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A Short Review about the Effects of Lasers on Enamel Surface

Soltanmohamadi Borujeni Elahe*

*Department of Orthodontics, School of Dentistry, Qom University of Medical Sciences, Qom, Iran.

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ABSTRACT

Enamel etching is a major step in preparing teeth for bonding of brackets. Due to the increasing use of lasers in different fields of dentistry, this mini-review is discussed effects of lasers on enamel structure.

Keywords: Laser, Enamel, Etching, SEM

Abbreviations: Er: YAG: Erbium-Doped Yttrium Aluminium Garnet Laser; Er, Cr: YSGG: Erbium, Chromium-Doped Yttrium, Scandium, Gallium and Garnet Laser; SEM: Scanning Electron Microscopy; SBS: Shear Bond Strength

INTRODUCTION

Direct bonding to enamel is one of the important parameters in orthodontics. Enamel etching is a major step in enhancing bond strength between tooth and bracket.

Currently, the use of 37% phosphoric acid is the standard protocol for enamel conditioning [1] but using lasers with different characteristics is also a new proposed way for etching enamel. Lasers such as Er: YAG seems to have minor side effects on enamel while this type of laser can etch enamel surface in an effective way. Regard shear bond strength, some articles have confirmed that Er: YAG laser can be an appropriate alternative for acid etching [2-7]; while the others have rejected this hypothesis [8-11]. By the way, enamel morphology is a less investigated part of studies about the effects of laser etching. Therefore, we conducted a study to find enamel morphological characteristics through scanning electron microscopy (SEM) after enamel conditioning using Er: YAG laser in first and second bonding procedure.

The results were somehow predictable; in both first and second bonding procedures, the enamel of acid etched samples showed regular honey comb etching pattern in most areas, while the other less popular patterns were observable in some parts. Laser etched enamels had amorphous irregular surface without any typical etching patterns.

In another study our team investigated the strength of enamel brace bonding using Er: YAG and found out that although the laser is effective and can potentially etch enamel but bond strength in laser etched samples is significantly lower than acid etched ones [12].

It can be concluded that bond strength has a relationship with enamel etching pattern; this relation seems to be partial but it's obvious that regular etching pattern can enhance shear bonding strength. From this point of view, conventional acid conditioning seems to be more effective than laser irradiation; but in some cases, this parameter is more than 40 MPa and can damage tooth structure during bracket debonding.

Therefore, laser irradiation seems to be a safer approach for enamel preparation. The paper was published in 2017; improving technology can enhance bond strength in laser-based teeth.

Not only the Er: YAG can affect enamel characteristics, but also another laser types may have the same or even better effect:

According to one study, despite fluoride varnish, lasers like CO2 and Er, Cr: YSGG are successful in increasing the enamel surface microhardness. Surface treatment with CO2 laser created cracks and fissures and Er, Cr: YSGG increases enamel resistance to demineralization [13]. Results of published literature about the effect of lasers on enamel structure are limited and controversial. As a study in 2014 showed no significant advantages in use of Er: YAG laser over phosphoric acid [14]. This controversy is the main reason to investigate strange world of Enamel.

Corresponding author: Soltanmohamadi Borujeni Elahe, Department of Orthodontics, School of Dentistry, Qom University of Medical Sciences, Qom, Iran, Tel: +989123058172; E-mail: Elahe.mohamadi25@gmail.com

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CONCLUSION

Although Er: YAG is a suitable laser for dental purposes, its effect on enamel is still unknown and controversial. Results of some studies indicated that using this laser as enamel etchant could make favorable SBS (mean bond strength is clinically acceptable although it is lower than SBS of acid etched enamel) but enamel structure seems to be irregular and no signs of honey comb view observed in most published papers; Thus, more studies are needed to find the relation between SEM analysis of laser etched enamel and decreased SBS of laser etched samples.

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