



AN IN-VIVO COMPARISON OF THE EFFECTS OF METAL AND CERAMIC BRACKETS ON THE EPITHELIAL CELLS OF BUCCAL MUCOSA IN PATIENTS UNDERGOING FIXED ORTHODONTIC TREATMENT

Dental Science

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ABSTRACT

The aim of the study is to compare the epithelial cells of the buccal mucosa adjacent to metal and ceramic brackets at three time points: baseline, 30 days after placement and 30 days after the removal of brackets.

A sample of 40 (20 metal and 20 ceramic) individuals of Indian population of mean age 14 years who came for orthodontic treatment in K.D. Dental College and Hospital, Mathura were selected.

Placement of metal and ceramic brackets induces cellular alterations in the buccal mucosa. These alterations do not suggest malignancy.

Buccal mucosa cells adjacent to the metal brackets show greater changes than seen in those adjacent to the ceramic brackets and buccal mucosa cells adjacent to metal and ceramic brackets tend to return to the initial morphology after removal of the brackets with more tendency towards normalcy seen with ceramic brackets than with metal brackets.

Exfoliative cytology can be an effective tool in diagnosis to detect and evaluate the cellular alteration, assuming that its limitations are well interpreted and applied.

KEYWORDS

Metal And Ceramic Brackets, Epithelial Cells, Buccal Mucosa

INTRODUCTION

Orthodontic treatment carries a high risk of mucosal lesions, exacerbate periodontal disease, gingival inflammation and ulceration in the buccal mucosa. This is due to the continuous accumulation of plaque¹, alteration of normal microflora² and friction between the bracket and mucosa which causes discomfort to the patient.^{1,3,4}

The oral mucosa is a mucous membrane that covers all structures inside the oral cavity except the teeth. Its structure varies depending on its location in the oral cavity and the function of the corresponding area⁵. The integrity of mucosa membrane is fundamental for the maintenance of oral health⁶. However, epithelial cells may change due to oral diseases, infections, traumatic agents or metabolic conditions, resulting in several clinical alterations and neoplasms⁷. In general, the most common oral lesions are associated with trauma⁸⁻¹¹. Placement of orthodontic appliances in a healthy oral cavity can induce a continuous accumulation of dental plaque,¹² alter the normal oral microbiota,^{13,14} cause lesions in the buccal mucosa¹⁵, exacerbate periodontal disease, and consequently cause infection.¹⁶ It is known that ulceration in the buccal mucosa is one of the most frequent complaints of patients because of the friction between bracket and mucosa, which causes discomfort for the patient.¹⁷ Thus, when these ulcerations persist during treatment, the orthodontist refers the patient to another specialist, who performs additional tests such as taking a biopsy and doing exfoliative cytology, which can detect alterations in the buccal mucosa caused by this irritation. However, this technique has stirred renewed interest because of the possibility of its being complemented with other laboratory techniques such as molecular biology, cytomorphology, and immunohistochemistry.¹⁸ Another major advance in cytopathology was the development of liquid-based cytology, which provides a series of advantages in relation to the conventional type, featuring¹² better evidence of epithelial cells,¹³ slides with fewer inflammatory cells and red blood cells, less cell debris, and fewer undesirable artifacts,^{19,14} less cell overlapping, and¹⁵ more representative samples for reading.²⁰

The aim of the study is to compare the epithelial cells of the buccal mucosa adjacent to metal and ceramic brackets at three time points:

baseline, 30 days after placement and 30 days after the removal of brackets.

MATERIAL AND METHOD:

A sample of 40 (20 metal and 20 ceramic) individuals of Indian population of mean age 14 years who came for orthodontic treatment in K.D. Dental College and Hospital, Mathura were selected.

Location of placement of bracket:

The location chosen for bracket placement were first and second premolars, all on the upper arch.

Four premolar brackets were bonded in each individual with Transbond XT adhesive (3M unitek Orthodontic Product, Monrovia, Calif.)

Two PEA metal brackets were placed on the right side.
Two PEA ceramic brackets were placed on the left side.

Smear Observation:

All the cells were observed under Trinocular Research Microscope (Olympus), attached with Olympus SLR digital camera (331E).

CYTOMORPHOMETRIC ANALYSIS OF CELLS:

Cytomorphometric analysis of cells was done by standard method.

Statistical Analysis:

For statistical analysis data were entered into a Microsoft excel spreadsheet and then analyzed by SPSS (version 25.0; SPSS Inc., Chicago, IL, USA). One-way analysis of variance (one-way ANOVA) was a technique used to compare means of three or more samples for numerical data (using the F distribution). A p-value ≤ 0.05 was considered for statistically significant.

RESULT AND ANALYSIS

We found that, in T0, the mean nuclear area (mean $\pm$ s.d.) of patients was 60.7975 ± 11.9978 . In T1 ceramic, the mean nuclear area (mean $\pm$ s.d.) of patients was 57.7185 ± 7.9799 . In T1 metal, the mean nuclear

area (mean $\pm$ s.d.) of patients was 55.3335 $\pm$ 7.1093. In T2 ceramic, the mean nuclear area (mean $\pm$ s.d.) of patients was 60.7025 $\pm$ 9.1605. In T2 metal, the mean nuclear area (mean $\pm$ s.d.) of patients was 59.6585 $\pm$ 6.7459. Distribution of mean nuclear area vs. group was statistically significant (p=0.0439).

Our study showed that, in T0, the mean cytoplasmic area (mean $\pm$ s.d.) of patients was 2270.5325 $\pm$ 162.9815. In T1 ceramic, the mean cytoplasmic area (mean $\pm$ s.d.) of patients was 2500.2725 $\pm$ 197.9036. In T1 metal, the mean cytoplasmic area (mean $\pm$ s.d.) of patients was 2539.7590 $\pm$ 215.0493. In T2 ceramic, the mean cytoplasmic area (mean $\pm$ s.d.) of patients was 2273.7290 $\pm$ 195.6160. In T2 metal, the mean cytoplasmic area (mean $\pm$ s.d.) of patients was 2298.6100 $\pm$ 211.6774. Distribution of mean cytoplasmic area vs. group was statistically significant (p<0.0001).

It was found that, in T0, the mean nuclear area:cytoplasmic area (mean $\pm$ s.d.) of patients was .0270 $\pm$.0063. In T1 ceramic, the mean nuclear area:cytoplasmic area (mean $\pm$ s.d.) of patients was .0232 $\pm$.0037. In T1 metal, the mean nuclear area:cytoplasmic area (mean $\pm$ s.d.) of patients was .0219 $\pm$.0034. In T2 ceramic, the mean nuclear area:cytoplasmic area (mean $\pm$ s.d.) of patients was .0267 $\pm$.0036. In T2 metal, the mean nuclear area:cytoplasmic area (mean $\pm$ s.d.) of patients was .0262 $\pm$.0038. Distribution of mean nuclear area:cytoplasmic area vs. group was statistically significant (p=0.0004).

DISCUSSION:

In the present study, the epithelial cells adjacent to the brackets caused diminution of nuclear size, an increase in cytoplasm and low nuclear/cytoplasmic ratio of buccal mucosa cells. The results are in correlation with the findings of BR Pereira et al²¹ and Sridhar Reddy et al²² who have reported a statistical increase in cytoplasmic area and decrease in nuclear area on placement of brackets for orthodontic treatment. These results also corroborate the findings of Shabana et al²³ who also reported a statistically significant increase in the size of cells of traumatic keratosis lesion.

In the present study, the results showed that the cells adjacent to metal and ceramic brackets showed cellular alterations at T1. There was a significant decrease in nuclear area in both metal and ceramic at T1 than in T0, p=(0.0439). The results show that there was more decrease in nuclear area in the cells adjacent to the metal than in ceramic brackets at T1. The mean value in Table shows that there was a significant increase in cytoplasmic area in the cells adjacent to metal and ceramic brackets at T1 than at T0. The increase in cells adjacent to the metal brackets showed more increase in cytoplasmic area than to the cells adjacent to the ceramic brackets. (p<0.0001). The mean nuclear N/C ratio showed a significant decrease, p=0.0004, to the cells adjacent to metal and ceramic brackets with more decrease seen in cells adjacent to metal brackets than in ceramic brackets.

At T2, ie 30 days after removal of brackets, the buccal mucosa cells returned to their normal size seen at T0. The nuclear area, cytoplasmic area and N/C ratio returned to the initial size as seen at T0 with more tendency toward normalcy seen with cells adjacent to ceramic bracket than in metal brackets.

Table: Distribution of mean Nuclear Area, Cytoplasmic Area and Nuclear Area: Cytoplasmic Area in T0, T1 Ceramic, T1 Metal, T2 Ceramic and T2 Metal

		Number	Mean	SD	Minimum	Maximum	Median	p-value
Nuclear Area	T0	20	60.7975	11.9978	42.6700	80.2000	59.8700	0.0439
	T1 Ceramic	20	57.7185	7.9799	44.5600	73.0200	57.9600	
	T1 Metal	20	55.3335	7.1093	43.8900	70.5800	53.0000	
	T2 Ceramic	20	60.7025	9.1605	45.8700	77.7000	60.7900	
	T2 Metal	20	59.6585	6.7459	47.6300	69.4000	59.4500	
Cytoplasmic Area	T0	20	2270.5325	162.9815	1968.0000	2494.5000	2250.6500	<0.0001
	T1 Ceramic	20	2500.2725	197.9036	2145.5500	2800.0000	2492.5000	
	T1 Metal	20	2539.7590	215.0493	2055.0000	2800.0000	2562.4500	
	T2 Ceramic	20	2273.7290	195.6160	2030.2000	2674.7400	2255.0300	
	T2 Metal	20	2298.6100	211.6774	2022.2300	2978.9200	2260.0500	
Nuclear Area: Cytoplasmic Area	T0	20	.0270	.0063	0.0182	0.0390	0.0261	0.0004
	T1 Ceramic	20	.0232	.0037	0.0179	0.0304	0.0235	
	T1 Metal	20	.0219	.0034	0.0172	0.0297	0.0218	

Greater cell alterations on the side with stainless steel brackets may have been caused by trauma to the buccal mucosa caused by the physical and compositional characteristics of the brackets i.e because of the fact that the wings are more rounded in the ceramic than metal brackets, or because of the cytotoxicity of the stainless steel which have been observed in other studies.^{24,25,26,27,28}

In this study, buccal mucosa cells were evaluated only 30 days after removal of the brackets as within, cells should have returned to their initial size after removal of the causative factor. According to Jones et al²⁹, if a lesion persists for longer than 14 days after removal of the causative factor, a biopsy should be performed immediately.

Saloom HF et al³⁰ in 2013 found that appliance with high esthetic appearance, sapphire brackets and coated arch wire showed the least adherence of *S.mutans* and *Candida albicans* in comparison to other appliance with less esthetic and more metal components. Salehi P et al³¹, 2018, found that nitrogen doped titanium dioxide (N-doped TiO2) coated orthodontic brackets showed strong microbial property against *S.mutans* over a period of 90 days, which is effective in preventing enamel decalcification during orthodontic appliance therapy.

Metals may cause allergic reactions and are known as allergens. Orthodontic appliance contains nickel, cobalt, chromium, copper, zinc etc. Reaction to these metals is due to biodegradation of metals in the oral cavity. This may lead to the formation of corrosion products and their exposure to the patient. Nickel²² is the most common metal to cause hypersensitivity reaction. Chromium ranks second among the metals, known to trigger allergic reactions. The adverse biological reactions to these metals may induce hypersensitivity, dermatitis and asthma.^{22,32} Titanium is the most biocompatible material used in the production of fixed orthodontic appliance³². Beautiful smiles at the end of orthodontic treatment is a primary concern to each patient but is also equally concerned with appearance while undergoing treatment. Someone mentioned the various advantages and disadvantages in selecting ceramic brackets for orthodontic treatment. Apart from offering esthetics, ceramic brackets exhibit excellent biocompatibility, corrosion resistance, stability in the oral environment and non-toxic nature, have made them an integral part of the orthodontist's armamentarium.

Although results of the present study does not suggest any deleterious and irreparable or malignant changes in the buccal mucosa with metal and ceramic brackets. In metal and ceramic brackets, the origins of the observed changes remain uncertain.

CONCLUSION

Buccal mucosa cells adjacent to the metal brackets show greater changes than seen in those adjacent to the ceramic brackets and buccal mucosa cells adjacent to metal and ceramic brackets tend to return to the initial morphology after removal of the brackets with more tendency towards normalcy seen with ceramic brackets than with metal brackets.

Exfoliative cytology can be an effective tool in diagnosis to detect and evaluate the cellular alteration, assuming that its limitations are well interpreted and applied. The clinician should be aware about this technique because the cells are studied individually and cannot be evaluated with regard to tissue conformation as in a biopsy.

	T2 Ceramic	20	.0267	.0036	0.0214	0.0326	0.0262	
	T2 Metal	20	.0262	.0038	0.0195	0.0322	0.0266	

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