

The effect of fixed orthodontic appliance therapy on oral *Candida* carriage

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رافق ارتداء الأجهزة التقويمية المتحركة مع زيادة في نسبة ومعدل نمو المبيضات الفطرية الفموية في حين أن العلاقة بين الأجهزة التقويمية الثابتة ونمو المبيضات الفطرية لا تزال غير واضحة. الأهداف: هو تحري تأثير الأجهزة التقويمية الثابتة على نمو المبيضات الفطرية الفموية وحدوث الأنتان. المواد وطرق البحث: أُجريت الدراسة بإجراء الفحص السريري الفموي وجمع العينات للفحص الجرثومي من مجموعتين من الأشخاص المرتدين للأجهزة التقويمية الثابتة. استعملت طريقة الغسل الفموي المركز لعزل المبيضات الفطرية وتم تحديد عضويات المبيضات باستعمال اختبار الأنبوب الجرثومي ونظام الحماثر. API20C AUX ضمن المجموعة الأولى (الدراسة ١). تم جمع العينات مباشرة بعد تثبيت جهاز التقويم الثابت ومن ثم بعد فترة ٢-٣ أشهر. أما في المجموعة الثانية (الدراسة ٢) فجرى جمع العينات من المجموعة بعد ٤-٣٦ شهراً من ارتداء جهاز التقويم. نتائج الدراسة: في الدراسة ١ ارتفعت نسبة المبيضات الفطرية المحمولة من ١٢% إلى ٣٦% وإلى ٦٨,٧% في الدراسة الثانية مع زيادة جوهرية في معدل عزل المبيضات وشدتها. لم يلاحظ حدوث أي داء بالمبيضات الفطرية عند العناصر المشاركة أثناء فترة الدراسة. الاستنتاج: تزيد الأجهزة التقويمية الثابتة من حمل المبيضات الفطرية الفموية وشدتها بأسلوب يعتمد على الوقت.

candidal growth. The relationship between wearing fixed orthodontic appliance and oral *Candida* carriage is not clear. The objective of this study was to investigate the effect of fixed orthodontic appliance therapy on oral candidal carriage and infection. Oral clinical examination and microbiological sampling were carried on two groups of subjects wearing fixed orthodontic appliances. The concentrated oral rinse technique was used for oral candidal isolation and *Candida* species were identified using the germtube test and the yeast identification system API 20C AUX. In the first group, subjects were sampled immediately before inserting the fixed orthodontic appliance and 2-3 months later. In the second group, subjects were sampled after 4-36 months of wearing the appliance. Results showed that in group 1 oral candidal carriage increased from 12% to 36%. In group 2, oral candidal carriage was 68.7% with a significant increase in frequency and density of candidal isolation. None of the subjects developed oral candidosis during the study period. The study demonstrated that fixed orthodontic appliance increases oral candidal carriage and density in a duration-dependent manner.

Introduction

It has been repeatedly demonstrated that full denture wearers have higher prevalence and density of oral candidal colonization than dentate subjects.¹ Therefore, wearing of removable dentures was recognized as a local etiologic factor for development of oral candidosis.² A review of the English dental literature revealed that data concerning the effect of orthodontic appliance on oral candidal flora is sparse^{3,4} and conflicting. Arendorf and Addy⁴ reported that the prevalence of oral *Candida* significantly increased after removable orthodontic appliance therapy. On the other hand, Addy *et al.*³ reported lack of significant difference in the prevalence of oral *Candida* recovery between subjects who were using fixed orthodontic appliances and a comparable group of subjects who were not

wearing appliances. However, using the imprint culture technique⁵ for *Candida* sampling, both studies^{3,4} described increased density of candidal growth among subjects on orthodontic appliance therapy generally. While this technique is the most sensitive sampling method in case of clinical candidal infection, it was proved not to be ideal to sample asymptomatic *Candida* carriers.⁶

The aim of this study was to assess the effect of fixed orthodontic appliance therapy on oral candidal carriage and infection in otherwise healthy individuals.

Materials and Method

Patients attending the Orthodontic Clinic in the College of Dentistry, King Saud University, Riyadh, Saudi Arabia for either treatment planning or fixed appliance therapy were selected to participate in the study. None of the subjects had received

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antibiotic or steroid therapy or used an antiseptic mouthwash for at least 3 months before entering the study. Any subject known, through his/her medical record to have a medical history influencing oral carriage of *Candida*, such as diabetes mellitus or anemia, was not included in the study. Parental consent was taken for the investigation for all participating children, while adults were asked to sign a consent form approved by the local ethics committee.

The concentrated oral rinse technique⁷ was used for oral candidal isolation. Briefly, each subject was asked to rinse the mouth thoroughly with 10 ml of sterile phosphate-buffered saline (PBS; 0.1M, pH 7.2) for one minute. The rinse was centrifuged at 3500 rpm for 15 minutes and the deposits were reconstituted in 1 ml PBS. Subsequently, 0.1 ml of the deposit was inoculated on to Sabouraud's agar* and incubated aerobically at 37°C for 48 hours.

Candida albicans and other *Candida* species were identified by germ-tube formation⁸ and by the yeast identification system API 20C AUX.^{9**} The number of *Candida* colonies on the culture plate was counted and expressed in colony forming unit per milliliter of the rinse (CFU/ml).

Group 1 subjects were requested to undertake the rinse test twice; immediately before fixing the brackets and the fixed orthodontic appliance as a base line, and 2-3 months later at the subsequent visit.

Group 2 subjects, who had been wearing fixed orthodontic appliances for periods ranging between 4 and 36 months undertook their oral rinses at their review visit, but were not sampled before they started on the orthodontic therapy. All subjects received oral hygiene care only before fixation of the brackets but not during the orthodontic treatment. The subjects were asked by the orthodontist to brush their teeth after each meal. Due to the relatively small sample size in group 2 (32 subjects), the group was not divided into subgroups according to the duration of orthodontic treatment.

Data were analyzed with a computer-run statistical program (SPSS*** version 9.0). Pearson's Chi-square test was used to test the difference in the prevalence of oral candidal carriage between the groups, and Mann Whitney U test to compare quantitative candidal carriage between groups. *P* value <0.05 was considered to be significant.

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Results

Age, gender and duration of orthodontic appliance therapy in the study subjects are presented in Table 1. Oral clinical examination revealed that none of the subjects had signs or symptoms suggestive of oral candidosis, or marked gingival inflammation.

Table 1. Subjects of the study

	Group 1 <i>n</i> = 25	Group 2 <i>n</i> = 32
Gender		
Male	15 (60%)	14 (43.7%)
Female	10 (40%)	18 (56.2%)
Age (years)		
Mean	15.5 ± 4.1	18.8 ± 4.2
Range	10-18	12-24
Duration of appliance (month)		
Mean ±SD	2.6 ± 0.5	17.7 ± 5
Range	2 - 3	4-36

The results from group 1 (Table 2) showed that wearing of fixed orthodontic appliance for a period of 2-3 months resulted in a significant increase in the prevalence of the asymptomatic oral candidal carriage from 12% to 36% (*P*<0.05). Six subjects initially identified as non-carriers become carriers after wearing fixed orthodontic appliance. Although the mean density of candidal growth increased after the appliance therapy, the difference was statistically significant (*P*<0.0001). In group 2, oral candidal carriage was up to 68.7%. The mean density of candidal growth was significantly higher in the subjects who wore the appliances for 4 - 36 months compared with those who wore the appliances for 2 - 3 months (Table 2).

Table 2. Prevalence and density of oral *Candida* carriage among the study subjects

	Before appliance		After appliance	
	Candida carriage <i>n</i> (%)	Density of growth Mean CFU/ml (SD)	Candida carriage <i>n</i> (%)	Density of growth Mean CFU/ml (SD)
Group 1 (<i>n</i> = 25)	3 (12%)	20 (2)	9 (36.0%)	369 (95)
Group 2 (<i>n</i> = 32)	-	-	22(68.7%)	3516 (115)

Five different *Candida* species were isolated from the study subjects. *Candida albicans* was the most commonly isolated species followed by *Candida glabrata* (Table 3).

Table 3. Frequency of *Candida* species isolated from the subjects

Species	Group 1		Group 2
	Before appliance (n= 3)	After appliance (n = 9)	n = 22
<i>C. albicans</i>	2 (66.7%)	5	16
<i>C. glabrata</i>	1 (33.3%)	(55.6%)	(72.7%)
<i>C. tropicalis</i>	-	2 (22.2%)	2 (9.1%)
<i>C. krusei</i>	-	1 (11.1%)	2 (9.1%)
<i>C.</i>	-	1 (11.1%)	1 (4.5%)

Discussion

It is widely accepted that the more important source of *Candida* species in human disease is endogenous, therefore, clinical infection can arise in subjects who are carriers who become predisposed by illness, debility or local or generalized reduction in their resistance.¹⁰

Previous studies have shown that wearing of fixed orthodontic appliance could alter the composition of oral microbial flora. This was manifested in an increase in the *subgingival Actinobacillus actinomycetemcomitans* and *Prophyromonas gingivalis*,^{11,12} decrease in Gram positive cocci,¹¹ and increase, albeit not significant, oral *Candida* species.³ Using the concentrated oral rinse technique for oral *Candida* isolation,⁷ our study provided convincing evidence that the placement of an orthodontic appliance did affect the oral mycological flora and change the non-carrier into a carrier of *Candida* species. This observation is consistent with data from other reports.^{13,14} In contrast to the present results, one study³ using the imprint culture technique for sampling oral *Candida*, failed to detect a significant effect of fixed orthodontic appliance therapy on the prevalence of oral candidal carriage. Nevertheless, wearing of either fixed³ or removable orthodontic appliance⁴ resulted in an increased density of oral *Candida*. The concentrated oral rinse technique used in this study is simple to perform and has a number of advantages over the imprint culture technique. In the later technique, a number of areas may have to be sampled to represent the oral cavity, hence, some carriers may be overlooked. However, it must be stressed that this technique is useful in sampling areas of clinical infection and to estimate the candidal load on a specific site. The concentrated oral rinse technique is known for its higher sensitivity especially when used in

epidemiological studies to sample non-infected subjects.⁷

Wearing of removable complete or partial denture has been shown to increase oral *Candida* carriage and to predispose the wearers to oral candidosis.¹⁵ The increase in the prevalence of oral candidal carriage after the wearing of a removable orthodontic appliance, which includes an acrylic plate, may be explained partly by the high affinity of *Candida* species to plastic polymers.¹⁶ Other possible factors include the occlusive and protective effect of an appliance to the growth of *Candida* species, and the high level of plaque accumulation.

Why wearing a fixed orthodontic appliance therapy increased oral candidal carriage and density in a duration-dependent manner is not clear. An increased frequency of oral *Candida* carriage with low salivary pH levels has been noted previously.¹⁷ Therefore, patients with Sjogren's syndrome usually have low oral pH milieu and oral candidal colonization is an inevitable accompaniment of this disease.¹⁸ Wearing of removable orthodontic appliance has been shown to be associated with significant fall in pH value inside the mouth and increased oral candidal carriage and density.⁴ Similarly, it is possible that fixed orthodontic appliance, in a way not identified yet, can alter the oral pH and predisposes to increased candidal growth. However, this theory needs further investigation. One of the possible mechanisms by which low pH conditions may promote oral candidal colonization is the facilitated ability of yeast to adhere to epithelial cells,¹⁹ adding to this the aciduric and acidophilic nature of *Candida* species which thrive in a low pH milieu.¹⁰

Despite the voluminous literature on dental plaque microbiology, its relationship to *Candida* species is not precisely clear. It has been demonstrated that *Candida* preferentially colonize the plaque-coated surfaces in carriers,²⁰ and poor denture hygiene was associated with higher level of oral candidal colonization.¹ Interestingly, increased prevalence of oral candidal carriage among patients wearing fixed orthodontic appliance has been shown to be related to the increase in the quantity of the dental plaque.¹³ None of our subjects demonstrated remarkable plaque deposits or gingival disease at the time of the study. Nevertheless, it is tempting to investigate whether the initiation of the carrier state is transient, and whether the subjects will revert to their original status after completion of

the orthodontic therapy and removal of the appliance. More longitudinal studies are needed to clarify this point.

Conclusions

The present study demonstrated that fixed orthodontic appliance therapy might have an adverse effect on the quality and quantity of *Candida* species in the mouth in a duration-dependent manner. Whether this might lead to the development of oral candidosis, in otherwise healthy subjects, is not known.

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