Early Enamel Caries Formation beneath Loose Orthodontic Bands - A Scanning Electron Microscopic Study

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Abstract:  
A clinical trial was conducted to investigate carious lesion development associated with ill fitted orthodontic bands. Specially designed orthodontic bands for plaque accumulation were attached to premolars scheduled to be extracted as a part of orthodontic treatment.  
Visible white spot lesions were seen within 4 weeks in the absence of any fluoride supplementation. SEM (Scanning Electron Microscopic) examinations showed surface demineralization. The superficial nature of the caries lesions observed and the rapidity of their formation is significant in the clinical management of decalcified areas forming beneath ill fitting orthodontic bands, caused by a high and continuous cariogenic challenge in the plaque developed underneath these bands. Careful inspection of the appliance at every visit and preventive fluoride programs are therefore required.

Key words: Enamel, caries, orthodontic bands

INTRODUCTION:  
Despite the increased popularity of bonded appliances in orthodontics, the usage of bands on premolar and molar are quite common due to the fact that cemented bands are stronger than bonded brackets. Fixed orthodontic appliances interfere with effective removal of plaque from teeth, resulting in increased plaque and food retention. Orthodontic bands should be checked regularly, since fluoride released from the glass ionomer cement may inhibit lesion development incompletely under loose bands or in areas where the cement is missing. Early carious lesions in the enamel are observed clinically as a white opaque spot. The area is slightly softer than the surrounding sound enamel. White spots or incipient caries are chalky colored and detectable when the involved tooth is dry. Caries formation on facial tooth surfaces can compromise esthetics, which is considered as one of the main goals of orthodontic therapy. White spots on the labial surface of bonded and banded teeth have long been recognized as a problem. The risk of decalcification in orthodontic patients can be reduced...
by meticulous oral hygiene and the use of fluorides. The aim of the study was to determine nature of enamel damage at ultra structural level under loose orthodontic bands.

MATERIALS AND METHODS
Orthodontic bands were modified by having 2 vertical 0.5 mm soft stainless steel wires welded to inner aspect of band at mesial and distal borders of the buccal surfaces to create space for plaque retention. They were luted using zinc polycarboxylate luting cement on 20 premolar teeth scheduled for extraction for orthodontic purposes in 8 patients. These teeth were previously screened for early enamel lesions. Bands were removed after 4 weeks and visual assessment of teeth was made to identify early enamel lesions. The premolar teeth were extracted and maintained in 100% humidity with moistened cotton roll at 4 °C. They were coated with conductive layer of gold and buccal surface was examined in JEOL 35C SEM. The surface was scanned and representative areas were photographed at X1000 magnification, X1300 magnification, X15000 magnifications.

RESULTS
1. Visual assessment on band removal- Out of 20 premolar teeth, eight premolars showed definite white spot lesions, six premolars showed faint enamel opacities and six premolars showed no discernable lesions.

2. Scanning electron microscope analysis:
   The buccal enamel of those premolars with definite white spot lesions, showed well circumscribed area of alteration in structure of enamel surface corresponding to the site of plaque retention zone. There was accentuation of perikymata and deep focal micropits.
   At X1000 magnification, Examination in Areas of Unaffected Enamel, the perikymata showed regular undulating pattern. (Photograph 1)
   In Areas of Definite White Spot Lesions, Perikymata were flattened so that a distinct shelf like border which was irregular in outline and had deep focal micropits was present.
   At X1300 magnification, Diameter of focal micropits at surface varied between 10-20μm. (Photograph 2)
   At X15000 magnification, Focal micropits were funnel shaped being wider at surface than deeper in enamel. Walls of micropits were not smooth, but irregular. (Photograph

DISCUSSION
Various clinical experimental techniques have shown two initial stages of enamel demineralization - Surface softening and subsurface lesion. The results of this study are in concordance with another study by Melrose et al using similarly modified bands. Their clinical trial examination of definite white spot lesions by scanning electron microscopy revealed characteristic patterns of initial tissue destruction. Focal holes and an accentuation of perikymata were observed affecting the enamel surface zone, an area previously considered to remain relatively intact during the development of a caries lesion. Initial caries process starts along the perikymata lines by exposing the prism endings and then progressing along the interprismatic area. The conventional view of structure of an incipient carious lesion is of a subsurface demineralized zone covered by intact surface. There is however an evidence that the type of caries lesions that form under orthodontic bands differ from naturally occurring incipient caries lesions. Ogaard et al found that white spot lesions produced in vivo beneath orthodontic bands did not show the characteristic surface zone and consisted of direct shallow erosions of the enamel surface. The term ‘surface softened defects’ has been used to describe these lesions. It is suggested that microenvironment of plaque retained on the enamel surface under an orthodontic band differs from the situation in which natural incipient carious lesion forms, in that in former case the enamel is relatively remote from remineralizing effects of saliva. The cariogenic attack beneath an orthodontic band is more or less continuous. In incipient naturally occurring caries lesion there are alternative periods of demineralization and remineralization which favour formation of caries lesion with intact surface layer overlying subsurface demineralization.

The ultrastructural changes in the surface enamel by SEM also suggest that direct caries attack beneath orthodontic bands is manifested by direct destruction of the enamel surface. The deep focal micropits are similar to those described as focal holes in natural caries lesions. It is thought that deep focal micropits observed in this study are result of caries process for the following reasons as the deep micropits were concentrated within area of white spot lesion and deep focal micropits had characteristic funnel shape being wider at enamel surface than at base.

Clinical significance
Observations from this study that white spot lesions forming beneath orthodontic bands are direct surface erosions with no intact surface zone may be of
significance in clinical management of these lesions in the following ways:
1. Initial conservative approach should be followed for decalcified lesions on band removal as prognosis for regression of the lesion by remineralization and surface abrasion is favourable.
2. Removal of luting cement on band removal should be carried out with care as altered enamel surface is liable to damage by scaling instruments.
3. Acid abrasion technique maybe more successful in treating surface softened lesions than subsurface lesions.

CONCLUSION
1. Early carious lesions can form under loose bands in 4 weeks so it is advisable to check integrity of luting cement at each visit.
2. First sign of enamel damage at ultra structural level are formation of focal holes and accentuation of perikymata pattern.
3. Early lesions are surface demineralization

REFERENCES