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ORIGINAL ARTICLE

In vitro study of white spot lesion: Maxilla and mandibular teeth

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KEYWORDS

Esthetics;
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Abstract *Aim:* The aim of the study was to evaluate the effect of resin infiltration on colour changes and surface roughness of artificial white spot lesions (WSLs) on maxillary and mandibular premolar.

Materials and methods: Sixty (60) extracted sound Maxilla (Mx) and Mandibular (Mn) premolars were randomly divided into 2 groups (test and control). Artificial WSLs were produced on buccal surface of teeth and were immersed in artificial saliva for 8 weeks. Colour components (L^*, a^*, b^*) and surface roughness (Sa^*) were assessed on 40 teeth using colour difference meter RD-100 and Alicona® Infinite Focus profilometer respectively. The measurements were done at baseline (T1), directly after artificial WSLs (T2), after 24 hours immersed in saliva and application of resin (T3) and immersion in artificial saliva for 1 (T4), 2 (T5), 4 (T6), 6 (T7) and 8 (T8) weeks. SEM images analysis were carried out on 20 teeth in four time points.

Results: The values of L^* (lightness), b^* (yellow/blue) and Sa^* (surface roughness) are gradually reduced to the baseline value. Whereas, the value of a^* gradually increased with distinct treatment time to achieve the baseline value. The higher value of L^* and Sa^*, the whiter the lesion suggesting higher degree of enamel demineralization and surface roughness. Lower L^* values suggest a masking colour effect.

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Conclusion: The material produced favorable esthetics on colour and the surface roughness of teeth at distinct treatment times. It is recommended to be used to improve WSL post orthodontic treatment.

1. Introduction

Demineralization of enamel resulted in a visible change in the appearance of tooth enamel. It starts to lose its gloss and shine and take an opaque and chalky-white appearance which is known as white spot lesions (WSLs; Thylstrup and Fejerskov, 1978). The demineralization surface characteristics of the enamel usually contribute to pigment precipitation, such as roughness and porosity causing enamel discolouration that can lead to unsatisfactory aesthetic (Heymann and Grauer, 2013; Murphy et al., 2007; Hattab et al., 1999). Furthermore, surface roughness plays an important role in plaque retention (Taher et al., 2012) and also bacterial adherence (Hattab et al., 1999; An and Friedman, 1998; Chapman et al., 2010). Overtime, colonization of acidogenic bacteria resulted in an active caries lesions (Chapman et al., 2010; Chang et al., 1997).

Orthodontic patients developed significantly more WSLs than non-orthodontic patients (Ogaard, 1989; Hadler-Olsen et al., 2012). The highest incidence of WSLs was recorded on the gingival areas of maxillary lateral incisor, canine, premolars and first molar, as well as mandibular premolars and first molars (Khalaf, 2014). WSLs often occured during fixed appliance treatment partly due to irregular surfaces of attachments such as brackets, bands and wires which created a stagnant areas for plaque accumulation. These attachments made conventional plaque removal more difficult, especially at areas adjacent to the brackets. In addition, plaque clearance by saliva and cheeks were also reduced (Mattousch et al., 2007). These WSLs has always been a concern to the orthodontist, patients, and parents (Ballard et al., 2013; Maxfield et al., 2012). Some WSLs might remineralize and improve to a visually acceptable appearance. However, some WSLs may persist and resulted in an unacceptable esthetic appearance where restorative treatment might be required.

Several ways of remineralization have been suggested such as using saliva, mouth rinses, and toothpastes containing increased fluoride concentrations. Casein phosphopeptide amorphous calcium phosphate, and calcium sodium phosphosilicate glass have also been suggested to increase remineralization (Ballard et al., 2013). Nevertheless, WSLs that are left untreated after removal of a fixed orthodontic appliance can reduce in size naturally without intervention (Benson et al., 2005; Willmot, 2008). However, the lesions appear to be very resistant to complete remineralization that they often persist and remain visible both clinically and radiographically which still triggers esthetic concerns (Ogaard, 1989).

Due to the reversible nature of WSLs, less invasive options are more preferred (Paris et al., 2013). The caries infiltration technique was introduced to fill the intercrystalline spaces with a low-viscosity resin, to arrest lesions (Paris et al., 2007a) without drilling (Taher et al., 2012; Chapman et al., 2010; Mueller et al., 2006). Caries infiltration is an approach between preventive and restorative actions in the treatment of non-cavitated carious lesions (Ogaard et al., 1998). Resin infiltration creates a diffusion barrier within the enamel lesion and reinforced the weakened demineralized enamel structure with the resin matrix, preventing cavity formation (Paris et al., 2013, 2007b; Kielbassa et al., 2009). Moreover, resin infiltration method produces a positive effect in masking the colour of teeth. This resulted in the lesions losing their whitish appearance hence looking similar to sound enamel (Paris et al., 2013, 2007b; Kielbassa et al., 2009; Yetkiner et al., 2014; Torres et al., 2011). The masking effect of enamel caries is cause by infiltrating the lesions using resins with a similar refractive index (RI of infiltrant: 1.52) to sound enamel. Thus, light scattering is reduced and visual colour differences to enamel decreased (Paris et al., 2013).

Differences in incidence of WSL between the arch and teeth have been reported. Studies showed that incidence of WSLs is higher in maxillary teeth and symmetrical between right and left quadrant (Lovrov et al., 2007; Julien et al., 2013). However, there is lack of literature which shows the differences of resin infiltration response between maxillary and mandibular teeth. Therefore, this study sought to test the hypothesis that under *in vitro* demineralizing (WSLs) characteristics, there will be difference between maxillary and mandibular teeth in comparison with controls in respond to the infiltration resins. The study aims to measure the colour component and surface roughness of maxillary and mandibular premolar teeth in distinct saliva immersion of time. The effect of the infiltrant resin on artificial WSLs was also compared between maxilla and mandibular teeth with control.

2. Materials and methods

2.1. Protocol Approval, study design, and samples

This study was approved by the UKM, Research Ethics Committee [Code DD/2013/002(2)]. Sixty (N = 60) extracted premolars; sound mandibular (n = 30) and maxillary (n = 30) premolars with no restoration, decalcification or obvious caries were collected from general practitioners and orthodontics clinics. The teeth were thoroughly cleaned with ultrasonic scaler and slurry pumice to remove all soft-tissue remnants, calculus and plaque and stored in normal saline.

The maxilla and mandibular teeth were randomly separated into two groups. Fifteen teeth of maxilla and mandible, each allocated into test and control group; maxilla test (MxT = 15), maxilla control (MxC = 15), mandibular test (MnT = 15) and mandibular control (MnC = 15). Each tooth was assigned with an identification number. All samples were demineralized with phosphoric etching acid material (Ormco, CA) as described by (Ogaard et al.,1998), to produce a WSL on the buccal surface. Prior the study, the WSL production method was verified by exposing 3 premolars to the