Estimation of bacterial load in patients wearing metallic and ceramic brackets

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**ABSTRACT**

To estimate the amount of bacteria present in patients wearing metallic and ceramic brackets. The objective of the present study is to investigate the amount of bacteria in patients wearing fixed orthodontic appliance. The fixed orthodontic appliance is the treatment of conditions like malocclusion. It includes brackets, tubes, band and ligating materials and archwires. Composite is used for bonding the brackets to the teeth surface, and it also induces the formation of plaque. Dental plaque is the main aetiology for causing gingivitis. This study shows that the metallic and ceramic brackets worn by the patients were contaminated with various microorganisms. The main focus of the study is to create awareness among patients with fixed orthodontic appliance and to improve their oral hygiene and to prevent periodontal problems.

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**INTRODUCTION**

Orthodontic fixed appliance therapy is the best method of treatment for various types of malocclusions and the most commonly used orthodontic materials are brackets, tubes, archwires, band material and ligating materials (Nikesh N Moolya, Arvind Shetty et al.; Pandurangan H, Thillai SS, et al., 2013). Orthodontic practice undergoes constant progress with the use of new techniques and materials that benefit both patients and practitioners (Bishara SE, Damon PL, et al., 1996). Bonding of brackets to the tooth requires acid etchant and composite and that will lead to retention of plaque being formed on the surface of the tooth. Most brackets are made of metal or ceramic. Some of the researches previously done have reported that fixed appliances promote continuous accumulation and retention of microbial growth (Boyd RI, Baumrind S. 1992). These appliances also serve as different loci for the formation of biofilm. Stainless steel presented the highest critical surface tension and can be found to induce specific changes in the oral environment such as reduced levels of PH and affinity of bacteria to a metallic surface because of electrostatic reactions also it increased plaque accumulation and elevated *S. mutans* colonization (Mitchell L. 1992).

This forms plaque biofilm traps and causes impaired plaque removal which causes changes in the oral environment like decreased pH, increased plaque accumulation and elevation of microbial counts in the saliva and the biofilm (Mitchell L. 1992; Naranjo AA, Triviño ML et al., 2006). There is also a common belief that plaque formation during orthodontic fixed appliance treatment is mainly attributed to its ligating methods and the complexity of the design of brackets. Fixed appliance induce continual accumulation and retention of the bacterial plaque on the tooth.
surface which constitutes a risk of the white lesion during orthodontic treatment. The quantity, as well as the quality of the plaque, is influenced by many factors, including surface characteristics, surface roughness, and surface free energy (Ai H, Lu HF, Liang HY et al., 2005; Hägg U, Kaveewatcharanont P, et al., 2004). The different components of the fixed orthodontic system may contribute to a shift in the balance of the oral ecology. During treatment, retentive areas are created that favour biofilm accumulation and bacterial growth. A large amount of research has dealt with the intimate contact of orthodontic materials with the tooth and periodontal tissue. The presence of brackets and ligatures has been shown to be related to an increase in gingival inflammation and increased risk of de-calcification (Lee SJ, Kho HS, Lee SW, Jang WS 2001; Øgaard B, Rølla G, Arends J 1988). Clinical observation has indicated that a common site of demineralisation is at the junction between the bonding resin and the enamel just peripheral and commonly gingival to the bracket space. Oral microbiota attachment in orthodontic patients has been mainly associated with increased risk of Streptococcus mutans and lactobacilli colonization, among other species, thus initiating a series of events, which may lead to the development of pathology of the hard tissues such as decalcification and, in specific cases, caries development (Caufield P W, Dasanayake AP et al., 2000). Even though the above-mentioned effects have been studied extensively, there is a lack of substantiation of the hypothesis of decreased plaque retention related to the use of self-ligating brackets. The insertion of orthodontic wire tends to create new surfaces available for plaque formation and therefore to increase the level of microorganisms in the oral cavity. It has long been showed that wires and orthodontic bands lead to an increased accumulation of plaque and elevated levels of Lactobacilli and Streptococci. In addition, orthodontic patients with fixed appliances frequently present an abundance of S. mutans in plaque compared with untreated orthodontic patients. Therefore, prevention of bacterial attachment to orthodontic wires is a critical concern for orthodontists (Øgaard B, Rølla G, Arends J 1988).

The oral cavity is a rich ecosystem with a plethora of microorganisms. While both caries and periodontal diseases are considered multifactorial diseases, a plaque is a major factor in their onset and progression (Naranjo AA, Triviño ML. et al., 2006). The presence of brackets and ligatures has been shown to be related to an increase in gingival inflammation and increased risk of decalcification. This demineralization of the tooth surfaces results in the appearance of white spots or even carious lesions (Caufield P W, Dasanayake AP et al., 2000). The most common organisms include Streptococcus mutans and lactobacilli colonization, among other species, thus initiating a series of events and leads to periodontal inflammation finally leading to periodontitits (Corbett JA, Brown LR. Et al., 1981; Azmi MG, Al-jasser N 2003). The aim of this study was therefore to assess the extent of contamination in patients wearing metallic and ceramic brackets and also to create awareness by taking bacteria as an indicator.

MATERIALS AND METHODS

The sample collected was 20 in number out of which 10 samples were obtained from patients wearing ceramic and 10 samples from metallic brackets. The samples were collected from patients undergoing treatment at Saveetha Dental College with a sterile cotton swab, and the swabs were sent to the Microbiology Department for culture. The samples were inoculated into Brain Heart Infusion (BHI) agar using spread plate technique. The culture plates were inoculated at 37°C for 24h and observed for microbial growth. The colony forming Units(CFU's) were manually counted and tabulated. Its colony morphology and gram staining identified the organisms.

RESULT AND DISCUSSION

Microbial growth was given in the table. From the table, it is seen that Staph. albums, Strep. mutans and Enterococcus and Micrococcus were largely found in patients wearing metallic and ceramic brackets.

This study shows that the metallic and ceramic brackets worn by the patients were contaminated with various microorganisms. These microorganisms can act as a possible source for causing infections to the patients wearing orthodontic brackets (Marsh P D. 2003) (Gorelick L, Geiger A M, Gwinnett A J 1982). The most predominant organisms that are found in the brackets were Staph. albums, Strept.mutans and Enterococcus. Staph. albums is a gram-positive bacteria that are not usually pathogenic but has a higher risk of causing infection to immune compromised individuals. They grow rapidly on blood agar and other laboratory media; not hemolytic on blood-agar plates. On solid culture, the bacterial colonies are often white or cream coloured. They are generally resistant to multiple types of antibiotics; it is the most essential cause of serious nosocomial infections occurring among patients. They are responsible for hospital-acquired infections, prosthetic joints infections, bloodstream infection, cerebrospinal fluid (CSF) shunt...
infection, urinary tract infections, peritoneal dialysis catheter infection, especially with indwelling

Urinary catheters resulting in urinary tract complications, infection among newborns, infection of vascular grafts, eye infection after eye surgery, infection of pacemakers or implantable cardioverter-defibrillators, infection of breast implants. These infections are indolent and often clinically silent, diagnosis and therapy are often difficult. They are most commonly seen in intravenous catheters and other medical prostheses. It causes endocarditis in patients with defective heart valves. (Naranjo A A, Trivino M L et al., 2006).

Strep. mutans are first introduced at an infant stage when a child is breastfeeding and continually re-introduced by a person’s food later. Nearly nineteen distinct species of streptococci have the human oral cavity as their natural habitat. S. mutans acquired the ability to increase the amount of carbohydrates that could be metabolized and subsequently more organic acid was produced as a byproduct. S. mutans were found in the human oral cavity and is responsible for causing dental caries. When dental biofilm remains on tooth surface along with sugars and bacteria, the sugars are converted into organic acid by metabolism. This will helps in the growth of bacteria leading to caries formation (Jayakeerthana S and Geetha, 2017). Susceptibility to disease varies between individuals and immunological mechanisms, and these mechanisms have yet to be fully elucidated. It is the most prevalent bacterial species detected in extirpated heart valve tissues, as well as in atheromatous plaques. They were also found in heart valves in cardiovascular patients (Fox, R. H. 1976). Daily brushing, flossing and the use of appropriate mouthwash can significantly reduce the number of bacteria that are present in the oral cavity.

Enterococcus are facultative anaerobes which are capable of cellular respiration in both oxygen-poor and oxygen-rich environment (Fey, P. D.; Olson, M. E. 2010). The genus Enterococcus includes more than seventeen species, although only a few cause clinical infections in humans. The genus Enterococcus includes more than 17 species, although only a few cause clinical infections in humans. Enterococci have both an intrinsic and acquired resistance to antibiotics causing nosocomial infection. The infections caused by Enterococcus include bacteremia, urinary tract infections, bacterial endocarditis, diverticulitis, and meningitis (Caufield P W, Dasanayake A P. et al., 2000; Levinson, W. 2010; Argimón, S; Caufield, PW.2011). Nitrofurantoin can be used to treat urinary tract infections even when it is resistant to vancomycin (Jayakeerthana S and Geetha. 2017; Nakano, K; Inaba, H; et al., 2006). Sensitive strains of these bacteria can be treated with penicillin, vancomycin and ampicillin (Jayakeerthana S and Geetha. 2017; Fischetti VA, Novick RP et al., 2000). They also acquired resistance to penicillin by chloramphenicol, tetracyclines, rifampin, beta-lactamases, fluoroquinolones, vancomycin and aminoglycosides even at high levels. The six phenotypes of vancomycin resistance are VanA, VanB, VanC, VanD, VanE, and VanG. The most common and exhibit high-level resistance to both teicoplanin and vancomycin is VanA, while VanB isolates have variable resistance to vancomycin and remain susceptible to teicoplanin. The phenotype of VanC is mediated by the chromosomal VanC1 and VanC2 genes. The phenotypes of VanD, VanE, and VanG were described only in a few strains of Enterococcus till now. Newer antibiotics like quinupristin-
dalfopristin, linezolid, daptomycin, tigecycline have increased activity against Enterococcus.

**Table 1: Provide caption (Table should be in text format)**

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<tr>
<th>Bacterial Load In Metallic Brackets</th>
<th>Bacterial Load In Ceramic Brackets</th>
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<tr>
<td><strong>Samples</strong></td>
<td><strong>No. Of CFU</strong></td>
</tr>
<tr>
<td>1</td>
<td>610</td>
</tr>
<tr>
<td>2</td>
<td>415</td>
</tr>
<tr>
<td>3</td>
<td>363</td>
</tr>
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<tr>
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Micrococcus occurs in a range of environments, particularly in water, dust, and soil. Micrococcus are human commensals that colonize the skin, mucosa and oropharynx. They are catalase-positive, oxidase-positive, strictly aerobic gram-positive cocci that grow in clusters. They are referred to as milk micrococi and can result in spoilage of milk products are considered contaminants from the skin and mucous membranes. They are resistance to mupirocin and staphyloysin and are susceptible to lysozyme and bacitracin which helps to differentiate it from Staphylococcus. It is a common cause of bloodstream infection in patients with pulmonary hypertension. Catheter-related bloodstream infections are the main contributor to the morbidity and mortality in patients. Rarely, pulmonary infections caused by Micrococcus leads to death in immunocompromised patients. They cause an infection like bacteremia, septic arthritis, septic shock, endocarditis, meningitis, and cavitating pneumonia in immunocompromised individuals. They also cause infections in the skin leading to pruritic eruptions and scattered papule lesions with or without central ulceration (Jayakeerthana S and Geetha. 2017; Ryan KJ, Ray CG, eds. 2004; Fisher K, Phillips C. 2009). The treatment should be based on the organism antibiotic susceptibilities (Zhanel GG et al., 2001). Micrococcus are relatively susceptible to most of the antibiotics, including gentamicin, vancomycin and penicillin which have been successfully used for treating infections caused by these type of bacteria. Cross-infection during clinical practice can occur with the transmission of infectious agents between patients and health workers in a clinical environment (Oudiz RJ et al., 2004). Transmission of dental infection can occur through infected air droplets, blood, saliva, and instruments contaminated with secretions. Some infectious diseases have prolonged incubation periods or post-infection “window period” during which antibodies can’t be detected.

Cross-infection in dentistry can occur through many pathogenic organisms found in the oral cavity and respiratory tract. Example of these organisms is cytomegalovirus, Hepatitis C Virus, Hepatitis B Virus, herpes simplex virus, HIV/AIDS, Mycobacterium tuberculosis, staphylocci, streptococci and other viruses and bacteria. Exposure to blood and body fluids need great concerns from both dental care providers and patients. Although many guidelines and recommendations are issued by medical and dental societies as well as governmental organizations, studies illustrated that infection is not well controlled in some dental practices and hospitals. Disinfection and sterilization of instruments are the most important significance in dental offices, for preventing the transmission of infection from instrument to patient and from patient to patient. Dental practices should develop a written infection-control program to prevent or reduce the risk of disease transmission (Yap RL, Mermel LA 2003; Valdivia-Arenas, Martin A. et al.,
Such a program should include the establishment and implementation of policies, procedures, and practices. The objective of assessing the accumulation of bacterial plaque in self-ligating and conventional brackets, the authors concluded that active self-ligating brackets are less likely to accumulate dental plaque when compared to conventional brackets. Nevertheless, it is speculated that active self-ligating brackets allow better hygiene, as they do not have locks or clips completely closing the bracket slot and forming a fourth wall (buccal) similar to molar tubes. And also, the passive brackets present in the buccal wall and this could be the cause of accumulation of plaque inside the bracket slot. Hence, the bacterial load can be reduced by following the brushing technique which is prescribed by the Dentist during orthodontic treatment and also by proper cleaning of the brackets.

**CONCLUSION**

This study finds out the capacity of microorganisms to adhere and grow is dependent on the materials of the orthodontic appliance used and was done to create awareness among the dentists and patients about the presence of various microorganisms in the metallic and ceramic brackets. Hence by creating awareness among the dentists, the researchers will be motivated to find a way to invent the brackets with antimicrobial function embedded in it. By creating awareness among the patients, they will be taking extra care to their brackets to get rid of the microorganisms and not to get infected.

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Valdivia-Arenas, Martin A. MD*; Sood, Namita MD, FCCP† Micrococcus Bloodstream Infection in Pa-

