

Remineralization of Initial Enamel Caries Lesion with Self-Assembling Peptide P11-4: A Case Report

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Abstract: *Self-assembling peptide (SAP) 11-4 is a biomimetic material for treatment of white spot lesions. After the application of the peptide on the lesion it diffuses into the lesion's body which is followed by a process of self-assembly and production of three-dimensional matrix for enamel remineralization. The present case report demonstrates the ability of SAP 11-4 to induce remineralization of non-cavitated enamel lesion, evaluated by means of quantitative light-induced fluorescence (QLF) camera, ICDAS and Nyvad criteria.*

Keywords: self-assembling peptide P11-4, biomimetic remineralization, enamel, white spot lesion, quantitative light-induced fluorescence

1. Introduction

Despite the recent progress in dentistry, dental caries remains one of the most common diseases in the world [9]. Initial non-cavitated enamel caries lesions, previously wide known as white spot lesions (WSL), are the earliest clinical sign of dental caries. They are one of the adverse effects during the orthodontic therapy with fixed appliances [14]. Various approaches have recently been advocated for treatment of these lesions such as fluoride-containing products, casein phosphopeptide-amorphous calcium phosphate (CPP-ACP), calcium sodium phosphosilicate glass [2], resin infiltration [13].

During the last several years there is a paradigm shift from the restorative to regenerative approach in dentistry [17]. Current knowledge of the natural enamel biomineralization provides an alternative biomimetic therapy that resembles the natural process of mineralization [3]. Self-assembling peptide (SAP) 11-4 is a relatively new biomimetic product for treatment of white spot lesions [10]. After the application of the peptide, the latter diffuses into the lesion's body, where it undergoes a process of self-assembly. A three-dimensional matrix that helps the remineralization of subsurface lesions is produced. SAP 11-4 has a high affinity to calcium ions which leads to the formation of enamel crystals around the enamel matrix [12].

The aim of the present case report is to demonstrate the ability of SAP 11-4 containing product to induce a remineralization of initial enamel caries lesion after orthodontic treatment. The results were obtained by means of quantitative light-induced fluorescence (QLF) camera prior the application of the peptide and 12 months later.

2. Case Report

This case report was included in controlled clinical trial approved by the Research Ethics Committee of Medical University-Sofia, Bulgaria, №76, 8717/18.12.2020.

Patient's presenting complaint

A twenty three years old female visited the dental office with the main complaint of an aesthetic problem after orthodontic therapy.

Medical history

The patient was in good general health and she was not taking any medication at the moment of the first appointment.

Dental history

During the last two years the patient was treated with fixed orthodontic appliances which were debonded a week before the first visit. The patient brushed her teeth twice daily with a manual toothbrush and reported of regular intake of sugar in her diet.

Examination

The patient signed a written informed consent prior the treatment. The following assessments were performed at the baseline: Simplified Oral Hygiene Index (OHI-S), Caries risk assessment, QLF (*QrayCam Pro, Inspektor Research Systems, Netherlands*), ICDAS II (International Caries Detection and Assessment System) code of the lesion and Nyvad Activity Criteria for the WSL.

The baseline examination showed inadequate oral hygiene and high caries risk. Therefore, a training for proper oral hygiene using the Bass method for toothbrushing and fluoride containing tooth paste (*Elmex, GP GABA GmbH, Hamburg, Germany, 1400 ppm F*). Instructions for a low-cariogenic diet were also delivered during this appointment.

In the course of the visual-tactile examination on the labial surface of tooth 22 a non-cavitated carious enamel lesion was detected. It was with chalky white colour and rough surface on probing. The lesion got score 2 of the ICDAS II and code 1 from Nyvad criteria.

The precise diagnosis of the caries lesion was established by Qray Cam Pro (Inspektor Systems, Netherlands). After air drying of the tooth surface for 5 seconds several images were done under standard conditions and further analyzed using a QrayCam Pro full clinical software. The parameters that we obtained were:

ΔF – Percentage fluorescence loss with respect to the fluorescence of sound tooth structure, related to lesion depth.

ΔQ – Percentage fluorescence loss with respect to the fluorescence of sound structure times the area, related to lesion volume.

$A \Delta F$ – Area with ΔF equal or smaller than a specific threshold value of ΔF (default – 5%) [18].

The white spot analysis of the evaluated lesion showed the following results: $\Delta F = -9.5\%$, $\Delta Q = -681\%px$, $A \Delta F = 72px$ (fig.1).

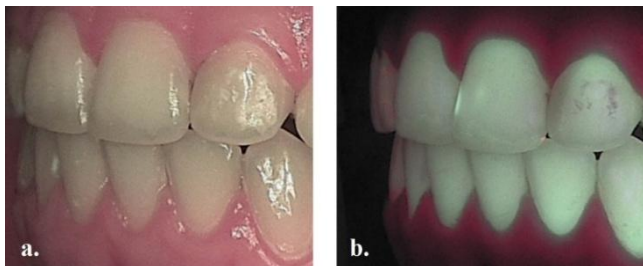


Figure 1: QLF images with a. white light; b. blue light, taken prior the application of the remineralizing agent.

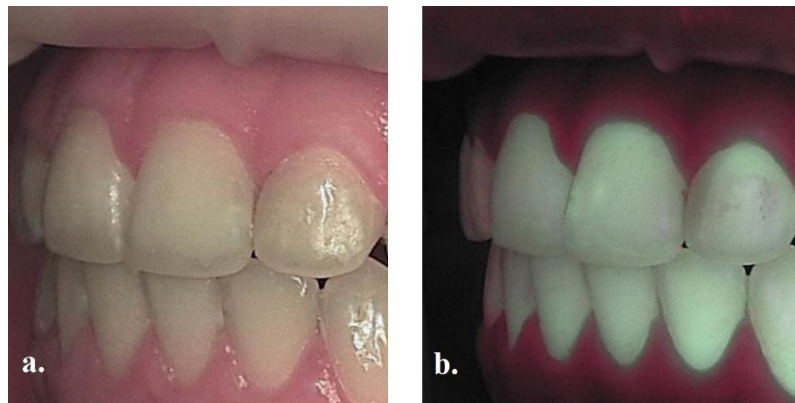


Figure 2: QLF images with a. white light; b. blue light, taken 12 months after the remineralization therapy

3. Discussion

The newly formed carious lesions after the orthodontic treatment predominantly develop on the buccal surfaces of the anterior teeth [7, 14]. Since these defects are in the visible area of the dental arch they can lead to poor aesthetics. This was the chief complaint of the patient in this case report, as well.

A relatively new, promising alternative for remineralization of initial non-cavitated enamel caries lesions is the self-assembling peptide P11-4. In the recent years, several

clinical studies confirmed the effectiveness of P11-4 and its pre-eminence over other remineralizing agents [1, 5, 16]. After the examination teeth were polished with a paste (Proxyl, Ivoclar Vivadent, Liechtenstein) and isolated by means of Optragate (Ivoclar Vivadent, Liechtenstein) and cotton rolls and then carefully air-dried. The lesion on tooth 22 was treated with self-assembling peptide P11-4 (Curdont Repair, Credentis, Switzerland) according to the manufacturer's instructions. Prior the application of the material, the lesion was wiped with 2% sodium hypochlorite (Chloraxid, Cerkamed, Poland) for pellicle removal and then etched for 20 s with 36% phosphoric acid etching gel (Blue etch, Cerkamed, Poland). The applicator containing SAP 11-4 was activated and the monomeric peptide was applied on the lesion and left for 5 minutes so that it can be absorbed. The patient was instructed not to eat or drink for one hour after the procedure.

After the treatment, the patient visited the dental office for follow-up appointments and remotivation for an adequate oral hygiene.

One year follow up

One year after the conclusion of the case, the lesion was found to be still with code 2 of ICDAS II but inactive according to Nyvad criteria (code 4). The analysis of the new QLF images showed increase values of the ΔF (-8.4%) and ΔQ (-568 %px) parameters and a decrease in the $A \Delta F$ (65px) values. This is an indication for the lesion's depth, volume and size reduction (fig.2.).

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In 2020 Bröseler et al. conducted a prospective, randomized, split-mouth clinical trial and reported that the efficiency of SAP11-4 in the treatment of non-cavitated enamel carious lesions is superior to fluoride varnish application. The size of the tested lesions was significantly reduced and stabilization of control lesions mean size was found at the end of the study compared to the baseline data [4].

Fluoride-based products are of a paramount importance for the prevention and management of non-cavitated enamel

caries lesions [7, 11]. Therefore, Alkilzy et al. evaluated the clinical advantage of P11-4 combined with fluoride varnish for treatment of early occlusal enamel caries in 70 children in comparison with fluoride varnish alone. The authors concluded that the usage of SAP11-4 and fluoride varnish together is an adequate method for enamel remineralization [1]. This statement was confirmed in another clinical study by Doberdoli et al. who found that the combination of the aforementioned products, presents a superior therapy for early occlusal caries [6].

Regardless of the stated advantages of this therapy, the remineralization process in the current clinical case was initiated by the sole use of SAP 11-4.

The minimally invasive approach in dentistry is based on the development of devices for early caries detection such as the QLF camera. The early detection of non-cavitated enamel lesions is highly significant for the correct diagnosis and treatment plan [11]. QLF can provide an objective and reliable information for the lesion progression, as well [18]. In this clinical case we found a decrease in the depth, volume and size of the evaluated lesion, using the analysis of the QLF images.

4. Conclusion

The presented case report confirms the scientific data obtained in other studies that P11-4 can improve the mineralization of initial enamel lesions in clinical conditions. Despite the encouraging results further long-term, controlled clinical trials are needed.

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