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Influence of Commercially Available Herbal Mouthwash on the Surface Tomography of Two Different Types of Nickel Titanium Orthodontic Arch Wires – An in vitro Study

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ABSTRACT

Oral hygiene maintenance is one of the most important aspects to look after during orthodontic treatment. This can be achieved by the use of mechanical plaque controlling agents as well as chemical plaque controlling agents. However, chemical plaque controlling agents such as chemical mouthwashes cause damage to the surface tomography of the orthodontic arch wires and its surface coating. This reduces the working efficiency of the wire and also deteriorates the aesthetic component of these tooth colour coated orthodontic arch wires. Hence, the purpose of this study was to evaluate the effect of herbal mouthwash (Befresh) on the surface tomography of two different types of Nickel Titanium (NiTi) orthodontic arch wires. The study comprised of two groups: Group A (Test Group) and Group B (Control group). Each group consisted of two different wires: (i) a single 0.016 Copper (Cu) NiTi arch wire of 25mm length and (ii) a single 0.016 Teflon coated NiTi arch wire of 25mm length. Group A was immersed in Befresh mouthwash for 90 minutes while Group B was kept unaltered in room temperature without any manipulations. Both the groups were later viewed under Scanning electron microscope (SEM) and were qualitatively analysed. The results showed no significant changes in the surface tomography of the two arch wires, pre and post immersion into the herbal mouthwash (Befresh). Therefore, Befresh mouthwash can be prescribed by orthodontists as an adjuvant to chemical plaque controlling agent as it does not exhibit any detrimental effects to the surface tomography of the orthodontic arch wires.

KEY WORDS: BEFRESH HERBAL MOUTHWASH, CINNAMONUM ZEYLANICUM, SURFACE TOMOGRAPHY, SCANNING ELECTRON MICROSCOPE, TEFLON COATED NITI ARCHWIRE.

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INTRODUCTION

The human oral cavity houses millions of microorganisms, which are termed as commensals. Although harmless in general conditions, certain alterations in the conditions of the oral environment causes these microflorae to exert a deteriorating effect on the oral hard and soft tissue structures. These alterations may be in the form of dental caries, gingivitis, periodontitis, halitosis, mucosal lesions, etc (Zachrisson and Zachrisson, 1972). In spite of all the technological advances in today's world, there are studies that show inadequacy in the levels of mechanical oral hygiene practice (Sälzer et al., 2015). In fact, the World Health Organisation also says that these intraoral diseases are a health hazard globally, which may affect the systematic health of people in the long term (da Costa et al., 2017).

Orthodontic treatment is a form of dental mechanotherapy that utilizes wires, bands and brackets of different types of materials to bring about the movement of teeth from a malposed position to an ideal aesthetically acceptable position. The attachment of these components to the tooth surface leads to an increase in the accumulation of plaque (LUNDSTRöM and Hamp, 1980) . Increase in plaque accumulation leads to deterioration of the oral hygiene, increase in the microbial count and decrease in the pH of the oral cavity. These alterations in the oral environment is the primary reason for post orthodontic decalcification of teeth (CIANCIO, 1985; Tanner et al., 2012) .

Furthermore, the fixed orthodontic appliance act as a physical barrier that has to be overcome, in order to achieve ideal dental hygiene (Erbe et al., 2019). This facilitates the absolute need for the reinforcement of oral hygiene measures. Although mechanical methods of plaque control are of paramount importance, its efficacy also depends on the dexterity of the individual. Here, chemical plaque control methods serve as important adjuvants in orthodontic treatment phase (Erbe et al., 2019).

Chemical plaque controlling agents like chlorhexidine mouthwashes (CHX) reduce the microbial colony forming units (CFU) in the oral cavity, restore the balance in pH of the oral environment and also help in alleviating malodour. The property of substantivity exerted by the CHX mouthwash also has a prolonged antimicrobial effect in the oral cavity (Brightman et al., 1991). CHX mouthwash is also active against a variety aerobic, facultative anaerobic, yeasts, gram positive and gram negative organisms (Van der Weijden et al., 2015). However, these chemical mouthwashes also have some deteriorating effects in the oral cavity and are not recommended for long term use. Long term usage of CHX mouthwash is said to cause alteration of taste perception, cause staining of teeth and these preparations also have alcohol in it, that also alter the physical and chemical properties of the orthodontic components that are being used (Eliades and Athanasiou, 2002; Serrano et al., 2015).

Herbal mouthwashes are slowly emerging as a viable alternative to these chemical mouthwashes. They do not possess alcohol and neither to they cause any sort of harm to the surrounding oral structures on prolonged exposure (Dilipkumar et al., 2017). In fact, some of the herbal mouthwashes have also been found to have a soothing and anti-inflammatory effect on the gingival tissues. One such mouthwash is the Befresh herbal mouthwash. It is made up of cinnamon oil, eucalyptus oil, clove oil and spearmint oil. Cinnamon (*Cinnamonum zeylanicum*) exerts an antifungal and antibacterial effect. Clove oil has an additional property of acting as an antiseptic and an anaesthetic, and also exhibiting an astringent effect. Eucalyptus oil and spearmint oil, apart from exerting an antimicrobial effect, also help neutralising halitosis (Kripal, 2017). Also, this mouthwash is devoid of alcohol, which is not in case of the gold standard chlorhexidine (Kripal, 2017).

Many studies have been done on the effects of chemical mouthwash on several properties of orthodontic arch wires. 0.5% sodium fluoride containing mouthwash has been shown to increase the frictional resistance of almost all orthodontic brackets and arch wires (Geramy et al., 2017). Chemical mouthwashes have also been shown to be responsible for the ionic leaching of nickel and chromium ions (Mirhashemi et al., 2018). Even topical application of fluorides and fluoridated mouthwashes when treated with orthodontic arch wires show surface morphological changes (Gupta et al., 2018). At present, there is a need for an alternative to such deleterious chemical oral hygiene adjuvants, that deteriorate the properties of orthodontic appliances intraorally. Hence, the purpose of this study was to evaluate the effect of Befresh mouthwash on the surface tomography of orthodontic arch wires (Gupta et al., 2018).

MATERIAL AND METHODS

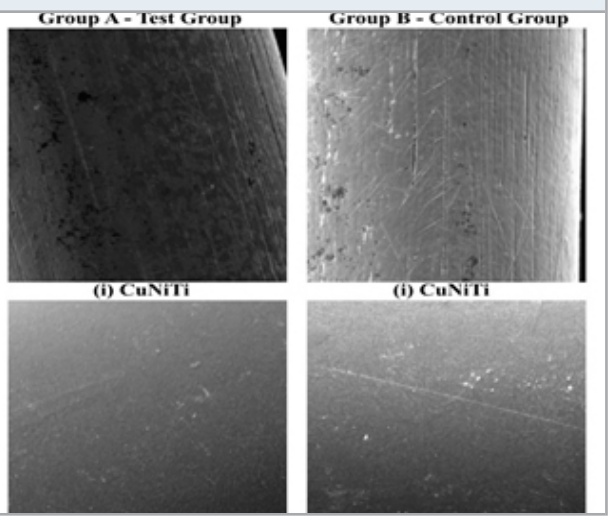
The study comprised of 2 groups, with each group comprising of two different types of 0.014 orthodontic archwires of 25mm length each. Group A was the Test Group, which consisted of (i) a 0.016 Copper (Cu) NiTi arch wire and (ii) a 0.016 Teflon coated NiTi arch wire, which was immersed in the Befresh herbal mouthwash. Group B was the Control Group, which consisted of (i) a 0.016 Copper (Cu) NiTi arch wire and (ii) a 0.016 Teflon coated NiTi arch wire, which was kept unaltered and stored at room temperature without any sort of manipulation.

Wires in Group A were immersed in the Befresh herbal mouthwash for a period of 90 minutes at room temperature. This exposure time is said to be equal to 3 months of exposure to routine 1-minute mouthwash usage (Walker et al., 2005). Wires in Group B were kept at room temperature without any manipulation. At the end of 90 minutes, the arch wires were removed from the mouthwash and rinsed thoroughly using distilled water. The archwires were kept to dry and were then subjected to qualitative analysis of the surface characteristics using a scanning electron microscope.

RESULTS AND DISCUSSION

The scanning electron microscopes were set to a magnification of 800x and the readings were evaluated. The CuNiTi and the Teflon coated NiTi arch wires showed certain linear areas, which can be attributed to the manufacturing process of that wire (Fig.1). There were no marked changes like pitting, mottling, globular patterns, smudges in the surface areas of both arch wires, indicating no obvious deformities in the tomography of both arch wires, pre and post immersion. Also, there was no loss of Teflon coating of the arch wire between Group A and B (Figure 1). This showed that the herbal mouthwash had no deteriorating effect on the surface characteristics as well as the surface coating of the orthodontic arch wires.

Figure 1: SEM image under 800x of Group A (Test Group) showing wire (i) CuNiTi and wire (ii) Teflon coated NiTi after immersion in Befresh mouthwash and Group B (Control Group) showing wire (i) CuNiTi and wire (ii) Teflon coated NiTi kept without any manipulations.



Oral hygiene maintenance is an important aspect of orthodontics as poor oral hygiene leads to poor gingival and periodontal health, which further affects tooth movement by altering the status of the bone (Schei et al., 1959). The components of fixed orthodontic appliances act as a scaffold onto which plaque gets accumulated, leading to the increase in the microflora. Bacteria found in the dental plaque have also been found to cause corrosion on metal surfaces (Kameda et al., 2014). Friction is a key determinant that influences the treatment duration and its outcome. Any sort of damage to the orthodontic components in the form of surface defects such as corrosion can hinder orthodontic tooth movement. This brings in the necessity for orthodontists to prescribe mouthwash, in order to maintain good oral hygiene as well as to preserve the integrity of the metallic components being used (Kameda et al., 2014).

Nickel titanium wires are the more commonly used wires for initial levelling and aligning procedures in orthodontic treatment. Since they make up for majority of treatment time, they were included as the wires of choice in this study. White spot lesions are one of the commonly occurring side effects of orthodontic therapy, if oral hygiene is not well maintained. This makes it necessary to prescribe a fluoride containing mouthwash for remineralization of the tooth (Khoroushi and Kachuie, 2017). Fluoride containing mouthwashes have been seen to cause surface changes in orthodontic archwires and brackets. Furthermore, fluoride containing mouthwashes cause leaching of metallic ions from the metallic components of the fixed orthodontic appliances, that alter the taste perception and also discolour the teeth (Aghili et al., 2017). Corrosion of orthodontic archwire is another drawback seen in the usage of alcohol containing fluoride mouthwashes. This is mainly because of its interference with the passivating layer of the orthodontic archwires (Huang, 2002). Studies show that fluoride containing mouthwashes cause reduction in the corrosion resistance of nickel titanium and stainless-steel wires.

This is directly proportional to the fluoride concentration in the mouthwash (Heravi et al., 2015). Study conducted by Geramy et al., (2017) shows that friction rate is increased in wires treated with fluoride mouthwashes. Although chlorhexidine is considered as the gold standard of mouthwashes, it cannot be prescribed for longer duration as it causes certain side effects. It causes staining and alteration of taste perception, imparting a metallic taste on prolonged use (Dolles et al., 1979). Study conducted by Danaei et al., (2011) shows that chlorhexidine mouthwash causes ion release from stainless steel orthodontic brackets. Alcohol containing chemical mouthwashes like Listerine are also not recommended in case of aesthetic coated archwires, as they have a detrimental effect on the surface coating (Hussein and Ghaib, 2017).

Herbal mouthwashes on the other hand are alcohol free and have been used for many years. Herbal derivates have no side effects on prolonged usage, are cost effective and easier to manufacture. Kripal et al., in his study shows Befresh mouthwash to be equivalent in efficiency to that of chlorhexidine mouthwash, in terms of antimicrobial activity (Kripal, 2017). Study conducted by Brar et al., has shown that Listerine and Chlorhexidine mouthwashes have more corrosive effect on the wire as compared to an organic herbal (neem) mouthwash (Brar et al., 2015). Furthermore, another study showed ion release in metal brackets and wires to be higher in the chlorhexidine group (Danaei et al., 2011). The reason for this is believed to be the higher acidic pH of chlorhexidine which is believed to be 6.5 as compared to the 7.75 pH of the organic herbal mouthwashes (Brar et al., 2015). Even though herbal mouthwash is not as effective as chlorhexidine mouthwash in similar concentration, their efficacy can be well augmented with the increase in its dosage and exposure time (Parwani et al., 2013). This is not possible in case of chemical mouthwashes, owing to their added side effects which do not permit long term exposure (Kripal, 2017).

Chemical mouthwashes are also contraindicated in cases which involve aesthetic arch wires. The epoxy coating of the arch wire gets disintegrated in the presence of alcohol (Mohsin and Al-Sheakli, 2016). However, this is not the case for organic mouthwashes, which are devoid of alcohol. This gives rise to fewer complications and side effects (Jongsma et al., 2015). Usage of herbal mouthwash can prove to be a valuable adjuvant to mechanical plaque controlling methods, as its reduced cytotoxicity, fewer to none detrimental effect on the orthodontic components and its antimicrobial activity puts it above the chemical mouthwashes. Although chlorhexidine is still considered to be the gold standard of mouthwash, herbal mouthwash can be an effective replacement. This is especially true in orthodontic cases, which warrant the use of mouthwashes for the longer run. This not only solves the purpose that the chemical mouthwashes were made for, it is also compatible with the treatment needs from an orthodontist's perspective. The physical properties as well as the aesthetic colour stability of the orthodontic components are well preserved. Since only one type of wire has been used in this study, there is a need to further evaluate the effect of herbal mouthwash on other types of orthodontic arch wires, which would be the scope for future studies.

CONCLUSION

The organic herbal mouthwashes like Befresh mouthwash, are a valuable and effective alternative to chemical mouthwash. They do not cause any changes to the surface tomography of orthodontic arch wires and orthodontic brackets. They are economic, environment friendly and are more accepted by patients owing to their natural taste and fragrance. They also have fever to no side effects as compared to chemical mouthwashes, which are deleterious on long term usage. Although herbal mouthwash is not as effective as chemical mouthwash in its antimicrobial efficacy, it could serve as an ideal adjuvant to the chemical plaque controlling agent as it is less deteriorating even in higher dosage and prolonged use, which would also increase its antimicrobial activity at higher dosage and exposure.

This is not the case with chemical mouthwash, without risking their deteriorating side effects. The results of this study have shown the influence of herbal mouthwash on the surface tomography of the CuNiTi orthodontic arch wires and also the surface coating of aesthetic NiTi arch wires. Further studies are required to look into the influence of herbal mouthwash on the physical characteristics of orthodontic arch wires and other components, which would be the scope for future studies.

Authors Contribution: All authors have equal contribution in bringing out this research work.

Conflict Of Interest: None.

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