



## BIOFILM IN ORTHODONTICS: A REVIEW

## Orthodontics

Dhritiman Barman M.D.S. Orthodontics and Dentofacial Orthopaedics

## ABSTRACT

The placement of fixed orthodontic appliances creates retentive areas for the accumulation of biofilm. The lodgment of biofilm leads to various gingival and periodontal diseases along with enamel demineralization, caries. The fixed appliance hinders the mechanical removal of the biofilm. The deposition also depends on the materials used for manufacturing brackets and ligatures. The following review article discusses about the biofilm along with the measures for the maintenance of oral hygiene.

## KEYWORDS

Biofilm, Brackets, Ligatures, Plaque, Bacteria

## INTRODUCTION

Fixed orthodontic appliances allow three-dimensional correction of malocclusion.<sup>1</sup> Fixed orthodontic therapy deals with superior efficacy in treatment time and treatment results compared to treatment with removable appliances.<sup>2</sup> The detrimental effects of fixed therapy can be observed in terms of changes in the tooth supporting structures. In most cases, stainless steel brackets are used for treatment.<sup>3</sup> In recent times due to esthetic demand in young adolescents, the use of tooth colored brackets made up of ceramic, plastic is increasing.<sup>4</sup> Biofilms are composed of micro-colonies of bacterial cells. Rapid formation of visible layers of micro-organisms due to extensive bacterial growth is typical for biofilms.<sup>5</sup> The oral environment provides optimum condition for colonization of a complex microbiota and these microorganisms co-exist in a balanced state.<sup>6</sup> This balanced flora changes and disease occurs due to changes in the normal oral environment. Such changes are brought about by introduction of orthodontic appliances.<sup>7</sup> Orthodontic therapy using fixed appliances induces changes in the oral environment due to more plaque retentive areas and impaired mechanical plaque removal.<sup>8</sup>

## Biofilm

Clinical studies have found that bracket insertion increases biofilm formation which is combined with an ecological change of the microbial profile.<sup>9</sup> The changes in composition, amount and pathogenicity of the oral microflora lead to gingival and periodontal inflammation along with incipient carious lesion.<sup>10</sup> Although the gingival and periodontal conditions are considered to be reversible<sup>11</sup>, the white spot lesions around the bracket peripheries are considered to be irreversible.<sup>12</sup>

The bracket material also affects the adhesion of bacterial species and plaque accumulation.<sup>13</sup> Studies have shown that surface roughness, surface free energy influence the plaque retaining capacity.<sup>14</sup> Metallic brackets and bands have been found to induce changes in the oral environment such as decreased pH and increased plaque accumulation.<sup>15</sup> There is also elevated levels of *Streptococcus mutans* as well as *Lactobacillus species*.<sup>16</sup> Elastic ligatures are also known to induce an increase in biofilm accumulation.<sup>17</sup>

Mechanical tooth cleaning, local application of fluorides, chemical mouth rinses can be used to counter the side effects of fixed orthodontic therapy.<sup>1</sup> Although there is no recommended tooth brush for cleansing of tooth, the orthodontic tooth brush should be small, medium, hard or soft, nylon bristled and multitufted.<sup>18</sup> Tooth brushing is the most common method of removing food debris. There is a debate among many researchers about the efficacy of various brushing methods. Roll technique was once advocated the most efficient.<sup>19</sup> Later, new investigations indicated that the roll method is inferior to the Bass, Charter and Fone's technique.<sup>20</sup> Children lack the dexterity to master the roll method. The best cleansing effect is seen when they use the horizontal techniques.<sup>18</sup> Horizontal techniques proved to be more effective than the vertical techniques especially along the gingival margins.<sup>21</sup> The procedure for horizontal technique should be back and forth scrub motion on the buccal and lingual surfaces. Short strokes covering approximately two teeth should be performed. As it is not established when the plaque turns cariogenic, the maximum limit on the cleansing should not be demarcated.<sup>22</sup> Neither damage to the appliances nor the tissues has been reported due to manual or electric

tooth brushing.<sup>23</sup> Increased thoroughness of brushing through-out the treatment span can lead to gingival recession.<sup>24</sup>

In addition to mechanical cleansing, chemical agents can be used as a plaque inhibitor. Chlorhexidine, a potent cationic disinfectant with an antimicrobial effect, can be used to prevent plaque formation.<sup>25</sup> Though chlorhexidine has side effects such as discoloration of teeth and tooth fillings, repeated studies have found that the use of chlorhexidine in 0.1 to 0.2 % aqueous solution can prevent the development of caries and gingivitis simultaneously. According to Gjermo, the mode of action of chemical agents include prevention of plaque formation, inhibition of calcification of microbial deposits and changes in the pathogenicity of dental plaque.<sup>21</sup> Urea peroxide in gel form has achieved success in removing supra-gingival plaque.<sup>26</sup> Fogel and Magill also reported a significant decrease in caries rate when used in supplement to the usual oral hygiene maintenance practice.<sup>26</sup>

Disclosing agents can be used as an aid for patient education as well as to improve oral hygiene.<sup>27</sup> Cohen and colleagues have reported that the use of disclosing agents not only resulted in better plaque removal but also helped in diminution of gingival inflammation.<sup>28</sup>

In addition to the general tooth brushes, supplemental aids such as tooth picks, dental floss, single tufted brush, interproximal brush have been introduced for cleansing of the interproximal areas. It is difficult to use dental floss below and past the orthodontic wires. In wide open interproximal areas, inter-dental brush is the most suitable aid for removing plaque.<sup>29</sup> Vigorous use of tooth picks and dental floss can cause severe gingival damage and lead to gingival recession.<sup>22</sup>

## DISCUSSION

Studies have shown a shift in microbial populations in the presence of fixed orthodontic appliances.<sup>6</sup> There has been a debate over the which bracket material is less prone to biofilm formation and adhesion of microbes.<sup>6</sup> Eliades et. al found the wettability of bracket material in their study by measuring the contact angle.<sup>13</sup> In their study, stainless steel presented the highest surface tension indicating an increased potential for bacterial adhesion on metallic brackets.<sup>13</sup> The study by Lindel et. al also indicated that ceramic brackets exhibit less biofilm accumulation than metal brackets.<sup>30</sup> Fournier et. al found that the adherence of *Streptococcus mutans* is weaker to metal than to plastic or ceramic brackets.<sup>31</sup> A recent study revealed that *Porphyromonas gingivalis* and *Escherichia coli* adherence was greater on stainless steel brackets than ceramic, plastic and gold brackets.<sup>32</sup> *A actinomycetemcomitans* were found in high numbers in stainless steel brackets.<sup>6</sup>

Uncoated orthodontic brackets are highly susceptible to biofilm formation. This leads to decalcification along with gingival and periodontal disease endangering the integrity of oral hard and soft tissues. A polytetrafluoroethylene coating on brackets reduced the biofilm formation. This coating was found partially abraded on surfaces exposed to high shear forces.<sup>1</sup>

## CONCLUSION

Orthodontic treatment with fixed appliances increases the chances of biofilm accumulation. This leads to change in oral environment along with increase in growth of oral microbes. It is of utmost importance to

follow strict oral hygiene maintenance procedures. It helps in finishing treatment in the prescribed period of time.

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