trimoxazole	15	33	30	67

Table 4. Degree of pain reported by patients according to Wong-Baker Faces Pain Rating Scale

Pain degree	24h	%	72h	%	1 week	%	2 weeks	%
10	1	2	0	0	0	0	0	0**
8	14	31	5	11	2	4	1	2*
6	16	36	14	31	4	9	1	2**
4	12	27	10	22	14	31	7	16*
2	2	4	15	33	9	20	13	29*
0	0	0	1	2	16	36	23	51**

Chi-squared test. *: $p < 0.05$ Significant. **: $p > 0.05$ Non-significant

Table 5. Trismus over post-treatment follow-up period.

Trismus finger test	24h	%	72h	%	1 week	%	2 weeks	%
Less than 1	10	22	3	7	1	2	1	2*
1	4	9	6	13	0	0	0	0*
Less than 2	9	20	13	29	10	22	0	0*
2	0	0	1	2	7	16	9	20**
Less than 3	1	2	0	0	3	7	8	18**
3	21	47	22	49	24	53	27	60**

Chi-squared test. *: $p < 0.05$ Significant. **: $p > 0.05$ Non-significant

DISCUSSION.

The study shows that orofacial infections mostly affect patients in their 3rd and 4th decade of life, this is in keeping with Fating *et al.*,⁸ who reported that orofacial infections were seen more often in these patients, and Kityamuwesi *et al.*,⁹ who reported the mean age of the patients was 29.5 years and most patients (73.1%) were younger than 35 years, which is lower than values recorded in other studies.

This prospective study revealed a higher frequency of infections in females than males, with a female to male ratio is about 1.25:1. However, the difference was not significant indicating that sex may not be considered a determinant factor in the prevalence of orofacial infections. Ishfaq *et al.*,¹⁰ reported that orofacial infections are more common in females with a male to female ratio of 1:1.87 and stated that this may be due to females having a higher pain threshold, for socioeconomic reasons and cultural restrictions for female patients to attend the dentist in some parts of world.

On the other hand males were more commonly involved than females in the study of Singh *et al.*,¹¹ but geographical differences in the study cohorts may explain this disparity.

The most commonly encountered orofacial infections were odontogenic in origin (62%), may be because most odontogenic infections arise from dental caries and periodontal disease which are associated with poor oral hygiene. This is in agreement with Chow *et al.*,¹² who mentioned that dental caries, gingivitis and periodontitis are prevalent in the general population, and Read-Fuller *et al.*,¹³ who showed that 79% infections had an odontogenic origin, as well as Veronez *et al.*,¹⁴ who reported that 113/157 cases had an odontogenic cause, while only 44 patients presented a non-odontogenic infection. The cause may be due to a delay in treatment due to the relatively high cost of dental care and public indifference to dental health.

The most common fascial space infected was submandibular space, probably because the lower molars, primarily second and third molars have roots which are below the attachment of the mylohyoid muscle, and the lingual cortical plate is thinner compared to the buccal cortical plate. Odontogenic infections from these teeth will perforate the lingual cortical plate in most cases, resulting in submandibular fascial space infection. Our data is in accordance to Bahl *et al.*,¹⁵ who also reported that the submandibular space was the most frequently

involved fascial space both in single and multiple fascial space infections.

Also the current study is in agreement İsmi *et al.*,¹⁶ who reported that the second and third mandibular molar teeth are important sources of deep neck infections, because their roots extend to the junction of the mylohyoid muscle with the mandibular corpus adjacent to the submandibular and parapharyngeal spaces, making the submandibular space the most commonly involved area in this type of infections. Additionally Walia *et al.*,¹⁷ also reported the submandibular space to be the most commonly infected space.

Infections can also involve more than one space, such as the submandibular and submental due to anatomical contiguity of these spaces. This study shows that the most common microorganism associated with orofacial infections was *Streptococcus pyogenes*, a Gram positive aerobic bacteria, in agreement with Celakovsky *et al.*,¹⁸ who recently also recorded this bacterial species to be the common microorganism isolated and Kim *et al.*,¹⁹ reported that *Streptococcus* spp was the most prevalent (54%), as *Streptococcus* is the most common commensal genus of the oral cavity. In the other hand this is contrast to Sobottka *et al.*,²⁰ who reported that anaerobic bacteria were the most commonly isolated organism in odontogenic infections, although the methodology employed differed.

Our data regarding anesthesia used is similar to Veronez *et al* [14] who reported 63% of cases were managed under local anesthesia and 37% required general anesthesia for the surgical treatment, due to possible risks associated with general anesthesia in addition to additional costs and time.

The most common approach used for surgical treatment of the infections in our study was extraoral, as submandibular fascial space infections were drained extra orally, and also because most of patients presented in a late stage either due to neglect or inaccurate management by dentists who usually confine their management to the medical part ignoring surgical aspects.

The results of this study show that the majority of patients experienced a high degree of pain ranging from 6-10 at 24 hours, which declined during the follow up period to between 0-4 in most of patients, in line with Chow *et al.*¹² Females were found to experience more pain than males, may be due to hormonal fluctuations that occur in females. Fillingim *et al.*,²¹ concluded that pain is higher among women, and women report greater pain

after invasive procedures than men, that pain thresholds for mechanical, thermal, and ischemic muscle pain were higher during the follicular phase of the menstrual cycle.

In this study the antibiotics that had the greatest susceptibility were netilmicin, cefoperazone and rifampicin, in contrast to Chunduri *et al.*,²² who reported 90% of Gram-positive cocci and 79% of Gram-negative rods were susceptible to amoxicillin, in contrast to our finding that there was relatively high resistance to amoxicillin/clavulanic compared to other antibiotics.

This may be due to the prevalent antibiotic abuse leading to the emergence of resistant strains of microorganisms. Trismus is a consequence of the inflammatory response to orofacial infection measured subjectively depending on the patient's own finger; trismus is defined as a motor disturbance of trigeminal nerve especially spasm of masticatory muscle with difficulty in opening of mouth.²³

This limitation in opening the mouth was encountered mostly in patients diagnosed with odontogenic infections, and improved gradually during the follow up period as a result of the treatment and physiotherapy for these patients, in line with Ishfaq *et al.*,¹⁰ and Santosh *et al.*,²⁴ who report that most of the patients suffered from mild trismus (63%), followed by moderate (23%) and severe trismus (13%).

CONCLUSION.

Orofacial infections were more common in females, in the third and fourth decade of life, were odontogenic in origin, were mostly caused by *Streptococcus pyogenes*, and most isolates were susceptible to netilmicin, cefoperazone and rifampicin. Pain and trismus decreased over two weeks post-treatment.

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