*Journal of Applied Dental and Medical Sciences*
*NLM ID: 101671413 ISSN:2454-2288*
*Volume 2 Issue 4 October-December 2016*

**Original Research**

# Diagnodent A Diagnostic Aid for the Detection of White Spot Lesions in Orthodontic Patients- A Longitudinal Study

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A R T I C L E I N F O

Keywords:
White spot lesion, DIAGNOdent, flourescence

A B S T R A C T

Orthodontic treatment with fixed appliances increases the caries risk in young persons. The aim of this study was to apply diagnostic method, a DIAGNOdent, for longitudinal in vivo quantification of changes in incipient enamel lesions related to fixed orthodontic appliances.

**Material and methods.** The comparison of diagnodent readings before and after orthodontic treatment was asssesed .Total (n=46; M=18 , F=28) subjects whose pretreatment evaluation were done for white spot enamel lesions (WSLs) and all subjects were recorded after treatment with a total number of teeth (n=1026) examined, who completed their comprehensive orthodontic treatment.

**Results:** The mean DIAGNOdent score was increased from pre-treatment value of 3.46±3.34 to 3.63±3.62 at the end of orthodontic treatment, but statistically non- significant (P=0.282).The individual teeth were also compared which showed statistically significant difference (P <0.001) among all the teeth except maxillary canines and mandibular second premolars.

**Conclusion.** The efficiency of the DIAGNOdent method to monitor small changes in incipient enamel lesions is reliable and reproducible. The method could be very useful, therefore, for investigations of the effect of preventive and therapeutic measures in various cariogenic risk groups, such as orthodontic patients.

## INTRODUCTION

Diagnodent (KaVo, Biberach, Germany) is a laser fluorescence device for caries detection and quantification on both occlusal and smooth surfaces.[1] The main unit generates laser light with a wavelength of 655 nm, which is absorbed by both organic and inorganic material in the tooth and re-emitted as fluorescence within the infrared region. In the presence of caries the fluorescence increases and the change is registered as an increased digital number. The mechanism underlying the enhanced fluorescence in the presence of caries has yet to be established but is presumed to result from the integration of bacterial metabolites rather than crystalline disintegration. Iwami et al.[2] (2003) found that Diagnodent offered a potential use for proximal surface caries as one of the screening tests in the clinical situation, especially proximal surface caries that have spread to dentin.

Material and methods.The present longitudinal study done in the Unit of Orthodontics, Oral Health Sciences Centre, Postgraduate Institute of Medical Education and Research, Chandigarh during the period 2010-2011. Thus in the present study, the comparison of Diagnodent readings before and after orthodontic treatment was asssesed .Total (n=46; M=18 , F=28) subjects were included in the study whose pretreatment evaluation were done for white spot enamel lesions (WSLs). Among them, all subjects were recorded after treatment

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(M=18, F=28) with a total number of teeth (n=1026) examined, who completed their comprehensive orthodontic treatment. The patients were instructed to do routine tooth brushing along with inter-dental tooth brushing twice a day. The study included the patients with full complement of teeth except those extracted for orthodontic purpose and 3rd molars and patients in the age range of 12 to 35 years. Patients having cleft lip and palate or any orofacial syndrome, patients with hypoplastic enamel defects, and patients having history of multiple restorations on facial surfaces were excluded from the study.

After completion of orthodontic treatment, severity of white spot lesion was evaluated by the diagnodent method. The Diagnodent operates at a wavelength of 655nm. The laser light at this wavelength gets absorbed by both organic and inorganic material in the tooth and reemitted as fluorescence within the region. In presence of caries, elevated scale readings displayed on the Diagnodent.[1] The Diagnodent was first calibrated for each patient with a sound enamel site (labial surface of central incisor or buccal surface of first molar if central incisors were missing, carious or restored or if both central and molars were missed then any tooth which showed minimum readings was calibrated as standard baseline). The Diagnodent recordings were done on the buccal surface of teeth. Measurements with the Diagnodent were performed with a conical tip B and the teeth were scanned carefully, with the tip held in contact with the tooth surface and tilted around the measuring site so that fluorescence was collected from all directions. An assistant resident was called upon to note the readings while examiner made the measurements. In each tooth the measurements were done thrice and the mean was considered for statistical analysis.

**Discussion**

In previous studies of white spot lesions have suggested that remineralization may occur in such lesions. However, because of the lack of means to quantify the changes in the mineral contents of these lesions, it has not been possible to document to which extent, in which pattern, and for how long a remineralization process continues. In the present study diagnodent score for white spot lesions that had formed around fixed appliances during orthodontic treatment were followed longitudinally. The mean Diagnodent score before orthodontic treatment was 3.46±3.34 and at the end of orthodontic treatment was 3.63±3.62 which was statistically non-significant (P = 0.282). which suggests that a process of remineralization had taken place. However the Diagnodent score of central incisors, lateral incisors, canines, premolars and molars of maxillary and mandibular arches before orthodontic treatment were compared with the corresponding teeth of maxillary and mandibular arches after orthodontic treatment and the value was found highly significant ($P<0.001$) shown in table 2. except maxillary canines and mandibular second premolars. Aljehani et al.[3] (2006) found that the mean Diagnodent value for all the teeth within the patients was 5.4 ± 3.5 at the first evaluation and had decreased to 3.9 ± 2.3 at the final evaluation. The mean Diagnodent values for all teeth decreased at the final evaluation, reflecting regression of the white spot lesions suggesting remineralization of enamel over a period of time. Benham et al.[4] (2009) found six lesions on the teeth with sealants and 22 lesions on the teeth without sealants. The teeth without sealants had 3.8 times the number of white spot lesions than were noted on the sealed teeth. The Diagnodent measured statistically significant differences between sealed and unsealed teeth in the maxilla and in the mandible. Ástvaldsdottir et al.[5] (2010) found that change in fluorescence measured with DIAGNOdent has a bacterial origin rather than occurring as a result of demineralization. The measurements are presumably dependent on bacterial metabolites rather than bacteria themselves.Therefore in this study the diagnodent score of individual teeth before and after orthodontic treatment showed significant differences because of demineralization caused by accumulation of plaque around the braces during the orthodontic treatment. Thus, the laser device could be a valuable tool for the longitudinal monitoring of caries and for assessing the outcome of preventive interventions.

**Result**

The mean DIAGNOdent score was calculated by combining total DIAGNOdent score per patient and dividing the resultant by number of total patients. The mean DIAGNOdent score was increased from pre-treatment value of 3.46±3.34 to 3.63±3.62 at the end of orthodontic treatment, but statistically non- significant (P=0.282) as shown in Table 1. and Figure-1.

**Table 1:** Mean Diagnodent score among the subjects at the beginning and end of orthodontic treatment.

| Diagnodent score | Number | Mean | Std. Deviation | Significance P-value |
|---|---|---|---|---|
| Diagnodent score before orthodontic treatment | 1026 | 3.46 | 3.34 | 0.282 |
| Diagnodent score after orthodontic treatment | 1026 | 3.63 | 3.62 | |

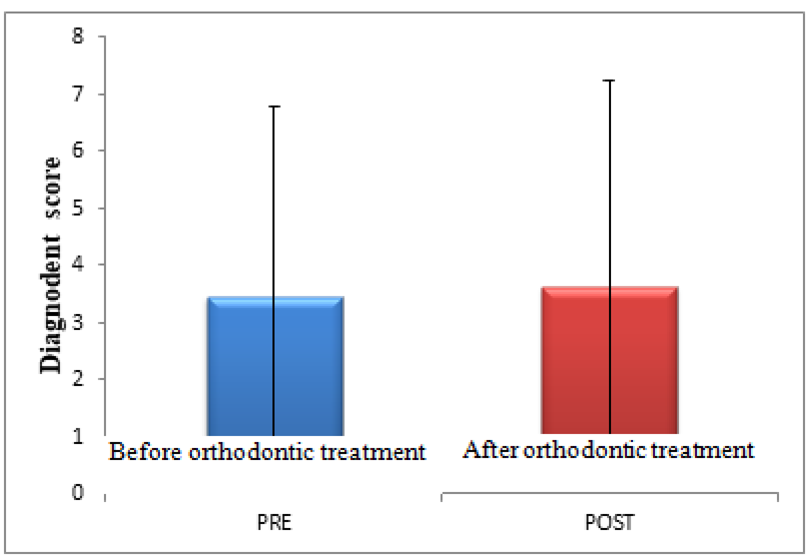


**Fig 1:** Diagnodent score before and after orthodontic treatment.

The Diagnodent score was calculated before and after the orthodontic treatment also from first molar to first molar in both the maxillary and Mandibular arches as tabulated in Table-2. All the examined teeth before the orthodontic treatment were compared with corresponding teeth after the orthodontic treatment. The values showed statistically significant difference (P <0.001) among all the teeth on comparison except maxillary canines and mandibular second premolars.

**Table 2:** Descriptive statistics for Diagnodent Score before and after orthodontic treatment

| Arch | Tooth type | | No of teeth | Mean ± S.D | P –value |
|---|---|---|---|---|---|
| Maxillary Arch | Central Incisor | Before | 92 | 5.40±5.57 | <0.001 |
| | | After | 92 | 3.00±1.30 | |
| | Lateral Incisor | Before | 91 | 4.58±2.95 | <0.001 |
| | | After | 91 | 3.47±2.30 | |
| | Canines | Before | 92 | 3.51±1.91 | 0.722 |
| | | After | 92 | 3.43±1.46 | |
| | First Premolars | Before | 50 | 2.84±1.01 | 0.002 |
| | | After | 50 | 3.52±1.23 | |
| | Second Premolars | Before | 90 | 3.62±6.48 | <0.001 |
| | | After | 90 | 3.78±2.42 | |
| | Molars | Before | 92 | 2.97±0.70 | <0.001 |
| | | After | 92 | 3.61±1.66 | |
| Mandibular Arch | C.I | Before | 91 | 2.75±2.19 | 0.013 |
| | | After | 91 | 3.02±1.16 | |
| | L.I | Before | 92 | 3.03±3.54 | 0.003 |
| | | After | 92 | 3.05±0.85 | |
| | Canines | Before | 92 | 2.72±1.02 | 0.008 |
| | | After | 92 | 3.09±0.93 | |
| | First Premolars | Before | 64 | 2.48±0.61 | <0.001 |
| | | After | 64 | 3.30±0.90 | |
| | Second Premolars | Before | 88 | 3.39±1.97 | 0.561 |
| | | After | 88 | 3.35±1.50 | |
| | Molars | Before | 92 | 3.65±3.20 | <0.001 |
| | | After | 92 | 6.73±10.59 | |

## Conclusion

The results from this study demonstrate the efficiency of the DIAGNOdent method to monitor longitudinally small changes in incipient enamel lesions. Thus, the laser device could be a valuable tool for the longitudinal monitoring of caries and for assessing the outcome of preventive interventions.The method could be very useful, therefore, for investigations of the effect of preventive and therapeutic measures in various cariogenic risk groups, such as orthodontic patients. Long-term follow-up studies and investigations would be necessary to further evaluate the development of these lesions quantitatively and aesthetically.

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