COMPARATIVE SCANNING ELECTRON MICROSCOPY OF ROOT SURFACES IN JUVENILE AND ADULT PERIODONTITIS: A REPORT OF TWO CASES

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تتطلب المعالجة الفعالة لأمراض المفصل الفكي الصدغي تشخيصًا سليمًا للحالة المرضية ، وهذا بدوره يحتاج إلى معرفة دقيقة بالتشريح الطبيعي والمرضي للمفصل وبميكانيكية حركته . اضف إلى هذا أهمية وجود الوسائل الفعالة للتشخيص والكشف على أقسام المفصل العظمية والعضلية والغضروفية ، وعلاقة هذه الأجزاء بعضها ببعض .

الوسـائل التشخيصية العديدة المستخدمة في فحص المفصل الفكي الصدغي تتضمن التصوير الطبقي البانورامي والتصوير عبر القحف والتصوير الطبقي الاعتيادي وتصوير المفصل باستخدام المواد الظليلة والتصوير بالحاسوب الآلي وكذلك التصوير بالرنين المغناطيسي . إلا أنه وبمقارنة إمكانيات ونقاط الضعف لكل من وسائل التشخيص المذكورة وجد أن التصوير الرنين المغناطيسي هو أفضل وسائل التشخيص لأمراض المفصل الفكي الصدغي ، حيث يظهر القرص الغضروفي ونقاط اتصاله ببقية اجزاء المفصل ، وكذلك لقمة الفك والاجزاء العظمية الأخرى المكونة للمفصل بصورة واضحة ، وهكذا تضاف وسيلة تشخيص جديدة وفعالة تساعد في عملية التشخيص التفريقي لآفات المفصل الفكي الصدغي .

The purpose of the present investigation was to compare the detailed topography of root surfaces adjacent to periodontal pockets in one case of juvenile and one case of adult periodon-titis. Clinical examination including periodontal charting was performed and complete medical history obtained in each case. Teeth that were extracted according to the treatment plan were prepared for scanning electron microscopy to examine and compare the root surfaces of the two cases.

The observations of the adult periodontitis (AP) specimens showed frequent coverage of the affected root surfaces by calculus and different types of plaque bacteria. In the juvenile periodontitis (JP) specimens, bacterial plaque and calculus were found on the cervical third of root surfaces. The middle part of the affected root surfaces appeared cracked with defects in cementum. Farther apically, the cracks increased in number and magnitude and appeared as furrows with some areas devoid of cementum.

In JP the severe cracking and focal loss of cementum may indicate a potential impairment of periodontal fiber attachment.

Introduction

Root surfaces adjacent to pathologic periodontal pockets are liable to undergo histological changes and modifications of cementum characteristics.[1] Toxic substances from the inflammatory process and from the subgingival microflora may be adsorbed to the outer part of such root surfaces.[2] These substances, including endotoxins from gram-negative bacteria, are toxic to connective tissue and cause periodontal disease.[3,4]

Saglie et al[5] used SEM to investigate tooth surfaces abutting on pathologic periodontal pockets. The subgingival plaque appeared granular at low magnifications but at higher ones, the surface layer was totally covered by coccal microorganisms and sometimes fusiform morphotypes.

The aim of this study was to examine and compare the topography of root surfaces of periodontal pockets in two cases, one diagnosed as juvenile and one as adult periodontitis.

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Case 1: Localized juvenile Periodontitis **(JP)**

A 23-year-old female patient attended the clinic of periodontics, Faculty of Dentistry, Alexandria University, complaining of looseness in the lower central incisors with dull pain. Upper first molars, lower right first molar and second premolar had been extracted during the last five years. Endodontic treatment was performed one year ago in the upper central incisors.

Periodontal destruction manifested by the presence of true pockets, loss of stippling, edema and bleeding on probing was observed. Deep pockets ranging from 7-9 mm were found around the lower central incisors. These teeth were considered as hopeless, and were extracted according to the treatment plan for this patient.

Periapical and bite wing radiographs [Fig. 1] showed generalized bone resorption, which was extensive around the lower and upper incisors. The lower left first permanent molar showed marked bone loss and obvious radiolucency in the furcation area.

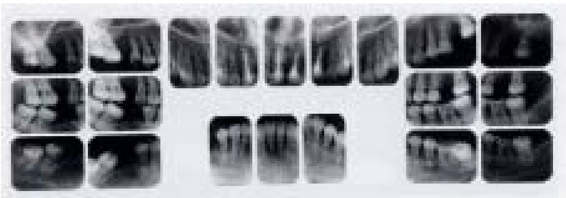

Figure 1. Full mouth periapical and bite wing radiographsof the juvenile periodontitis case.

In a patient of this age, these clinical features, including the bilateral loss of teeth in the first molar region, and the severe periodontal destruction around the upper and lower incisors, together with the radiographic evidence of severe periodontal disease at these sites, confirm the criteria of Baer[6] for a diagnosis of localized juvenile periodontitis.

Case 2: Adult Periodontitis **(AP)**

A 42-year-old female patient diagnosed as having advanced adult periodontitis was also included in the study for comparative purposes. The past dental history indicated a chronic and slowly progressing disease process. The patient had lower central incisors with poor prognosis as presented by 8 mm pocket depths, marked mobility and radiographic evidence of advanced bone loss. The two teeth were extracted according to the treatment plan.

Both patients showed negative past medical history. Their consents were obtained after explaining the procedure and the need for extraction.

Preparation of teeth for examination by scanning electron microscope (SEM):

The extracted teeth were rinsed in cold saline solution to remove blood and debris and immediately fixed in 4% glutaraldehyde in phosphate buffer, pH 7.4 for 24 hours. The teeth were then passed through a series of ascending grades of ethanol (20% to 100%) for dehydration and were dried again using a critical point drying apparatus in liquid carbon dioxide. The specimens were mounted on copper stubs using colloidal graphite solution, and coated with carbon and gold. Specimens were examined by a Cambridge Stereoscan S4-10 microscope operated at 10kV, using a specimen tilt angle of 20° - 45°.

Scanning electron microscope observations:

Root surfaces adjacent to periodontal pockets can be easily identified because of the distinguishable boundary between the remnants of junctional epithelium and the affected part of root surface.

Case 1

Juvenile periodontitis specimens showed a thin layer of plaque at the junction of the crown and root. The subjacent area, comprising the cervical third of the root surface abutting on the periodontal pocket was covered by a layer of calculus [Fig. 2].

Figure 2. Scanning electron micrograph of cervical area of a tooth affected by JP showing a thin layer of plaque (P) adjacent to a layer of calculus *(Ca),* (CR) crown. (Magnification x 160)

The plaque bacteria showed a mixture of filamentous and coccoid microorganisms [Fig. 3].

In the middle third of root surfaces adjacent to periodontal pockets, occasional defects in the form of triangular depressions [Fig. 4] were observed in cementum. These depressions were often filled with debris and plaque bacteria.

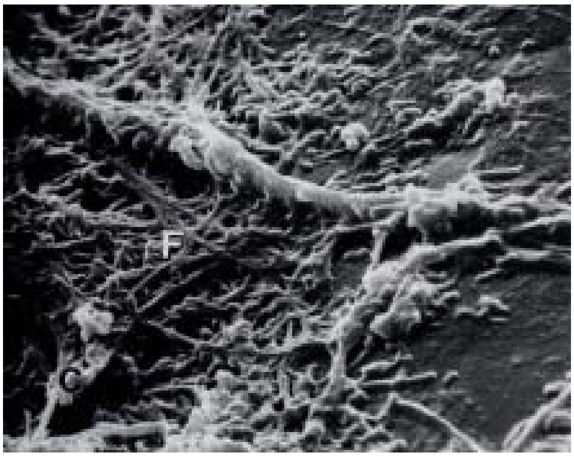

Figure 3. Higher magnification of delineated area in Fig. 4 showing bacteria) plaque composed of several microorganisms including abundant filamentous forms (F), and few cocci (C). (Magnification X 1570)

Figure 4. Scanning electron micrograph of root surface of a JP specimen showing the apical margin of calculus (Ca) in the cer-vical area and part of the root surface in the middle area of the pocket where cementum shows several cracks (asterisks) and a depressed area (arrows) which is not related to the prominenl cracks. (Magnification X 450)

In the apical third of root surfaces contiguous to periodontal pockets, the cementum appeared highly cracked and some areas were even devoid of cementum showing the underlying dentin [Fig. 5].

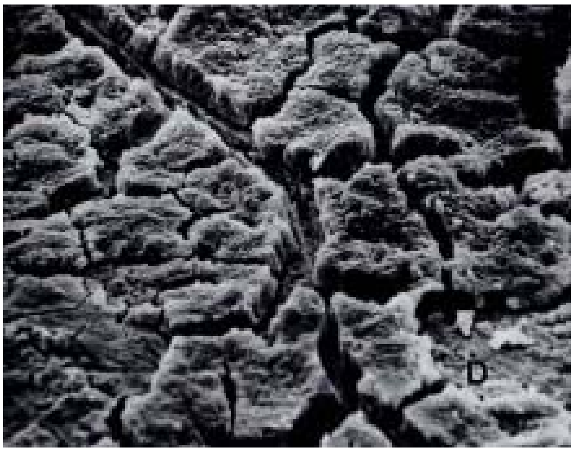

Figure 5. Scanning electron micrograph of the most apical part of the root surface in the pocket area of a tooth affected by JP showing highly cracked cemental surface displaying deep furrows with an area devoid of cementum where the underlying dentin (D) can be seen. (Magnification X 410)

Case 2

In the AP specimens, the root surface was frequently covered by a calculus layer. Some areas of exposed cementum surface uncovered by calculus exhibited numerous cracks [Fig. 6]. Thick mats of plaque, consisting of a mixed microbial population of coccoid and filamentous morphotypes, were found on the calculus surfaces. The characteristic corn-cob formations, reflecting filamentous organisms covered by a layer of cocci, were also observed [Fig. 7].

Figure 6. Scanning electron micrograph of the root surface affected by AP where remnants of the iunctional epithelium (JE) are attached and the adjacent denuded cemental surface (C) appears cracked. Note the boundary (arrowheads) between the crown (CR) and the root surface covered by calculus (arrows). (Magnification X 40)

Figure 7. Scanning electron micrograph of bacterial plaque on calculus surface in the pocket area of a tooth affected by AP, showing corn-cob formations of cocci-covered filamentous organisms. (Magnification X 2500)

Discussion

In the present study, the root surfaces of both JP and AP cases that manifested periodontal destruction and cemental changes, extended from the cemento-enamel junction to the remnants of junctional epithelium. These remnants indicated the apical boundary ofthe periodontal pockets.

Calculus layer was found to be distributed on the root surfaces of the AP specimens. In JP roots the presence of calculus was only restricted to the cervical third of the cemental pocket walls, however. These findings confirm previous observations by Baer[6] and Lindhe[7]. Both reported that JP is characterized by deep periodontal pockets with an absence of gross accumulations.

The corn-cob formations that were observed in this study on the calculus surface in the AP specimens are similar to those described in several studies of tooth surfaces including those abutting on periodontal pockets.[8,9] These formations consisted of filamentous microorganisms covered by coccoid morphotype. Firskopp and Hammarstrom10 claimed that the filamentous forms may facilitate precipitation of minerals from saliva by slowing down its flow at the surface ofthe tooth. They also stated that the filamentous microorganisms may have some properties that promote precipitation of calcium salts.

The different forms of microorganisms that were observed on the tooth and calculus surfaces in the cervical area of JP specimens are consistent with the results reported by Allen and Brady.[11] They used SEM to examine root surfaces of a tooth affected by JP and reported that it was covered with scattered clumps of microorganisms of various shapes including filaments, cocci and rods, as were found in the present study.

The present observations showed cracks in the cementum on root surfaces of JP and AP specimens which confirm the previous findings by Eide *et al.*[12] They stated that numerous cracks visible on the denuded cementum surface are artifacts caused by the dehydration during specimen processing. They also claimed that these artifacts occur extensively in diseased cementum as compared to uninvolved cementum. We observed more cracking with respect to both density and depth on the affected parts of root surfaces in JP teeth than in that of the AP roots. It is conceivable that in JP the cementum structure was abnormally weak leading to aggravation of the processing effects especially during dehydration ofthe specimens by the critical point drying apparatus. It should be noted that both JP and AP teeth were similarly processed. However, exposed cementum areas in the AP specimen showed shallow cracks while JP roots displayed severe and extensive cracks in the cementum which argue against dismissing these effects as merely artifacts. This altered cementum in the JP roots could explain the defective periodontal attachment and the extreme rapidity of alveolar bone destruction in the JP case.

Several forms of defects in the cementum of JP specimens were observed, such as triangular depressions and concavities, and even areas of complete absence of cementum. These confirm the earlier findings by Lindskog and Blomlof[13]. They used the SEM to examine cementum of teeth affected by J P and found that the entire roots of the diseased teeth showed extensive areas of cementum hypoplasia with exposed focal spots where the cementum was lost. It is significant that Gottlieb[14] in an early study using light microscopy to investigate the histology of periodontally diseased teeth, described several cemental resorptions "cementopathia". He considered resorption a cause leading to gingival recession and pocket formation. This concept has not been seriously considered until recently. Page and Baabl5 claimed that metabolic disorders, such as hypophosphatasia, during the time of root formation may lead to abnormalities in cementum. They also suggested that abnormalities or lack of cementum in children, teenagers and young adults would affect periodontal attachment and render the affected teeth highly susceptible to invasion by periodontal pathogens. This may account for the periodontal involvement of the permanent first molars and incisors characteristic of JP.

Conclusions

Calculus and plaque bacteria were confined to the cervical region in JP specimens, while the remaining parts of the root surfaces showed extensive destruction of the cementum without obvious plaque accumulation. This is consistent with the viewpoint that factors beside bacterial plaque play a role in periodontal tissue destruction in JP.

The cementum in JP was structurally weak as indicated by severe cracks, triangular depressions and focal absence of cementum, which impair fiber attachment. These defects and the related decreased periodontal attachment may be considered as an aggravating factors which may have a bearing on the significant bone destruction observed in JP.

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