Evaluation of bacterial spectrum of orofacial infections and their antibiotic susceptibility

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ABSTRACT

Introduction: The inappropriate use of antibiotics has contributed to a worldwide problem of antimicrobial resistance. The objective of present study is to assess the most common microorganisms causing orofacial infections and their antimicrobial susceptibility to routinely used antibiotics in this part of India. **Materials and Methods:** Sixty eight patients with orofacial infection were selected on the basis of a series of predefined inclusion and exclusion criteria. Samples were collected under aseptic conditions and subjected to culture and antibiotic susceptibility testing. Descriptive statistics were provided. **Results:** A total of 64 aerobic and 87 anaerobic strains were isolated. The predominant bacteria were *Streptococci viridans* (64%), *Prevotella* (43%), *Peptostreptococcus* (26%), *Porphyromonas* (7%), and *Fusobacterium* (14%). The isolated strains seemed to be highly sensitive to the routinely used antibiotics such as amoxicillin – clavulanate and amoxicillin alone, clindamycin, and levofloxacin. In contrast, more resistance to erythromycin was observed. **Conclusion:** Amoxicillin still possesses powerful antimicrobial activity against major pathogens in orofacial odontogenic infections. Amoxicillin/clavulanate and clindamycin would also be advocated as being useful alternatives for the management of severe orofacial infections. However, the findings of this study indicate that erythromycin is of questionable benefit in the treatment of severe orofacial odontogenic infections.

Keywords: Amoxicillin, antibiotic susceptibility, microbiological flora, orofacial infections

INTRODUCTION

Orofacial infections have plagued humankind for as long as our species has 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]

Truly we live in the "antibiotic era." Beginning with early work of Sir Alexander Fleming in 1929, when penicillin become the first "miracle drug," innumerable lives have been saved from such scourges as pneumonia, wound sepsis, and bacteremia.[5] Dentists benefited greatly from discovery of penicillin because most of the orofacial infections are caused by penicillin-sensitive microorganisms.[6] The serious epidemic of penicillin-resistance staphylococcal infections of 1950s and 1960s finally was resolved by the development of the semisynthetic antibiotics. The microbiological environment has been polluted with bacteria that are resistant to many antibiotics, this alteration in antibiotic sensitivity is now the expected result of wide spread use of antibiotics.[7,8] The risk of the individual patient from a single prescription of antibiotic is small, but altered bacterial flora represents a present and future risk to the community.

The laboratory data regarding bacteriology and microbial susceptibility are crucial information for the clinician who is considering the administration of antimicrobial therapy. However, it may take several days or even longer to obtain such data. Hence, a pragmatic rational approach to empirical antibiotic selection is acceptable, if the choice is based on scientific data and contemporary experience with constantly evolving flora of orofacial infections.

It was therefore decided to carry out a clinical study to re-evaluate the putative pathogens involved in the orofacial infections and their susceptibility to the routinely used antibiotics in this part of the world.

MATERIALS AND METHODS

Microbial specimens were obtained from 68 patients, who attended the Department of Oral and Maxillofacial surgery with orofacial infections. Selection was done randomly irrespective of the cause of infection, age ranging from 18 to 50 years of age. The basis for selection was that none of the patients were receiving continuing antibiotic therapy that might lead to the harboring of antibiotic resistant bacterial strains, that available records and clinical observations indicated no existing systemic disease that might predispose the patients to infections. Prior to the collection, oral consent was obtained from the patient. The study was exempted from Institutional Review Board approval as there was no deviation from the prescribed standard protocol of treatment. The culture and antibiotic susceptibility tests were conducted with clinical specimens obtained from the patients before initiation of any antibiotic therapy.

The pus samples were collected aseptically by aspirating the abscess using sterile syringe. After aspirating, the specimen was immediately inoculated in sterile Robertson cooked meat broth for transportation of anaerobic organisms. The specimens were inoculated on to blood agar and McConckey agar and incubated aerobically and anaerobically at 37°C for 48 hours.

Isolated bacteria were identified using conventional methods.[4] Selective media were employed to grow the isolates for antibiotic sensitivity assay. Antibiotic sensitivity tests for the isolates were performed in nutrient agar by disc diffusion method of Kirby-Bauer. Antimicrobial susceptibilities were determined in *Streptococcus viridans*, *Prevotella*, *Peptostreptococcus*, *Porphyromonas*, and *Fusobacterium* for routinely used antibiotics such as amoxicillin, amoxicillin - clavulanate, erythromycin, clindamycin, and levofloxacin.

RESULTS

The study comprised 37 males (54%) and 31 females (46%) patients with a mean age of 32 years and a range of 20–50 years. The submandibular space was most commonly involved (34%) followed by buccal space (28%) [Figure 1].

A total of 151 bacterial strains from 68 patients, accounting for 2.2 isolates per patient were isolated. *Streptococcus viridans* (64%) are prominent among aerobic organisms isolated, followed by *Staphylococcus* (13%) [Table 1]. Among anaerobic flora *Prevotella* (43%), *Peptostreptococcus* (26%), and *Fusobacterium* (14%) are predominant [Table 2]. The anaerobic gram-negative bacilli (40%) are predominant organisms followed by aerobic gram-positive cocci (34%) [Figure 2]. Four strains of *Candia albicans* were also identified.

Antimicrobial susceptibilities were determined in *Streptococcus viridans*, *Prevotella*, *Peptostreptococcus*, *Porphyromonas*, and *Fusobacterium* for routinely used antibiotics such as amoxicillin, amoxicillin - clavulanate, erythromycin, clindamycin, and levofloxacin. *Streptococci viridans* showed high susceptibility to amoxicillin – clavulanate (95%), amoxicillin (90%), and levofloxacin (83%). *Prevotella* showed high susceptibility to amoxicillin – clavulanate (97%) and less susceptible to erythromycin (62%). *Peptostreptococcus* and *Porphyromonas* are highly sensitive to amoxicillin – clavulanate (100%) and clindamycin (100%). Bacterial susceptibility to different antibiotics is summarized in Table 3. In absolute terms, the isolated strains were seemed to be highly sensitive to the routinely used antibiotics such as amoxicillin – clavulanate and amoxicillin

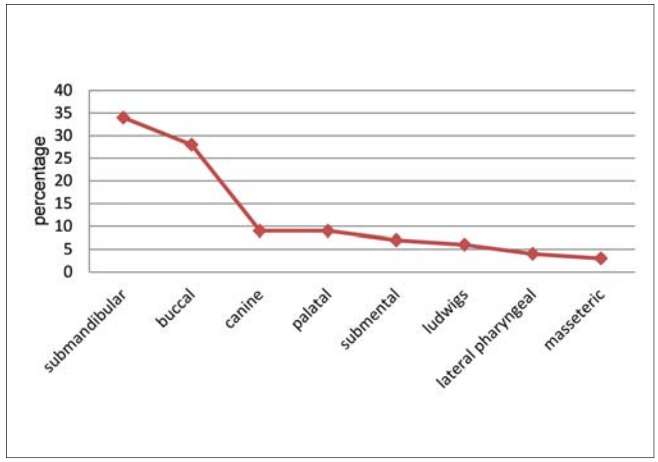

Figure 1: Frequency of fascial spaces involved in the study population

Table 1: Aerobic organisms isolated in the study population

Aerobic spectrum	No. of strains (%)
Streptococcus viridans	41 (64)
Staphylococcus	8 (13)
Corynebacterium	5 (8)
Candida albicans	4 (6)
Enterobacter	4 (6)
Haemophilus	2 (3)
Total	64

Table 2: Anaerobic organisms isolated in the study population

Anaerobic spectrum	No. of strains (%)
Prevotella species	31 (36)
Prevotella oralis	3 (3)
Prevotella buccalis	2 (2)
Prevotella dentalis	2 (2)
Peptostreptococcus	23 (26)
Fusobacterium	12 (14)
Porphyromonas	6 (7)
Bacteroides	4 (5)
Eubacterium	3 (3)
Veillonella	2 (2)
Total	88

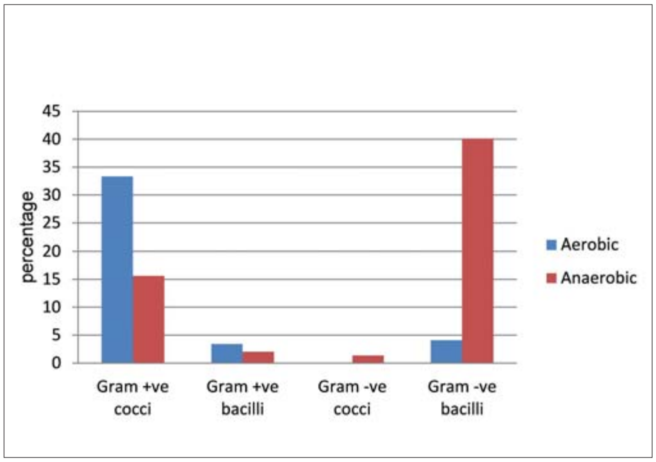

Figure 2: Distribution of isolated organisms in the study population

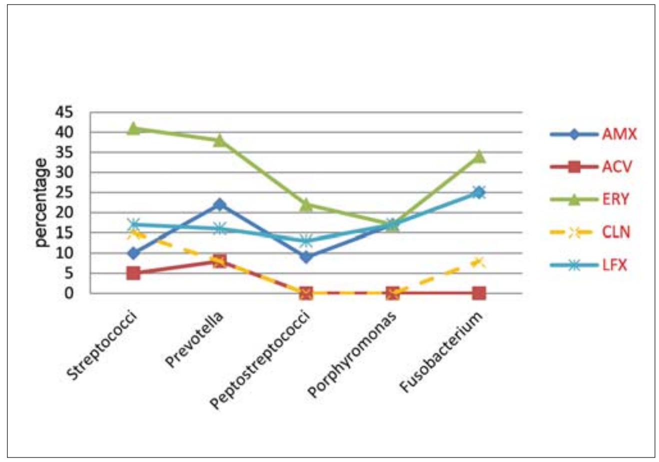

Figure 3: Resistance pattern of isolated organisms to amoxicillin (AMX), amoxicillin–clavulanic acid (ACV), erythromycin (ERY), clindamycin (CLN), and levofloxacin (LFX) in the present study population

Table 3: Antimicrobial susceptibility observed in the study population

Pathogen	Susceptibility rate (%)				
	Amoxicillin	Amoxicillin/ clavulanate	Erythromycin	Clindamycin	Levofloxacin
Streptococci	37 (90)	39 (95)	24 (59)	35 (85)	34 (83)
Prevotella	29 (78)	34 (92)	23 (62)	34 (92)	31 (84)
Peptostreptococcus	21 (91)	23 (100)	18 (78)	23 (100)	20 (87)
Porphyromonas	5 (83)	6 (100)	5 (83)	6 (100)	5 (83)
Fusobacterium	9 (75)	12 (100)	8 (66)	11 (92)	3 (75)

Figures in parentheses indicates in percentage

alone, clindamycin, and levofloxacin. In contrast, more resistance to erythromycin was observed [Figure 3].

DISCUSSION

Odontogenic infections of maxillofacial region play an important role, even now in the era of antimicrobial chemotherapy, because of the danger of spreading and complications through general and metastatic infection. Knowledge of the potential spectrum of pathogens, as well as the regional resistance status is important for rational chemotherapeutics.

Studies have described the development of odontogenic infections in varying age groups ranging from 6 to 79 years.[9] Bartlett and O'Keefe reported a mean of 43 years involving 20 patients.[10] In present study, out of the total 68 cases a majority 40 (59%) were between age groups of 25 and 35 years.

In the English literature, the submandibular space is the most commonly seen in multiple-space infections, followed by the lateral pharyngeal space, buccal space, and submental space.[11] The present study data deviated from this trend with more submental spaces than lateral pharyngeal spaces on presentation of multiple space infections. Our findings are consistent with previous studies in terms of the single-space abscess where submandibular space is the most predominant, followed by the buccal space and the canine space abscesses.[11,12]

Bacteria that were isolated in the present study consisted of both aerobic and anaerobic organisms. Infections due to anaerobic and gram-negative organisms have increased in comparison with past reports in medical and dental literature. This may be related to improvements in isolating and culturing methods of anaerobic organisms.[9] Earlier studies from other parts of the world have reported about mixed anaerobic flora in orofacial infection.[12-14] The pure anaerobic organisms are produced in the late stage of abscess formation, through overgrowth of anaerobes.[15] The present study showed predominance in anaerobic (strict and facultative) over aerobic species isolated.

Many investigators have demonstrated that *Streptococcus viridans*, *Peptostreptococcus*, *Prevotella*, *Porphyromonas*, and *Fusobacterium* are frequently isolated from orofacial odontogenic infections.[3,4,13,16-19] Other microorganisms like fungi, virus as causative for abscesses are rarely reported in literature.[20] In this study, *Streptococcus viridans* were the predominant species, followed by *Prevotella*, *Peptostreptococcus*, *Fusobacterium*, and *Staphylococci*. A high rate of *Staphylococci* (13%) was cultured from the total isolates, which may be due to contaminant of cultures from the skin or an actual finding. The prevalence of bacterial species varies, with multiple studies demonstrating *Streptococcus viridans* as their predominant species[10-12,21] and other studies that show predominance of gram-negative rods (*Bacteroides*/*Prevotella*).[9,19,22] Many studies have demonstrated that *Prevotella*, *Porphyromonas*, and *Fusobacterium* are the predominant bacteria among anaerobic gram-negative rods isolated from orofacial odontogenic infections.[4,17,19] The results of the present study support these findings. The differences may be due to the way the cultures are obtained, suggesting that aspirations of cultures may produce predominant anaerobic species, and swabbing of cultures may grow predominantly aerobic species.

Gilmor *et al*. reported strict anaerobe resistance to penicillins to range from 8.9 to 16%, depending on the genus involved.[23] Amoxicillin still exhibits a high level of activity against the majority of oral anaerobes, while reduced susceptibility of *Prevotella* strains could be a matter of concern with penicillins.[24] In our study, 90% of gram-positive cocci and 79% of gram-negative rods are susceptible to amoxicillin. The addition of β-lactamase inhibitors such as clavulanate to broad-spectrum penicillins has expanded the antimicrobial spectrum of the original agents to include many β-lactamase producing bacteria, among which are most β-lactamase producing anaerobes.[25,26] In our study, almost all strains were susceptible to amoxicillin/clavulanate; as a result, it appears to be the most effective option in the treatment of dentoalveolar infection.

Kuriyama *et al*. reported *Streptococcus viridans* to have susceptibility rate of 77% to penicillin, 87% to clindamycin, 77% to erythromycin, and 92% to levofloxacin.[13,27] Erythromycin showed less activity against *Fusobacterium* and very poor activity against *Prevotella*. Erythromycin has been recommended for the treatment of patients with orofacial odontogenic infections who also have β-lactam allergies.[16,28,29] However, the findings of the present study cast doubt on the usefulness of erythromycin.

Clindamycin and levofloxacin were also powerful agents against test anaerobic gram-negative rods; their activities were not affected by β-lactamase production.[16,25] Thus, clindamycin and levofloxacin may be recommended for patients in whom antimicrobial therapy with β-lactam antibiotics has failed. In the present study, the susceptibility rates of the test bacteria were rather high against levofloxacin. However, the Minimum Inhibitory Concentration values of levofloxacin were high. Thus, the benefit of prescribing fluoroquinolones for orofacial odontogenic infections may be small.

In conclusion, *Streptococcus viridans*, anaerobic gram-positive cocci, and anaerobic gram-negative rods were isolated frequently from orofacial odontogenic infections. To treat orofacial odontogenic infections with antibiotics, an antimicrobial spectrum against both *Streptococcus viridans* and oral anaerobes may be required. Amoxicillin still possesses powerful antimicrobial activity against major pathogens in orofacial odontogenic infections, while reduced susceptibility of *Prevotella* strains could be a matter of concern with penicillins. Amoxicillin/clavulanate and clindamycin would also be advocated as being useful alternatives for the management of dentoalveolar infection. However, the findings of this study indicate that erythromycin of questionable benefit in the treatment of severe orofacial odontogenic infections.

The study is conducted in a narrow geographical location and hence for the extrapolation of these results to a wider national population needs a large scale, multicentric studies to confirm the findings of this pilot study. The changes in the trend of space infections as well as microbiological spectrum of odontological infection is an absolute necessity to impart sufficient knowledge to practitioners for prescribing antibiotics.

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