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Research Article

Effects of Conventional and Self-Ligating Brackets on Plaque Accumulation and Periodontal Status

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Abstract

Objective: The aim of this study was to evaluate the effects of self-ligating brackets and conventional brackets on the accumulation of microbial dental plaque and periodontal health.

Materials and Methods: Forty patients requiring orthodontic treatment and aged 12 to 25 were included in the study. Gingival Index (GI), Bleeding on Probing (BOP), Orthodontic Plaque Index (OPI) and stained tooth surface (STS) scores were recorded from upper and lower canine to canine teeth.

Results: There was no statistical difference between the self-ligating bracket and conventional bracket for the 4 criteria compared.

Conclusion: Neither of the bracket types conferred a plaque accumulation and periodontal health advantage relative to the other.

Keywords: Conventional Bracket; Self-ligating Bracket; Periodontal Health; Dental Plaque

Introduction

One of the reasons for choosing the self-ligating bracket is its less complex and less retentive surface which allows better cleaning than the elastomeric or stainless steel bracket and improves oral hygiene [1].

Orthodontic brackets negatively impact both the composition and rate of accumulation of subgingival microbiota and this condition can lead to more gingival inflammation and bleeding on probing [2].

Numerous authors have reported the increased risk of caries and periodontal disease related to orthodontic fixed appliances which impede good oral hygiene practices and result in the accumulation of plaque [2,3]. Although some authors have reported that bracket design and surface properties affect microbial dental plaque accumulation, bacterial species and periodontal status [4-6], Pandis et al. reported that bracket type did not affect plaque accumulation and periodontal status [1].

To help clarify the situation, the aim of this study was to evaluate the effects of two different brackets on the accumulation of microbial dental plaque and the consequences for periodontal health.

Materials and Methods

Forty healthy patients aged between 12 and 25 years and ready to commence orthodontic treatment at the clinics of the Orthodontic Department of Ondokuz Mayis University Hospital in Samsun, Turkey were invited to participate in the study. There were 18 males and 22 females. The study design was approved by the Ethics Committee of Ondokuz Mayis University. All subjects were informed of all relevant aspects of the study and provided their written consent for participation; parents signed and approved the participation of underage patients (<18 years of age). The forty patients were randomly divided into two equal groups according to the type of bracket. Group 1 patients were bonded self-ligating brackets (Time 2, American Orthodontics, Sheboygan, Wisconsin, USA) and group 2 patients were bonded conventional brackets (Mini Master, American Orthodontics, Sheboygan, Wisconsin, USA).

Before bonding of the brackets, all patients were free of dental plaque and periodontally healthy and they received oral hygiene instructions regarding the correct use of both a tooth brush and interdental brush for fixed appliances three times a day. To improve plaque removal around orthodontic brackets, the patients were instructed to use 15 brush strokes on each tooth surface. Periodontal measurements were recorded for the set of canine to canine teeth in both jaws. The same trained examiner evaluated the periodontal status of all participants with a Williams periodontal probe and visual inspection. To test intra-examiner reliability for index reproducibility, the examiner performed duplicate examinations on five subjects which showed very good repeatability.

The clinical parameters assessed included Gingival Index (GI) [7], Bleeding on Probing (BOP) [8], Orthodontic Plaque Index (OPI) [9] and Stained Tooth Surface (STS). GI and BOP values were determined from 3 sites (mesial, median and distal) of the vestibular surface. Sites that bled within 30 sec after probing were designated BOP. Teeth with brackets that were not properly in place were excluded from the recorded indices at that session. The related teeth and brackets were stained with basic fucsin and patients rinsed for at least 30 seconds. Stained areas were recorded to determine OPI and STS. To evaluate STS, the area surrounding the bracket of each tooth was divided into 3 parts from incisal to cervical, the parts of the bracket's middle third were divided mesially and distally, and finally the incisal and cervical areas of the crown were divided into 3 parts (mesial, median and distal). Stained areas were recorded as positive or negative for STS and the percentage for each patient was calculated. Clinical measurements were obtained at 1, 2 and 3 months

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Table 1: Descriptive values for GI, BOP, OPI and STS for conventional and self-ligating brackets.

		N	Minimum	Maximum	Mean	Std. Error	Std. Deviation
Group 1	GI-upper	20	0.24	1.59	0.9	0.07	0.36
	GI-lower	20	0.5	1.59	1.02	0.05	0.26
	BOP-upper	20	0	50	15.37	2.67	13.12
	BOP-lower	20	3.7	38.89	13.91	1.76	8.64
	OPI -upper (%)	20	10.42	73.61	31.31	3	14.73
	OPI-lower (%)	20	6.94	61.11	35.86	2.77	13.57
	STS-upper (%)	20	27.78	89.81	57.48	3.49	17.19
	STS-lower (%)	20	19.44	82.41	62.72	3.2	15.7
Group 2	GI-upper	20	0.54	1.61	1	0.07	0.29
	GI-lower	20	0.8	1.61	1.17	0.05	0.21
	BOP-upper	20	0	40.74	13.67	2.84	11.73
	BOP-lower	20	3.7	40.74	17.32	2.46	10.16
	OPI-upper (%)	20	9.72	43.06	27.28	2.11	8.73
	OPI-lower (%)	20	17.36	52.08	34.55	2.53	10.44
	STS-upper (%)	20	30.56	72.22	53.39	2.93	12.09
	STS-lower (%)	20	37.96	79.63	60.56	2.91	12.01

GI: Gingival Index; BOP: Bleeding on Probing; OPI: Orthodontic Plaque Index; STS: Stained Tooth Surface; SE: Standard Error; SD: Standard Deviation

after bracket placement, and mean value of the three measurements was calculated. Wilcoxon test was used to compare GI, BOP, OPI and STS between upper and lower teeth. Mann-Whitney U test was used to compare GI, BOP, OPI and STS between the groups.

Results

Descriptive values for GI, BOP, OPI and STS are given in Table 1. There was a significant difference for GI between mandibular and maxillary arches for self-ligating brackets (Table 2). In addition, there were significant differences for GI, OPI and STS between the mandibular and maxillary arches for conventional brackets (Table 2).

Due to these differences between the two arches, bracket type was compared with for each jaw. These comparisons did not demonstrate any significant differences between bracket type (Table 3).

Discussion

Turkkahraman et al. reported no significant differences between elastomeric rings and ligature wires for gingival index, bonded bracket plaque index and pocket depths of bonded teeth. However, elastomeric rings caused more gingival bleeding sites than ligature wires. Therefore, elastomeric rings are not recommended for patients with poor oral hygiene [3].

Pellegrini et al. reported that there was less bacterial accumulation surrounding self-ligating brackets than elastomeric ligating brackets [10]. Nalçacı et al. stated that the GI, PI and BOP values of the self-ligating brackets group was lower than that of the conventional brackets group [11]. In the current study, we found no difference between the two bracket types with respect to GI, STS, BOP and OPI of the mandibular and maxillary anterior teeth. Pandis et al. reported that there were no differences between self-ligating brackets and conventional brackets with respect to PI, GI, calculus index and probing depth of mandibular anterior teeth [1].

Table 2: Comparison of GI, BOP, OPI and STS between upper and lower jaws for conventional and self-ligating brackets.

		Mean	Std. Deviation	P
Group 1	GI-upper	0.9	0.36	0.030*
	GI-lower	1.02	0.26	
	BOP-upper	15.37	13.12	0.386
	BOP-lower	13.91	8.64	
	OPI-upper (%)	31.31	14.73	0.054
	OPI-lower (%)	35.86	13.57	
	STS-upper (%)	57.48	17.11	0.063
	STS-lower (%)	62.72	15.7	
Group 2	GI-upper	1	0.29	0.019*
	GI-lower	1.17	0.21	
	BOP-upper	13.67	11.73	0.079
	BOP-lower	17.32	10.16	
	OPI-upper (%)	27.28	8.73	0.005***
	OPI-lower (%)	34.55	10.44	
	STS-upper (%)	53.39	12.09	0.010**
	STS-lower (%)	60.56	12.01	

GI: Gingival Index; BOP: Bleeding on Probing; OPI: Orthodontic Plaque Index; ST: Stained Tooth Surface
*P<0.05, **P<0.01, ***P<0.001

Scanning electron microscopic images and microbial culture studies revealed that the irregular surfaces of self-ligating brackets caused plaque accumulation [12,13].

In our study in which microbial samples were not taken, plaque accumulation was investigated on the anterior teeth and parameters were scored at months 1, 2 and 3. There were significant differences between the GI, OPI and STS scores of mandibular and maxillary

Table 3: Comparison of GI, BOP, OPI and STS between conventional and self-ligating brackets.

		Group 1		Group 2		
		Mean	SD	Mean	SD	P
Upper	GI	0.9	0.36	1	0.29	0.682
	BOP	15.37	13.12	13.67	11.73	0.653
	OPI (%)	31.31	14.73	27.28	8.73	0.341
	STS (%)	57.48	17.11	53.39	12.09	0.321
Lower	GI	1.02	0.26	1.17	0.21	0.053
	BOP	13.91	8.64	17.32	10.16	0.265
	OPI (%)	35.86	13.57	34.55	10.44	0.517
	STS (%)	62.72	15.7	60.56	12.01	0.341

GI: Gingival Index; BOP: Bleeding on Probing; OPI: Orthodontic Plaque Index; STS: Stained Tooth Surface; SD: Standard Deviation: P>0.05

anterior teeth bonded with conventional brackets, and the GI scores of mandibular and maxillary anterior teeth bonded with self-ligating brackets. Because of these differences between the two arches, bracket type was compared for each jaw. Results of these comparisons showed that the self-ligating bracket was not superior to the conventional bracket. Our three month follow up study confirmed the results of the 18, 3 and 2 month follow up studies of Pandis et al., Baka et al. and Kaygisiz et al [1,14,15].

In studies that compared bracket type for plaque accumulation, there were some differences for tooth type, bracket type and time period [10,12,16]. In addition to these factors, the level of oral hygiene, surface energy of bracket materials and use of different orthodontic adhesives may have caused the differences between the results of studies. The differences in the fabrication procedures may influence the surface free energy of components, so bracket metals can show significantly different surface free energy characteristics according to manufacturers. The surface free energy of bracket metals was lower than that of ceramic brackets [17]. However, Eliades et al. reported that the stainless steel metals had higher surface tension than polycarbonate and ceramic alumina materials, so the retention of plaque on polycarbonate and ceramic alumina brackets is lower than on stainless steel appliances [18].

Orthodontic brackets cause more accumulation of plaque and inflammation. Therefore, special oral hygiene and remotivation must be provided during orthodontic treatment [2,16,19]. In the present study, before orthodontic treatment all patients were informed of the need for oral hygiene, especially with regard to toothbrush type and brushing method. Staged and V-shaped toothbrushes clean more effectively than planar bristle field toothbrushes [20]. Therefore, all patients were instructed to brush their teeth with a staged toothbrush.

Conclusion

The self-ligating bracket did not confer any advantages over the conventional bracket with respect to the accumulation of microbial dental plaque and the periodontal status of anterior teeth.

Clinical relevance: Self-ligating brackets and conventional brackets can be confidently used with good oral hygiene and motivation during orthodontic treatment according to the results of plaque accumulation.

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