Research Article
Cemento-Dental Junction in Health and Disease: A Light Microscopic Study
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Abstract
Background: The ultimate goal of periodontal therapy is periodontal regeneration. For regeneration to be reasonably predictable, it is necessary that the tooth roots have cementum left on them after instrumentation as cementum is a better substrate for regeneration. But, instrumentation results in dentin exposure due to complete removal of cementum. The reason for this to happen could either be over-zealous root planing or presence of a weakened junctional tissue - the cemento-dental junction that forms a biological and structural link between the cementum and dentin. Aims and Objectives: The objective of this study was to observe the cemento-dental junction in health and disease under a light microscope, report the differences and discuss the probable clinical implications of this junction affected with periodontitis. Materials and Methods: 10 Healthy and 20 periodontitis affected teeth were collected, sectioned into two halves, demineralized in 10% formic acid, and frozen sections obtained for observation under a light microscope. Results: Pathologic granules were present in periodontitis affected teeth [roots exposed to the oral cavity due to periodontitis] and absent in all healthy samples except in one sample. The unexposed apical thirds of root surfaces of periodontitis affected samples to a large extent showed absence of granules except in few, where few isolated granules were present.

Keywords: Tooth Abnormalities; Dental Cementum; Tooth Root; Cementodental Junction; Pathologic Granules; Periodontal Regeneration; Scaling.


Received on: 14/08/2011 Accepted on: 19/10/2011

Introduction
The cemento-dental junction (CDJ) cements the cementum to dentin and forms a biological and structural link between cementum and dentin. This layer was mistaken to be the intermediate cementum and the hyaline layer of Hopewell and Smith in the past.1,2 But now it is clear that this is a distinct tissue on its own right.3 Certain important proteins crucial to periodontal regeneration, like bone morphogenetic protein-2 and osteogenin* are also reported to be present in this tissue. Prolonged exposure of cementum to a microbial environment during periodontitis causes structural and compositional changes to cementum and the CDJ.5-7

Many studies have attempted to discuss the structure and composition of this layer. But documentation regarding the changes that occur in periodontitis at the CDJ and particularly the clinical implications of a diseased CDJ is still unclear. The aims & objectives of this study therefore was to study the structural changes that occur at CDJ in periodontitis affected teeth and to report the differences observed in health and disease as seen under a light microscope. The probable clinical implications of periodontitis affected CDJ have also been discussed.

Materials and Methods
Ten healthy and 20 periodontitis teeth were collected and processed for observing under a light microscope. Inclusion criteria for healthy samples comprised of teeth that were extracted for orthodontic reasons [premolars], prior to commencement of orthodontic treatment and also included impacted molars and canines. Inclusion criteria for periodontitis samples comprised of teeth that had hopeless prognosis and extracted from patients with either chronic (or) aggressive periodontitis [graded as severe in terms of disease severity]. It was also ensured that patients did not have history of prior dental treatment (or) any kind of periodontal therapy. The collected samples were preserved in 10% formalin and sectioned into 2 halves. One half was processed for light microscopy and the other half processed for scanning electron microscopy. The light microscopic observations alone have been discussed in this study.

The samples were demineralized in 10% formic acid for a period of 1 month. Extent of
demineralization was checked radiographically. After adequate
demineralization was confirmed, frozen sections of samples were made. The
temperature of cryostat was set at -20°C and
10-12µm sections were obtained. One best
section from each sample was taken up for
observation, evaluation and interpretation.8

Results
Frozen sections of 10 healthy and 20
periodontitis samples were viewed under
light microscope. In the healthy samples,
dentin showed presence of dentinal tubules
as numerous pin point openings; cementum
thickness appeared notably constant in most
of the samples where periodontal ligament
fibers could be appreciated; 'Pathologic
granules' were absent in all healthy samples
(Fig 1a) except in one sample, where few
isolated granules were present in the
coronal thirds of root surface.

The dentin in periodontitis samples
appeared similar to healthy samples, but the
thickness of cementum was not constant.
Areas of thinning denoted areas of
resorption of cementum on the root surface.
All periodontitis samples showed presence
of pathologic granules in exposed root
surface (Fig 1b). In few samples even in
unexposed apical thirds, few granules were
spotted which were circular to ovoid in
shape. The granules were always present
either as aggregates of granules (Fig 2a);
isolated single granules spaced throughout
cementum (Fig 2b); or as long chain-like
clusters (Fig 2c). The pathologic granules
were always present in exposed root
surfaces and absent in the unexposed apical
thirds. In the outermost layers of cementum,
in almost all the samples, few isolated
granules were present. But the highest
concentration of granules was always
observed near the CDJ. There was no
variation in granule patterns observed
between chronic and aggressive
periodontitis samples.

Figure 1: Healthy sample showing total absence of granules at high power view (a) and presence
of both exposed (E) and unexposed (UE) areas (b). Arrows show presence of granules only in
exposed areas. Granules were absent in unexposed areas (X200).

Figure 2: Arrows show presence of granules in clusters (a), Arrows show presence of numerous
isolated pathologic granules (b) and Arrows show presence of granules in long chain like clusters
(c) *- Artifact
Discussion
In periodontitis, the destruction caused by bacteria and its products can be traced right from the surface of cementum through CDJ and at times, beyond the CDJ till dentin. The effects of damage on cemental surface may be seen as areas of hypo or hypermineralisation and areas of resorption due to alterations in organic and inorganic components. The bacterial toxin traverses cementum, reaches CDJ and causes destruction of the unmineralised collagen which is present in abundance at CDJ. Collagen at the cemento-dentinal junction is particularly susceptible to denaturation because this interface is rich in unmineralised collagen. The area of destruction where collagen is lost appears as vacuoles under the microscope and is known as “pathologic granules.”

The results of our study are in agreement with those of Armitage et al. in that, the maximum concentration of pathologic granules was found at CDJ. In healthy samples the granules were usually absent. Based on the results of our study, we propose that the destruction of fibres at CDJ could cause weakening of the cemento-dentinal junction in periodontitis affected teeth, and that a weakened junctional tissue may not withstand mechanical periodontal therapeutic procedures like root planing resulting in complete removal of cementum, thus exposing dentin.

Cementum removal deprives us of important cementum attachment proteins such as osteopontin, fibrolectin and vitronectin that are crucial to periodontal regeneration and the feasibility of regeneration is more predictable on cementum compared to dentin. Root planing aims to remove altered cementum and provide a healthier cemental surface more suitable for regeneration. In periodontitis affected teeth where the cemento-dentinal junction could either be rendered weak or detached due to disease, root planing is likely to result in complete cemental removal exposing dentin which is not suited for periodontal regeneration. Studies on root planing suggest the optimal pressure required for root planning and the number of strokes adequate to remove altered cementum.

But the pressure generated during root planing is subjective and varies from one person to the other and we do not have pressure indicating armamentarium for root planing. How can optimal root planing be ensured? The shear strength of the cemento-dentinal junction that can withstand the impact of root planing needs to be ascertained. These queries may have to be addressed in order to prevent unnecessary removal of healthy cementum and to safeguard cemento-dentinal junction as they are crucial to periodontal regeneration. We therefore want to emphasize the need to revisit and re-evaluate the impact of clinical procedures like root planing on periodontitis affected root surfaces that probably have weakened cemento-dentinal junctions.

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Acknowledgement
We would like to thank all the staff members of Department of Oral Pathology and Microbiology for their support.

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Source of Support: Nil, Conflict of Interest: None Declared.