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**IDENTIFICATION OF BACTERIAL AETIOLOGIES AND  
ASSESSMENT OF FACTORS ASSOCIATED WITH DENTO  
ALVEOLAR ABSCESSSES OF INCREASED SEVERITY: A STUDY  
DONE IN PATIENTS ATTENDING SELECTED DENTAL UNITS, SRI  
LANKA**

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**ABSTRACT**

**Introduction** - Acute dentoalveolar abscesses cause significant morbidity, financial impact and loss of income. Knowledge of the aetiology, susceptibility patterns and associated factors would help in effectively managing patients. **Objectives** - To identify the bacterial aetiologies and the antibiotic sensitivity patterns of the aerobic bacteria at selected dental units in Sri Lanka, and to assess the risk factors for dentoalveolar abscesses of increased severity and determine the relationship between pathogen and the clinical severity of illness. **Materials and Methods** - A descriptive cross sectional study was undertaken among thirty patients presenting to selected dental units, with acute dentoalveolar abscesses. An interviewer administered questionnaire was used to assess the associated factors. An aspirated

sample was processed to isolate the aerobic and anaerobic bacteria. Antimicrobial susceptibility was performed for the aerobes. **Results** - Viridans streptococci were the most isolated facultative anaerobe, while *Porphyromonas* species was the commonest strict

anaerobe isolated. These organisms were sensitive to amoxicillin and clindamycin. Multiple risk factors associated with acute dentoalveolar abscesses of increased severity include male sex, educational level, frequency of changing the toothbrush, time spent brushing teeth, technique of cleaning teeth, frequency of performing mouth rinsing, use of tobacco and consuming snacks high in refined sugars. No statistically significant relationship could be demonstrated between pathogen and clinical severity of illness. **Conclusions** - Polymicrobial etiology was demonstrated, with the majority being anaerobes. The aerobes were mostly sensitive to the commonly used antibiotic. Multiple modifiable and non-modifiable factors were associated with dentoalveolar abscesses of increased severity.

**KEYWORDS** – dentoalveolar abscess, anaerobic bacteria, antimicrobial agents.

## INTRODUCTION

Endodontic infections establish themselves in root canals devoid of a pulp, which may occur as a consequence of caries, trauma or following root canal surgery.<sup>[1]</sup> When an individual has poor oral hygiene, the colonizing bacteria on the teeth, can increase 2 to 10 fold.<sup>[2]</sup>

Once the bacteria are introduced, they may establish themselves, leading to acute or chronic inflammation.<sup>[1]</sup> Periodontitis causes destruction of the periodontal ligament and alveolar bone, resulting in the formation of periodontal pockets.<sup>[2]</sup> Acute dental abscess is an advanced stage of the symptomatic acute periodontitis.<sup>[1]</sup>

The infection is usually polymicrobial. Among them, strict anaerobes outnumber facultative anaerobes by a ratio of 1.5:1 to 3:1.

Management involves surgical drainage. Antibiotics should be prescribed if the abscess is associated with systemic symptoms of sepsis and in patients who are medically compromised. The knowledge on the probable aetiology will help to guide the clinician on the best choice of empirical antibiotics.<sup>[1]</sup>

According to the World Health Organisation (WHO), most oral diseases and chronic diseases share common risk factors. These include unhealthy environments and behaviours, such as tobacco smoking and excessive consumption of alcohol or sugar.<sup>[3]</sup>

In order to achieve sound oral health, the WHO recommends promotion of a healthy diet, with special emphasis on lower consumption of sugars and increased consumption of fruits

and vegetables, further there is emphasis on prevention of oral diseases related to tobacco use and the routine use of fluoride toothpaste and to promote good oral health.

The present study was undertaken to identify the bacterial aetiologies of acute dentoalveolar abscesses, the antibiotic sensitivity patterns of the aerobic bacteria, to assess the factors associated with dentoalveolar abscesses of increased severity and the relationship between pathogen and the clinical severity of illness.

## MATERIAL AND METHODS

All patients who presented to two dental units in Colombo, Sri Lanka, during December 2014 to March 2015 were included in the study. Patients who had taken antibiotics within one week of presentation were excluded from the study.

Ethical clearance was obtained from the relevant institutes. Written, informed consent was obtained from the patients.

A pus sample was aspirated from the patient's acute dentoalveolar abscess, by the attending dental surgeon, as part of the normal protocol, after rinsing the mouth with sterile normal saline. After expelling air, the syringe was recapped and tightly sealed. This sample was transported to the Microbiology laboratory at the Faculty of Medical Sciences, University of Sri Jayewardenepura immediately and processed.

Aerobic organisms were identified performing conventional biochemical tests and for anaerobic isolates a validated commercial kit (RapID ANA II™) was used.<sup>[3]</sup>

## RESULTS

All the specimen obtained from these patients produced aerobic, anaerobic or mixed growths. Due to the polymicrobial nature of these samples, most of the specimen yielded more than a single isolate. Between one to four organisms were isolated from each specimen of pus. In total, from the thirty samples, 84 organisms were isolated. This included 24 aerobic isolates and 60 obligate anaerobic isolates.

**Table I Summary of aerobic isolates from acute dentoalveolar abscesses**

Facultative Anaerobic Organisms	No. Of Isolates (%)
Viridans group streptococci	17 (56.7)
No aerobic growth	6 (20.0)
<i>Staphylococcus aureus</i>	3 (10.0)

Coagulase negative staphylococci	2 (6.7)
<i>Klebsiella pneumoniae</i>	1 (3.3)
Non groupable $\beta$ -haemolytic streptococci	1 (3.3)
<b>Total number of aerobic isolates</b>	<b>30 (100.0)</b>

Table II Summary of isolated anaerobic bacteria from acute dentoalveolar abscesses

Strict anaerobic organism	Number of isolates (%)
<i>Porphyromonas prevotii</i>	8 (13.3)
<i>Gemella morbillorum</i>	8 (13.3)
<i>Porphyromonas micros</i>	5 (8.3)
<i>Peptostreptococcus stomatis</i>	5 (8.3)
<i>Bacteroides distasonis</i>	4 (6.7)
<i>Streptococcus intermedius</i>	4 (6.7)
<i>Streptococcus constellatus</i>	4 (6.7)
<i>Fusobacterium</i> species	3 (5.0)
<i>Clostridium hastiforme</i>	3 (5.0)
<i>Porphyromonas gingivalis</i>	3 (5.0)
<i>Capnocytophaga</i> species	3 (5.0)
<i>Porphyromonas magnus</i>	2 (3.3)
<i>Propriobacter granulosum</i>	2 (3.3)
<i>Prevotella disiens</i>	2 (3.3)
<i>Propriobacter acnes</i>	1 (1.7)
<i>Actinomyces odontolyticus</i>	1 (1.7)
<i>Propriobacter proprionicus</i>	1 (1.7)
<i>Veillonella</i> species	1 (1.7)
<b>Total number of anaerobic isolates</b>	<b>60 (100.0)</b>

Accordingly, the most commonly found isolates was *Porphyromonas* species (n=18), which included *Porphyromonas prevotii*(n=8), *Porphyromonas micros*(n=5), *Porphyromonas gingivalis*(n=3) and *Porphyromonas magnus*(n=2).

The anaerobic streptococcus species were the second most common species isolated (n=16). This included *Gemella morbillorum*(n=8), *Streptococcus intermedius*(n=4) and *Streptococcus constellatus*(n=4).

Fifteen of the seventeen streptococcal isolates (88.2%) were sensitive to penicillin and/or ampicillin. The third generation cephalosporins were uniformly effective for the streptococcal, staphylococcal and coliform isolates. Ten isolates of viridans streptococci, three staphylococcal species and the single non-groupable  $\beta$ -haemolytic *Streptococcus* were sensitive to erythromycin (60.9%). Twelve isolates of viridans streptococci were susceptible clarithromycin (70.6%). Only a single isolate of viridans streptococci was resistant to clindamycin.

Table III Clinical severity was assessed as local and systemic symptoms.

Presence of localized symptoms	Number of patients	Percentage
1. sudden onset intense, persistent, throbbing pain gradually worsening over time	28	93.3
2. pain radiating to the ipsilateral ear, lower jaw and neck	19	63.3
3. facial cellulites	21	70.0
4. hot/cold sensitive teeth	13	43.3
5. pain on mastication	15	50.0
6. nocturnal pain disturbing sleep pattern	22	73.3
7. enlarged, inflamed lymph nodes.	19	63.3

Presence of systemic symptoms	Number of patients	Percentage
1. difficulty in opening the mouth	25	83.3
2. difficulty swallowing	10	33.3
3. fever, chills and/or rigors	22	73.3
4. pain unresponsive to analgesics	11	36.7
5. difficulties breathing	0	0.0

Out of the twelve symptoms, those who complained of seven or more were assumed to have more severe illness. The respondents who admitted to less than seven symptoms were assumed to be having less severe symptoms. The above two groups were compared for the purpose of assessment of the risk factors and the organisms.

#### Risk factors for severe dentoalveolar abscesses

The epidemiological factors considered were age, sex, educational level of patient (or guardian in the case of minors), employment status of the patient (or guardian in the case of minors) and monthly income.

The mean age of the patients was 32.3 years. Just under two thirds of patients were male ( $n=19$ ), while most of the patients (8 out of 30) were in the 21-30 years' age group.

There was a statistically significant difference in sex distribution when considering the severity of illness. Male sex was found to be associated with more severe clinical symptoms ( $p$  value=0.035).

It was found that those who had at least passed their ordinary level examination had dentoalveolar abscesses of lesser severity. There was no statistically significant relationship between the other epidemiological factors and the severity of dentoalveolar abscesses ( $p$  values > 0.05).

The oral hygiene related questions were use of toothbrush and fluoridated toothpaste, frequency of changing the toothbrush, time spent brushing teeth, technique used to clean teeth, number of times per day cleaning teeth, frequency of mouth rinsing and frequency of tongue cleaning.

Ninety percent of the respondents ( $n=27$ ) used a toothbrush, while 93.3% ( $n=28$ ) used fluoride containing toothpaste. Those who changed their toothbrushes at least monthly had disease of lower severity ( $p$  value = 0.00), which was statistically significant.

Less than a quarter of respondents brushed their teeth for at least six minutes. There was a statistically significant increase in the severity of dental abscesses, in those brushing their teeth for five minutes or less ( $p$  value = 0.00).

It was noted that less than half ( $n=13$ ) of the respondents employed a good brushing technique. There was a statistically significant relationship ( $p$  value = 0.00) between employing the incorrect brushing technique, and increased severity of dentoalveolar abscesses.

Seventy percent of the respondents ( $n=21$ ) admitted to never rinsing after meals, with either tap water or a commercially prepared mouthwash. There was a statistically significant relationship between not rinsing between meals, and increased severity of dentoalveolar abscesses ( $p$  value = 0.00). Also, those who rinsed their mouths after every meal had dentoalveolar abscesses of lesser severity ( $p=0.005$ ).

There was no statistically significant relationship between the severity of dentoalveolar abscesses and the other oral hygiene related questions.

The personal habits detrimental to oral health were the use of tobacco, alcohol, betel chewing and snacking.

There was a statistically significant relationship between higher consumption of tobacco and increased severity of dentoalveolar abscesses. Those who smoked daily had abscesses of increased severity ( $p=0.013$ ), while those who never used tobacco had abscesses of lesser severity ( $p=0.00$ ). Of note, all the respondents who admitted to smoking at least once daily complained of more severe illness ( $n=10$ ).

More than a third of respondents admitted to consuming snacks high in refined sugars on a daily basis. A statistically significant relationship was found between increased severity of dental abscesses and frequent consumption of sugary snacks in between meals (p value=0.01).

The other personal habits did not demonstrate a statistically significant relationship with the severity of dentoalveolar abscesses.

The symptoms of unhealthy gums were halitosis, dental caries, presence of sore / painful or bleeding gums, toothache, dental plaque, previous root treatment, dental extractions or oral trauma. The symptoms associated with dentoalveolar abscesses of increased severity were as follows.

Two fifths of the patients (n=12) complained of halitosis. There was a statistically significant relationship between the presence of halitosis and increased severity of dentoalveolar abscesses (p=0.049).

Sixty percent of patients (n=18) admitted to having suffered from dental caries. There was a statistically significant relationship between a history of dental caries (both treated and untreated) and increased severity of dentoalveolar abscesses (p value = 0.047).

Two thirds of patients (n=20) admitted to suffering from toothache. There was a statistically significant relationship between the presence of toothache and increased severity of dentoalveolar abscesses (p value = 0.00). The presence of dental plaque was associated with dentoalveolar abscesses of increased severity (p=0.00).

It was noted that there was a slightly higher percentage of anaerobic organisms isolated from the group with more severe symptoms. It was also noted that *Porphyromonas* species, were found in higher percentage in the group with more severe symptoms. However, these differences were not found to be statistically significant.

The facultative anaerobic bacteria inclusive of the viridans streptococci, non-groupable streptococci, *Streptococcus constellatus* and *Streptococcus intermedius* were found to be lower in the patients complaining of less severe symptoms (25.86%, n=15). However, this difference was also not found to be statistically significant (p=0.20).

## DISCUSSION

The factors leading to evolution and progression of periodontal disease are related to those that cause periapical lesions.<sup>[4]</sup> Therefore, the same risk factors that lead to unhealthy gums also lead to periapical abscess formation.

In the present study, the mean age of the patients was 32.3 years and male sex was associated with dental abscesses of greater severity. These results were similar to the results obtained by Kudiyirickal *et al*<sup>[5]</sup> in a primary care dental practice, where majority of dentoalveolar abscess patients were in the 21-40 years age category. In that study, 42.9% patients were males, but the sex difference was not statistically significant.

AlJehani<sup>[6]</sup> assesses the risk factors for periodontal disease, and notes that there is higher periodontal destruction in males. The reasons for the sex difference were unclear, but the author concludes that this may be due to their general ignorance of oral hygiene.

In the present study, those who had higher educational qualifications had dentoalveolar abscesses of lesser severity. This was mirrored by AlJehani<sup>[6]</sup>, who reiterates that those with higher educational level had lesser periodontal disease.

In a study conducted among school children aged 12-13-years-old in Guangzhou, Southern China<sup>[7]</sup>, it was found that there was a significant correlation between mother's education level and the prevalence of dental erosions in their children. Children whose mothers had a better education level had a lower prevalence of dental erosions and vice versa. This may be attributed to the mother's improved awareness on oral hygiene, leading to better oral health habits.

The respondents who brushed for five minutes or less had dental abscesses of increased severity. ( $p$  value = 0.00). Less than a quarter of patients brushed for at least six minutes. In the study by Clement *et al*<sup>[8]</sup>, the data was almost identical, with 23% spending more than five minutes brushing their teeth.

Regarding brushing technique, the current consensus is that no single technique is favoured over another. Therefore, in the present study, it was assessed if the respondents brushed without injuring the hard and soft tissues, while covering all tooth surfaces properly.<sup>[9]</sup> Accordingly, less than half ( $n=13$ ) of the respondents in the present study employed a good brushing technique. There was a statistically significant relationship ( $p$  value = 0.00) between



employing the incorrect brushing technique, and increased severity of dentoalveolar abscesses.

In the study by Jain *et al*<sup>[10]</sup>, it was found that 29% of respondents rinsed their mouth after meals, while only a tenth used a mouthwash. There was a statistically significant relationship between not rinsing between meals and increased severity of dentoalveolar abscesses in the present study (p value = 0.00).

In the present study, there was a statistically significant relationship between higher consumption of tobacco and increased severity of dentoalveolar abscesses (p=0.013). In the study by Hassija *et al*<sup>[9]</sup>, it is noted that escalated consumption of alcohol and tobacco (both in the smoked and smokeless forms) increases the prevalence of gingivitis and periodontitis. The American Journal of Public Health also notes that the use of tobacco alone is responsible for more than half of cases of periodontitis in the United States.<sup>[11]</sup>

In the present study, a statistically significant relationship was found between increased severity of dental abscesses, and frequent consumption of sugary snacks in between meals (p value=0.01). In the study by Clement *et al*<sup>[8]</sup>, this figure was lower, with only 20.2% doing so on a regular basis. This may be due to the composition of the study population. The present study included both children and adults, while the above study was conducted among students of Dental Therapy and Technology. The WHO recommends diminished consumption of sugary soft drinks, as it increases the likelihood of dental caries and dental erosions.<sup>[12]</sup>

In the present study, two fifths (n=12) of patients complained of halitosis. This was much lower than that found by Jain *et al*<sup>[10]</sup>, where 80% of the respondents complained of the same. There was a statistically significant relationship between the presence of halitosis and increased severity of dentoalveolar abscesses (p=0.049). According to Hassija *et al*<sup>[9]</sup> the presence of halitosis is a symptom of gingivitis, which leads to the destruction of the hard and soft structures around teeth.

Sixty percent of patients (n=18) in the current study admitted to having suffered from dental caries. In the study done by Gianopoulos *et al*<sup>[13]</sup> it was found that, out of 216 participants examined, 88.4% had at least one decayed tooth. In the present study it was found that there

was a statistically significant relationship between a history of dental caries (both treated and untreated) and increased severity of dentoalveolar abscesses ( $p$  value = 0.047).

In the present study, the presence of dental plaque was associated with dentoalveolar abscesses of increased severity ( $p=0.00$ ). According to Hassija *et al*<sup>[9]</sup>, dental plaque contains subgingival bacteria, which are capable of causing gingivitis. Therefore, the removal of dental plaque, either through self-administered plaque removal aids, or with professional assistance is mandatory for good oral hygiene.

Uhuibau<sup>[14]</sup> states that, as the severity of the odontogenic infection increases, the anaerobes take predominance. Therefore, organisms such as peptostreptococci, pigmented and non-pigmented *Prevotella* species and *Fusobacterium* species are seen with increased frequency. In the present study, it was noted that, even though there was a slightly higher percentage of anaerobic organisms isolated from the group with more severe symptoms, these differences were not found to be statistically significant, as all  $p$  values were  $>0.05$ . It must be noted that the sample size was inadequate in order to make a proper assessment of the pathogens and the clinical severity of the illness, and this should be extended island wide to obtain a higher number of specimens.

## CONCLUSION

Acute dentoalveolar abscesses have polymicrobial aetiology. Among these organisms, the anaerobic bacteria predominate. The treatment of these infections is mostly through surgical drainage. When antibiotics are indicated amoxicillin, clindamycin and the quinolones seem reasonable choices.

Male sex was associated with dentoalveolar abscesses of increased severity, while patients with higher educational level were found to have dentoalveolar abscesses of lesser clinical severity.

Certain behaviours related to oral hygiene and personal habits, increased the risk of having dentoalveolar abscesses of increased severity. This included not rinsing after meals, smoking and use of other forms of tobacco and consuming snacks high in refined sugars.

Patients who changed their toothbrushes at least monthly, those who brushed for at least six minutes per session and those that utilized a sound technique for tooth brushing, had abscesses of less clinical severity.

No statistically significant relationship could be demonstrated between pathogen and clinical severity of illness.

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### Conflicts of interest

The authors have no conflicts of interest to declare.

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