

Effects of Components of Orthodontic Appliances on the Epithelial Cells of the Buccal Mucosa That are in Contact with the Appliances: A Cytomorphometric Analysis

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Abstract: Orthodontic appliances cause ulceration of the adjacent mucosa. Oral exfoliative cytology reveals the classical changes that may occur within the buccal mucosa that are in contact with the appliances. The aim of the present study is to evaluate the effects of stainless steel and ceramic orthodontic appliances on the epithelial cells of the buccal mucosa and to compare the morphometric and morphological alterations in the epithelial cells of the buccal mucosa adjacent to the metal and ceramic brackets at three time points. 29 individuals in need of orthodontic treatment are divided into two groups (Group A with metal brackets & Group B with ceramic brackets). At T1, an increase in the cytoplasmic area was found in buccal mucosal cells adjacent to both metal and ceramic brackets. At T2, this altered cytoplasmic morphometry persisted only in cells adjacent to the metal brackets, although to a lesser degree than at T1. At T1, a greater decrease in nuclear area was noted in cells adjacent to the metal brackets than in those next to the ceramic brackets. At T2, there was complete recovery of nuclear area to normal in buccal mucosal cells adjacent to ceramic brackets, in metal brackets the recovery was not complete. Exfoliative cytology can be an effective tool in diagnosis to detect and evaluate these alterations, assuming that its limitations are well elucidated and applied. The clinician should be knowledgeable about this technique because the cells are studied individually and cannot be evaluated with regard to tissue conformation, as in a biopsy.

I. Introduction

Orthodontic appliances cause continuous accumulation of plaque around the teeth. Along with this, ulceration of the adjacent mucosa due to continuous friction of the components of the appliances is a common finding¹. The presence of continuous irritational factors (Chronic irritation) is one of the etiological factors of cancer¹⁻⁴. It is always desirable to minimize the effects of irritation due to orthodontic appliances.

To avoid this phase, there should be continuous monitoring of patients undergoing orthodontic treatment during which, taking of oral smears is mandatory⁵. Oral exfoliative cytology reveals the classical changes that may occur within the buccal mucosa that are in contact with the appliances.

The aim of the present study is to evaluate the effects of stainless steel and ceramic orthodontic appliances on the epithelial cells of the buccal mucosa and to compare the morphometric and morphological alterations in the epithelial cells of the buccal mucosa adjacent to the metal and ceramic brackets at three time points. Secondary objectives of the study are to examine cells for alterations in the nuclear/cytoplasmic ratio at selected intervals of time and to examine cells for alterations in the cytologic criteria for malignancy.

II. Methodology

29 individuals in need of orthodontic treatment are divided into two groups. Group A included patients treated with metal brackets and its components. Group B included patients treated with ceramic brackets and its components. (Fig 1 & 2)

Smears were taken from buccal mucosa opposing the metal and ceramic brackets in the region of upper premolar and molar region. Epithelial cells were collected 1. Before the placement of Brackets {Baseline (T0)} 2. 60 days after placement of appliances (T1), 3. 30 days after removal of the appliances (T2). The smears were stained with PAP. The slides were examined under a binocular light microscope. Prior to reading, the identification number of the slides was covered to avoid bias. Fifty cells on each slide were selected randomly for examination. Areas with cells folded over or clumped were avoided because of the difficulty involved in determining cell boundaries. The image of the cytologic fields was captured at a magnification of 40X to measure nuclear and cytoplasmic areas. The morphometric analysis was done using the windows® based image analyser software (Image J 1.34s) developed by NIH, Bethesda USA (<http://rsb.info.nih.gov/ij/>) was used in the measurement of nuclear and cytoplasmic area. After its measurement the nuclear/cytoplasmic ratio was determined for each cell.

Orthodontic patients with permanent dentition in upper arch from permanent first molar on right side to the permanent first molar on left side and with clinically normal buccal mucosa at the region of premolars and 1st molar are included in the study. Patients with history of smoking, alcohol intake, systemic diseases, long term

alcohol based mouth wash use, under long term antibiotics or steroid therapy, tooth with sharp edges at the region of premolars and molars and any kind of existing lesions on the buccal mucosa are excluded from the study.

III. Results

A total of 3,300 epithelial cells were assessed among 15 patients. Group A (n=15) and Group B(n=14). The mean age of the patients was 18.3 ± 3.3 years. The mean frequency of micronucleated cells in the buccal mucosa of patients before appliance placement was 10.6 ± 5.7 per 1000 cells. Nine months after therapy, the MN frequency was measured as 9.2 ± 6.37 per 1000 cells. At T1, an increase in the cytoplasmic area was found in buccal mucosal cells adjacent to both metal and ceramic brackets. At T2, this altered cytoplasmic morphometry persisted only in cells adjacent to the metal brackets, although to a lesser degree than at T1 (Fig 3). At T1, a greater decrease in nuclear area was noted in cells adjacent to the metal brackets than in those next to the ceramic brackets. At T2, there was complete recovery of nuclear area to normal in buccal mucosal cells adjacent to ceramic brackets, in metal brackets the recovery was not complete (Fig 4).



Figure 1 & 2 : Metal and ceramic Braces

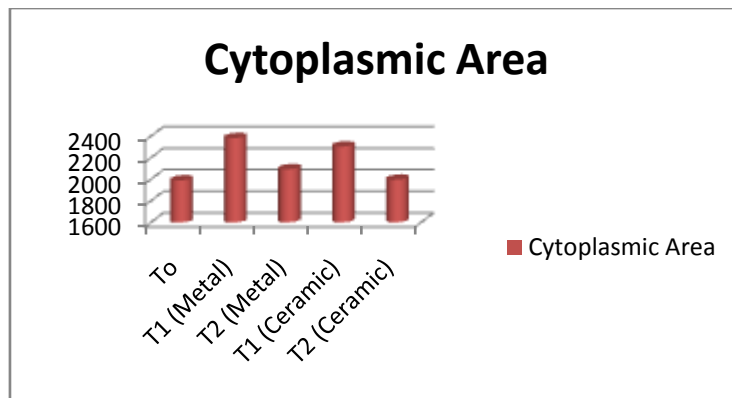


Fig 3 : Analysis of Cytoplasmic morphometry analysis in both groups.

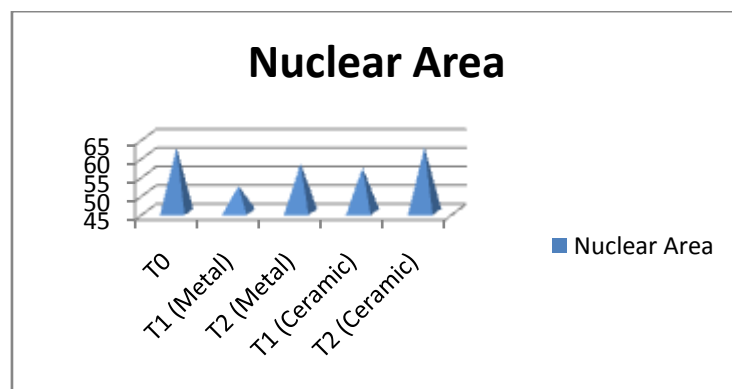


Fig 4 : Nuclear area analysis among both the groups.

The nuclear cytoplasmic ratio in buccal mucosal cells adjacent to ceramic brackets recovered completely to normal, but in buccal mucosal cells adjacent to metal brackets the recovery was not complete.

IV. Discussion

Ulcerations in the buccal mucosa are frequent complaints among orthodontic patients⁶. Studies indicate that approximately 76% to 95% of patients reported ulcerations in the buccal mucosa during treatment⁶⁻⁸. The epithelium of the buccal mucosa is exposed to aggravating agents, such as brackets that are capable of causing epithelial alterations at various stages of orthodontic treatment. Oral exfoliative cytology can be an effective tool in diagnosis of evaluating these alterations^{7,8}.

In the present study, the epithelial cells adjacent to the brackets caused diminution of the nuclear size, an increase in cytoplasmic area and a lower nuclear/cytoplasmic ratio. These results are in correlation with the findings of BR Pereira et al⁹(2009), who have reported that the cytoplasmic area increases and nuclear area decreases upon using brackets for orthodontic patients. These results also collaborate the findings of Shabana et al¹⁰ (1989), who also reported a statistically significant increase in the size of cells of traumatic keratosis lesions. However, in the buccal cells of individuals with malignant lesions or of smokers, alterations distinct from those in the present study were found. In individuals with a tobacco-chewing habit and in those with smoking and tobacco-chewing habits combined, an increase in nuclear diameter and a decrease in cell diameter were observed. Ogden et al¹¹ (1990) observed an increased nuclear area only in the buccal mucosa cells of smokers and did not note an alteration in the cytoplasmic area. Normal cells of the buccal mucosa have abundant cytoplasm and a single, small centralized nucleus; malignant cells have a broad, enlarged nucleus that occupies a large area of the cytoplasm, with well-stained chromatin and an irregular nuclear membrane. Therefore, the cellular changes that occurred in the buccal mucosa adjacent to the metal and ceramic brackets in the present study do not suggest malignancy. This diagnosis was confirmed by the evaluation of cytologic criteria for malignancy; smears of only Classes I and II of Papanicolaou were noted. Alterations in sizes of the nucleus and cytoplasm as demonstrated here suggest hyperkeratosis of the stratified squamous epithelium of the buccal mucosa adjacent to the brackets. Greater cell alterations on the side with the stainless steel bracket may have been caused by trauma to the buccal mucosa caused by the physical characteristics of brackets. In other words, because of the fact that the wings were less rounded than those of the ceramic brackets, or because of the cytotoxicity of stainless steel, which has been observed in other studies. In this study, buccal mucosa cells were evaluated only 30 days after removal of the brackets, because Jones et al¹²(1995) recommend that if a lesion persists for longer than 14 days after removal of the causative factors, a biopsy should be performed immediately. Therefore, within 30 days, cells should have returned to their initial size. In future studies, the buccal mucosa cells should be analyzed after longer periods to determine whether these alterations persist in the buccal mucosa. This is one of the rare studies that were undertaken to describe cellular changes in the buccal mucosa adjacent to metal and ceramic brackets. Brackets are essential components of fixed orthodontic appliances, biocompatibility is needed to prevent irreversible deleterious damage to tissues. Although results of this investigation suggest that brackets do not cause any malignant changes in the buccal mucosa, the origin of the observed changes remains uncertain. Future studies in this regard will explore ways to prevent these alterations.

V. Conclusion

Placement of metal and ceramic brackets in the buccal cavity induces cellular alterations. These alterations do not suggest malignancy. Exfoliative cytology can be an effective tool in diagnosis to detect and evaluate these alterations, assuming that its limitations are well elucidated and applied. The clinician should be knowledgeable about this technique because the cells are studied individually and cannot be evaluated with regard to tissue conformation, as in a biopsy.

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