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Microflora of Orofacial Space Infections of Odontogenic Origin in Children – A Bacteriological Study

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Abstract

Objectives: To investigate the causative micro-organisms and also to assess the anatomic distribution of orofacial space infections of odontogenic origin in pediatric patients.

Materials and methods: A total of 25 patients, aged 3-14 years with orofacial odontogenic infections were selected and pus was collected using 22 gauge needles. The pus samples were immediately processed for Gram staining, aerobic and anaerobic cultures. Various parameters like gender, age, micro-organisms isolated and involved facial spaces were studied.

Results: From 25 patients, total of 23 (92%) bacterial strains were isolated. In 2 (8%) patients no growth from cultures was observed. Among 23 isolates, 13 (56%) isolates were of mixed growth, 8 (34%) isolates of anaerobic growth and only 2 (8%) isolates of aerobic growth. Most commonly isolated aerobic species was *Streptococcus viridans* (47%). *Peptostreptococcous* (48%) was the most commonly isolated anaerobic species. The submandibular space (56%) was the most frequently involved space among single space infections. Involvement of multiple spaces was not observed.

Conclusion: Pediatric orofacial space infections of odontogenic origin are a polymicrobial, mixed (aerobic – anaerobic) infection with predominance of anaerobic bacteria. Submandibular space is the most frequently involved space in children.

Keywords: Aerobic-anaerobic growth; Gram staining; Odontogenic infection; Space infection

Introduction

Oral cavity is an ideal niche for the growth of microorganisms. Despite a great advance in the pediatric dental care, infection of the oral cavity remains the major problem in today's dental practice. Although we live in an era of antibiotics, odontogenic infections are still a common problem with which a dentist must deal.

Orofacial space infections of odontogenic origin are very common in children and most of them originate from necrotic pulps, partially erupted teeth, or traumatized teeth [1-3]. However, Seow [4] has reported that developmental abnormalities like dens evaginatus, dentin dysplasia, dentinogenesis imperfecta and familial hypophospatasia can lead to space infections.

Infections in the jaws of a child may spread rapidly because of the wide marrow spaces and also due to the bones of developing children are less dense than adult bones [5]. An intraosseous infection can also cause complete destruction of the permanent tooth germs and if undiagnosed may reach the critical growth centers of jaws like the condyle. The condylar region of the mandible is the most sensitive area that can be grossly disfigured if its growth is disturbed. Moreover, abscess formation and cellulitis are quite exaggerated in children and if correct treatment is not rendered, severe consequences like cavernous sinus thrombosis, blindness, brain abscess, septicemia, airway obstruction, and mediastinitis can occur [5-10].

In children, detection of the primary etiologic site and micro-organisms responsible for the orofacial infection is very difficult, because of the close proximity of the skin, teeth, salivary glands, sinuses, and eustachian tubes [5]. Moreover, management of these infections in pediatric patients is critical as they have the tendency to become dehydrated and systemically ill very rapidly as a result of his/her refusal to take fluids because of oral pain [10]. And also clinical manifestations of orofacial infections are protean, and are largely dictated by complex microflora and anatomic routes of spread of infection [5,11]. Therefore pediatric dentist must have a proper concept of the etiology and overall management of these young patients as he/she is the first health profession to see children with facial swelling, pain and fever.

The objective of this study is to investigate the causative micro-organisms and also to assess the anatomic distribution of orofacial space infections of odontogenic origin in children.

Materials and Methods

25 children with age group ranging from 3-14 years old, diagnosed to have orofacial space infection of odontogenic origin were selected

for the study. After taking detailed history, each patient was thoroughly examined and investigated. Patients who gave a history of prior medication were excluded from this study. Before commencement of the study, approval of the Institutional Ethics committee to conduct the study and also signed consent form from respective parents were obtained.

Collection of pus sample

5 ml sterile disposable syringes with disposable needle of 22 gauges were used to aspirate the pus from the abscess. The aspirated syringes with needle were immediately sealed and subjected to the laboratory for processing of pus sample.

Processing of pus sample

Pus samples were processed as follows:

Smear study of Gram staining

Aerobic culture

Anaerobic culture

For aerobic culture, the samples were inoculated on Mac-Conkey's agar, blood agar and nutrient broth. After overnight inoculation, the plates were observed for colony formation. The colonies were identified by Gram staining and biochemical tests. For gram positive cocci, catalase, bacitracin sensitivity, optochin sensitivity, coagulase test and growth in 6.5% sodium chloride were used. For gram negative bacilli, oxidase test, catalase test, indole test, urease test, citrate test and triple sugar iron were used. If no growth was observed after the first culture, sub cultures from nutrient broth was made on Mac-Conkey's agar, blood agar and looked for growth after overnight incubation. Growth was identified using appropriate biochemical tests.

For anaerobic culture, samples were inoculated into plain blood agar, Kanamycin and Vancomycin blood agar, Bile-Esculin agar and incubated anaerobically in gas pack anaerobic jar for 48-72 hours. The plates were observed for colony formation. The colonies were identified by gram stain, haemolysis, pigmentation, Brick red fluorescence under UV light.

If no growth was observed after first culture, sub-culture was done from Robert Cook Meat Broth on plain blood agar, Kanamycin-Vancomycin blood agar, bile esculin agar and identified as mentioned above.

Statistical analysis

The data obtained was tabulated and subjected to statistical analysis. Descriptive statistics was used to calculate the percentages.

Results

Among 25 patients studied, there were 18 males and 7 females. Patient's age ranged from 3-14 years with a mean age of 5.9 years.

Gram stain smear study showed presence of pus cells and organisms in 24 (96%) samples and in one sample (4%) showed only pus cells. The bacteria were found to be 78% gram positive and 21.5% gram negative organisms. Gram positive cocci were observed in 21 (63%) samples. Gram positive bacilli were isolated in 5 (15%) samples whereas the gram negative bacilli were isolated in 6 (18%) specimens as compared to 3.3% of gram negative cocci (Table 1).

From 25 patients, 23 (92%) cultures yielded growth and 2 (8%) cultures did not yield any growth. Among 23 positive cultures, 2 (8%) cultures yielded aerobic bacteria only, 8 (34%) yielded anaerobic bacteria only and 13 (56%) cultures yielded mixed (aerobic-anaerobic) growth (Table 2). From aerobic culture, total of 17 aerobic strains of 6 different types (Table 3) and 29 anaerobes of 5 different types were identified (Table 4).

Bacterial type	Frequency	Percentage
Gram positive cocci	21	63.3
Gram negative cocci	1	3.3
Gram positive bacilli	5	15.2
Gram negative bacilli	6	18.2
Total	33	100.0

Table 1: Types of bacteria in Gram stain smear study

Isolates	Frequency	Percentage
Aerobic bacteria only	2	8.7
Anaerobic bacteria only	8	34.8
Mixed growth (both aerobic & anaerobic bacteria)	13	56.5
Total	23	100

Table 2: Types of bacterial isolates

Organism	Number of isolates	Percentage
Streptococcus viridans	8	47
Coagulase negative streptococci	3	17.64
Staphylococcus aureus	1	5.88
Beta hemolytic streptococcus	2	11.76
Escherichia coli	1	5.88
Non-hemolytic streptococci	2	11.76
Total	17	100

Table 3: Number and type of Aerobic bacteria

Organism	Number of isolates	Percentage
Peptostreptococci	14	48.27

Bacterioids	9	31.03
Prevotella	3	10.34
Fusobacterium	2	6.89
Prophyromonas	1	3.44
Total	29	100

Table 4: Number and type of anaerobic bacteria

Among aerobic bacteria, *Streptococcous viridans* is the most common (47%) bacterial strain isolated. Other aerobic organisms isolated were *Coagulase negative Streptococci* (17%), *Beta Haemolytic Streptococci* (11%), *Non-haemolytic Streptococci* (11%), *Staphylococcus Aureus* (5.88%) and *Escherichia Coli* (5.88%) (Table 3). Among five different anaerobes isolated, the most common anaerobic bacteria isolated were *Peptostreptococcous* that feature in 48% of the anaerobic bacterias. Other anaerobic organisms isolated were *Bacterioids* (31%), *Prevotella* (10%), *Fusobacterium* (6%) and *Prophyromonas* (3%) (Table 4).

Involvement of anatomical spaces was also analyzed in all 25 children. All 25 children exhibited with single space infections. The different anatomical spaces recorded were buccal, canine, submandibular, submental and submesseteric spaces. Among these spaces, the submandibular space (56%) was the most frequently involved space infection followed by the buccal space infection (16%). Other spaces involved were canine (4%), submental (4%) and submesseteric (4%) spaces. Involvement of multiple spaces was not observed in none of the patients (Table 5).

Involved anatomical space	Total	Percentage
Buccal	04	16.0
Canine	01	4.0
Submandibular	14	56.0
Submental	01	4.0
Submasseteric	01	4.0

Table 5: Anatomical distribution of orofacial space infection

Discussion

The present study was undertaken to assess the anatomical spaces involved and also to evaluate the causative micro-organisms responsible for primary orofacial space infections of odontogenic origin in children.

The sex distribution in this study showed that, male patients were more commonly involved than female patients with ratio being 2.5:1. This figure is similar to the finding reported by Abose who found male and female proportion of 1:3:1 [12]. The age of the patients ranged from 3-14 years.ars. It is reported that the patient's age is helpful as a guide in determining the source of infection and bacterial etiology [13,14]. In a retrospective study of 113 children, Dodson et al [13] found that upper face infections especially preseptal (periorbital) cellulitis, were most common in children under age 5, whereas lower face infections were more common in those between ages 6 and 12. In the younger age group, the exact source of infection was less likely to be found, and these patients had a higher incidence of *Haemophilus influenzae* and *Staphylococcus Aureus* growing from blood or pus cultures. In the older age group, the infections were more likely to be odontogenic in origin and caused by penicillin sensitive organisms [14].

In the present study, when the type of anatomical spaces involved in children was analyzed it was found that single space infections were more commonly found than multiple space infections. This may be attributed to the fact that early visit of the parents before the infection spreads rapidly to involve multiple spaces. Among the single space infections studied, submandibular space infection was most commonly observed space infection followed by buccal space infection coinciding with the studies done by Biederman and Dodson [14], Henry [15], Dodson et al [16] and Scutari and Dodson [17]. This may be due to the fact that both primary and permanent mandibular molars are more susceptible to dental caries and consequently are more frequently get infected leading to buccal space infection [5,18]. The primary difference between adults and children as far as the spread of infection is concerned is the relationship of the apices of teeth to the attachment of facial muscles on the maxilla and mandible [5]. Compared to adults, children have a relatively short facial height. As a result, the apices of teeth, especially the permanent first molars, incisors and canines found to be outside the limits of the attachment of the facial muscles. In the mandible, molar infections tend to spread into the submandibular spaces [5,14]. Infections from the anterior teeth may spread into the submental space or into the fibers of the mentalis muscle, causing very painful cellulitis. In the maxilla, infections that break out above its attachment tend to dissect medially to the nasolabial fold region [5].

Gram positive cocci were the most common bacteria cultured from specimens of this study and gram negative bacilli were the second most common bacteria isolated. The predominance of mixed (aerobic-anaerobic) cultures has been confirmed in most of the studies [19-23]. In our study mixed growth was 56.52%. There was predominance in anaerobic species isolated than aerobes in mixed cultures. Recent clinical studies have emphasized the importance of anaerobic bacteria in orofacial infections [19,20]. Even adult studies have also shown that anaerobes are isolated from virtually all dentoalveolar infections [20,21]. Though aerobic microoraganisms are isolated from about one third of all infections, but always predominated by anaerobic bacteria. This may be related to improvements in isolating and culturing methods of anaerobic organisms. The reason for this difference could also be due to the difference in the cultures obtained; suggesting that aspirations of cultures may grow predominance of anaerobic growth, and swabbing of cultures may produce predominantly aerobic species [21].

Among the six aerobic organisms isolated, the predominant bacteria isolated were *Streptococcus viridans* followed by *Coagulase negative staphylococci* and *Beta hemolytic streptococci, non-hemolytic Streptococci, Staphylococcus aureus* and *Escherichia coli*. Other studies showed predominance of *Staphylococcal species, Haemophilus Influenza* and *Streptococcal pneumonia* [22-25]. Among the five different anaerobes isolated, the most common anaerobic bacteria isolated was *Peptostreptococcous* that feature in 48.27% of the anaerobic bacterias, 66.66% of anaerobic culture and 60.86% of all positive cultures. Other anaerobic organisms isolated in our study were *Bacterioids* (31.03%), *Prevotella* (10.34%), *Fusobacterium* (6.89%) and *Prophyromonas* (3.44%).

Finally, it was concluded that pediatric orofacial space infections of odontogenic origin are a polymicrobial and mixed (combination of both aerobic – anaerobic) in nature with predominance of anaerobes. So, the diagnosis and treatment of various space infections seen in growing and relatively vulnerable child patients is really a great challenge to all pediatric dentists. Therefore the basic principles of the treatment for these infections must be followed including mainly the identification of causative organisms and involvement of different spaces which will provide a guide for initial empirical therapy.

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