Resin Infiltration Versus Fluoride Varnish for Esthetic Improvement of Post- Orthodontic White Spot Lesions

A Randomized Controlled Trial

A thesis
Submitted to the Faculty of Dentistry,
Ain Shams University
In partial fulfillment of the requirements for master's degree in Orthodontics.

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2019

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Dedication

To my mother and father for all your sacrifices,
unconditional love and support you gave us.

To my brother and sisters nothing would be possible
without you

To my Aunt's Elham soul
I hope that I made you proud

&

To Azhar, Bassma, Jaffer and Tarteel
for your continuous support

Acknowledgments

I would like to express my sincere gratitude to my respectful supervisor; **Prof. Dr. Islam Tarek Abbas**, Head of Orthodontic Department Faculty of Dentistry, Ain Shams University, for his continuous support, encouragement, valuable guidance, patience, and the great effort throughout the course of this study.

I am deeply grateful of my supervisor; **Dr. Noha Hussein Abbas,** Associate Professor of Orthodontics Faculty of Dentistry, Ain Shams University, for her unwavering support, guidance, valuable comments, extreme care about the work efficiency and constructive criticism. Her research experience was undoubtedly helpful to complete this work. I have been lucky to get the opportunity to work under her supervision.

I would like to express my profound gratitude and appreciation to German Academic Exchange Service DAAD for its continuous and generous support during my scholarship.

Last, I would like to thank the Faculty of Dentistry Ain Shams University, who honored me with the privilege to learn the art and science of orthodontics from them, the faculty members, staff, and residents of the Department of Orthodontics, Ain Shams University for their continuous support.

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List of Abbreviation

Abbreviation	Full Term
WSLs	**White spot lesions**
ICDAS II	**International Caries Detection and Assessment System II**
CCD	**Charged Couple device**
UV	**UltraViolet**
FOTI	**Fiber Optic Transillumination**
DIFOTI	**Digital Fiber Optic Transillumination**
LIF	**Laser-induced fluorescence**
QLF	**Quantitative Light-induced Fluorescence**
LED	**Light Emitting Diodes**
CaF2	**Calcium Fluoride**
CPP-ACP	**Casein phosphopeptide–amorphous calcium phosphate**
EDX	**Energy Dispersive X-ray Spectroscopy**
SEM	**Scanning Electron Microscopy**
CIE	**Commission International de l'Eclariage (CIE) L*a*b***
ΔE	**Color change**
ΔF	**Fluorescence change**
TEGDMA	**Triethylene Glycol Dimethacrylate**

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INTRODUCTION

Despite the fact that fixed orthodontic appliance treatment has become a complementary part of modern orthodontics, it has also been associated with certain adverse effects. Among these effects white spot lesions (WSLs) are notable, as they have a negative impact on the esthetic outcome of orthodontic treatment and might progress into carious lesions.[1] This side effect is due to the facts that [1] oral hygiene is more difficult in patients with multi-bracket orthodontics than without fixed treatment, and [2] orthodontic patients develop significantly more white spot lesions than non orthodontically treated persons.[2]

White spot lesion formation has been described as an extremely rapid process of a few weeks' duration,[3] with a sharp increase in white spot lesion numbers within the first 6 months. Moreover, inattentive surplus orthodontic etching has been shown to has significant triggering or deteriorating effects on white spot lesion formation.

Much effort has been directed toward prevention of white spot lesions; yet, despite best efforts, they still occur. The reported incidence rates of white spot lesions are 2% to 96% of tooth surfaces.[4] It has been reported that the greatest prevalence of white spot lesions is on the cervical and middle thirds of the crowns of the first molars, lateral incisors, and canines. Large variations in the rates of demineralization and remineralization might be due to large variations in enamel composition including local concentration gradients of specific mineral ions, as well as endogenous organic

material and organic acids. The fact that many white spot lesions occur in the anterior part of the mouth carries with it the issue of unpleasant esthetics. This demineralized enamel causes a diffuse backscattering of light that is seen as a dull white chalky area.

Interventions for the treatment of WSLs after appliance removal proceed mainly in two directions. First, remineralization of WSLs which occur naturally to a some degree after appliance removal and the shift to a more enamel-friendly ecosystem.[5] However, interventions such as topical fluoride, casein phosphopeptide amorphous calcium phosphate (CPP–ACP), or self-assembling peptides have also been used as adjuncts to the daily use of fluoride toothpaste to enhance remineralization and improve its efficacy. Second, the more invasive techniques like bleaching, the hydrochloric acid pumice microabrasion technique , or resin infiltration have been used in an attempt to improve the clinical appearance of WSLs. Infiltration of caries lesions with low-viscosity light curing resins is considered a treatment option for non-cavitated lesions not expected to arrest or remineralize. Caries infiltrants are optimized for rapid capillary penetration and exhibit very low viscosity and high surface tension.[6]

Will this new approach in treating WSLs be able to provide the patients with the esthetic results that they expect better than the conventional approaches ? From this point came the idea of our study to compare the effectiveness of resin infiltration to fluoride varnish in the esthetic improvement of white spot lesions associated with orthodontic treatment.

REVIEW OF LITERATURE

Topics to be discussed:

1. Etiology of demineralization

2. White Spot Lesions and caries process.

3. Prevalence of white spot lesions.

4. Methods of white spot lesions detection

- 4.1. Clilical Examination
- 4.2. The International Caries Detection and Assessment System (ICDAS II).
- 4.3. Dental Photography.
- 4.4. Fluorescent dye uptake.
- 4.5. Ultraviolet Light.
- 4.6. Fiber optic transillumination (FOTI and DIFOTI)
- 4.7. Laser Fluorescence.
- 4.8. Quantitative Light-Induced Fluorescence (QLF)

5. Prevention and management of white spot lesions

- 5.1. Fluoride.
- 5.2. Casein phosphopeptide–amorphous calcium phosphate CPP-ACP.
- 5.3. Microabrasion.
- 5.4. Infiltrant Resins.

1. Etiology of demineralization

White spot lesions develop as a result of a dietary carbohydrate and saliva modified bacterial infection, resulting in an imbalance between demineralization and remineralization of the enamel.[7] This is an interrupted process, with periods of remineralization and demineralization occurring, depending on the state of the oral environment in terms of the prolonged accumulation and retention of bacterial plaque on the enamel surface, the standard of individual oral hygiene and the inherent resistance of that person.[7,8]

A white spot lesion is the precursor of frank enamel caries. The white appearance of early enamel caries is due to an optical phenomenon which is caused by mineral loss in the surface or subsurface enamel. Enamel crystal dissolution begins with subsurface demineralization, creating pores between the enamel rods. The resultant alteration of the refractive index in the affected area is then a consequence of surface roughness, loss of surface shine and alterations in internal reflection. All this result in greater visual enamel opacity, as porous enamel scatters more light than sound enamel.[1,9] The demineralization process may encompass the full thickness of the enamel and some of the dentin before the relatively hypermineralized surface layer is actually lost.

Research has shown a reduction in the size of white spot lesions over time without the use of any products directed at their resolution. Resolution is thought to occur via two mechanisms: (1) the concentration of various soluble ions in saliva, particularly

calcium, phosphate, and fluoride, which promote remineralization of the lesions ; and (2) surface abrasion to remove the dissolved surface enamel of the lesion, exposing the underlying enamel crystals, which are tightly packed and thus provide proper light reflection.[10]

2. White Spot Lesions and caries process

Different factors contribute to the formation of dental caries. Mutans streptococci and lactobacilli, which colonize tooth structure and thrive in an acidic environment, are frequently associated with dental caries. These organisms metabolize fermentable carbohydrates to form glucans and lactic acid. Simultaneously, the bacteria and its by-products make up a sticky substance known as plaque. This process is cyclic, as the presence of plaque creates retention for subsequent colonization of different bacteria which form glucans and acid.[7] Unless plaque is adequately removed from the teeth, bacterial produced acid penetrates into the enamel and causes the hydroxyapatite crystals that compose the mineralized tooth structure to release calcium and phosphate ions.[11] As these ions diffuse out of the tooth, demineralization occurs. Remineralization, or the reverse process, can occur in the presence of calcium, phosphate, and fluoride ions [12] and a neutral pH. When demineralization and remineralization rates are in equilibrium, the enamel remains essentially unchanged. However, when the demineralization process outweighs the remineralization process, caries development continues.

Demineralization of the enamel occurs in two sequential stages.[3] The first is known as surface softening, where the mineral