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GINGIVAL CONDITION ASSOCIATED WITH PARTIAL ORTHODONTIC TREATMENT

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A longitudinal clinical study on gingival condition was made on seventy-five patients treated with fixed orthodontic appliances in one or both dental arches. Fifty-three non-treated subjects of comparable age were included for further reference. The prevalence and severity of gingivitis about the maxillary teeth were compared for partial (i.e. banding of all maxillary teeth) and full (i.e. banding of all maxillary and mandibular teeth) orthodontic treatment. Plaque accumulation and gingival status were assessed according to the Plaque and Gingival Index systems. Gingival hyperplasia was recorded by linear measurements using pocket probes.

The results demonstrated that all patients developed generalized gingivitis during the period of active treatment. The proximal areas were invariably more affected than the buccal areas, and posterior teeth more than anterior teeth. Although the GI, PlI and pocket depth values were constantly lower when treatment was limited to the maxillary teeth, the differences were small and generally not significant. Also the healing of the gingiva after removal of the appliances was more rapid when partial treatment was used. In neither orthodontic group, however, any permanent damage to the periodontal tissues could be demonstrated with the methods used.

In previous studies on dental caries in patients that have undergone orthodontic therapy (*Zachrisson & Zachrisson,* 1971 a, b), the caries incidence of maxillary teeth was found to be lower when treatment was limited to the maxilla than when appliances were placed in both dental arches. This difference was accompanied by differences in the degree of plaque accumulation. Since the state of the gingiva is more sensitive to changes in the amount of plaque than the caries attack rate (*Bibby*, 1966; *Koch & Lindhe*, 1969; *Fehr et. al,* 1970; *Ainamo* 1970), the present investigation was performed in order to study the prevalence and severity of gingivitis in patients where the orthodontic treatment was limited to the maxilla, and to compare the

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results with those obtained during full orthodontic treatment (*Zachrisson & Zachrisson*, 1972).

MATERIAL AND METHODS

Experimental group. Twenty-six individuals (Table I) were treated in the maxillary arch with fixed appliances according to a standardized edgewise-light wire technique. Six participants received bands on one or both first mandibular molars, and two patients on their mandibular canines as well.

Reference groups. Two reference groups were used (Table I). The *treated reference (TR)* group consisted of fourty-nine subjects receiving orthodontic treatment in both dental arches, using the same technique as the experimental group. The *non-treated reference (NTR)* group comprised fifty-three children not treated orthodontically. These individuals were selected to match the others as nearly as possible in all respects, particularly with regard to caries experience, age and social class.

Oral hygiene instruction. A few weeks before any orthodontic appliance was placed, patients and parents were instructed according to a standardized oral hygiene program (*Zachrisson & Zachrisson*, 1971b). The horisontal scrub toothbrushing technique was used, with particular emphasis directed towards the areas along the gingival margins. Except toothbrushing no instruction in interdental cleaning was given. Also during the study period, several procedures were instituted to ensure that the oral hygiene status of the treatment groups was maintained at a high level (*Zachrisson & Zachrisson*, 1971 b). All patients receiving orthodontic appliances were instructed to rinse at home with 0,2 % sodium fluoride twice a week throughout the observation period. The patients of the NTR group were given no toothbrushing instruction by the authors prior to the examination.

Scoring methods. Assessments of oral hygiene were performed according to the criteria of the Plaque Index (PII) system (*Silness & Löe*, 1964). The gingival condition was assessed according to the Gingival Index (GI) system (*Löe & Silness*, 1963). These recordings were supplemented by a series of linear measurements from the bottom of the gingival pocket to the gingival margin and to stable reference points on the teeth or on the appliances (*Zachrisson & Zachrisson*, 1972). The distances were measured and recorded in complete millimetres (*Glavind & Löe*, 1967) with the aid of pocket probes marked at every 2 mm. All registrations were made as partial recordings on the buccal and mesial surfaces of the maxillary right first molar, second premolar, canine and central incisor. The assessments were made in all

Table I.
Experimental and reference material

		Experimental group		Treated reference (TR) group		Non-treated reference (NTR) group	
Region of orthodontic treatment		Maxilla		Maxilla + Mandible		—	
		$\bar{x}$	S.E.	$\bar{x}$	S.E.	$\bar{x}$	S.E.
Age at start (years)		14.2	0.9	12.5	0.3	13.5	0.1
Duration of orthodontic treatment in maxilla (months)		15.9	0.6	17.5	0.4	—	
Bands on maxillary incisors (months)		12.7	0.9	14.2	0.7	—	
Number of subjects	Male	13		21		27	
	Female	13		28		26	

patients: (a) At the start of the treatment, (b) 2—5 times during the period of active treatment, (c) At the removal of the appliances, and (d) At each of four monthly appointments after the removal of the appliances. Separate indices were calculated in the usual manner for the areas, for the teeth and for the individual at each examination (*Löe*, 1967). Individual indices during the treatment period were calculated by adding the separate indices for the individual at each examination and dividing by the number of examinations.

Student's t — test was used for assessment of significance with regard to the linear measurements.

RESULTS

The mean values for gingival condition, plaque accumulation and pocket depth in the experimental and the TR groups at different stages during the entire observation period, and the corresponding figures in the NTR group, are given in Table II. The mean values for the individual teeth during the period of orthodontic treatment appear in Table III. Fig. 1 shows the status for the individual teeth at the time of band removal and the changes at each of four consequentive months.

Table II.

Mean scores and standard errors for gingival condition, plaque accumulation and pocket depth in the experimental and the treated reference (TR) groups. The corresponding mean scores in the non-treated reference (NTR) group are included

	During treatment				At band removal				One month after band removal				Four months after band removal					
	Exp. group		TR group		Exp. group		TR group		Exp. group		TR group		Exp. group		TR group		NTR group	
	$\bar{x}$	S.E.	$\bar{x}$	S.E.	$\bar{x}$	S.E.	$\bar{x}$	S.E.	$\bar{x}$	S.E.	$\bar{x}$	S.E.	$\bar{x}$	S.E.	$\bar{x}$	S.E.	$\bar{x}$	S.E.
GI proximal	1.71	0.06	1.78	0.04	1.83	0.06	1.84	0.03	1.21	0.10	1.40	0.06	0.86	0.12	0.75	0.06	1.23	0.05
GI buccal	1.22	0.08	1.33	0.05	1.22	0.08	1.42	0.05	0.57	0.09	0.74	0.06	0.35	0.06	0.36	0.05	0.92	0.07
PlI	0.33	0.06	0.43	0.05	0.44	0.08	0.51	0.06	0.25	0.07	0.30	0.04	0.39	0.08	0.45	0.07	0.68	0.08
Pocket depth proximal	3.23	0.08	3.36	0.06	3.40	0.10	3.61	0.04	2.69	0.08	2.89	0.06	2.60	0.06	2.59	0.05	2.86	0.05
Pocket depth buccal	2.35	0.09	2.55	0.07	2.26	0.09	2.46	0.06	1.86	0.08	2.08	0.05	1.70	0.06	1.93	0.05	2.13	0.05

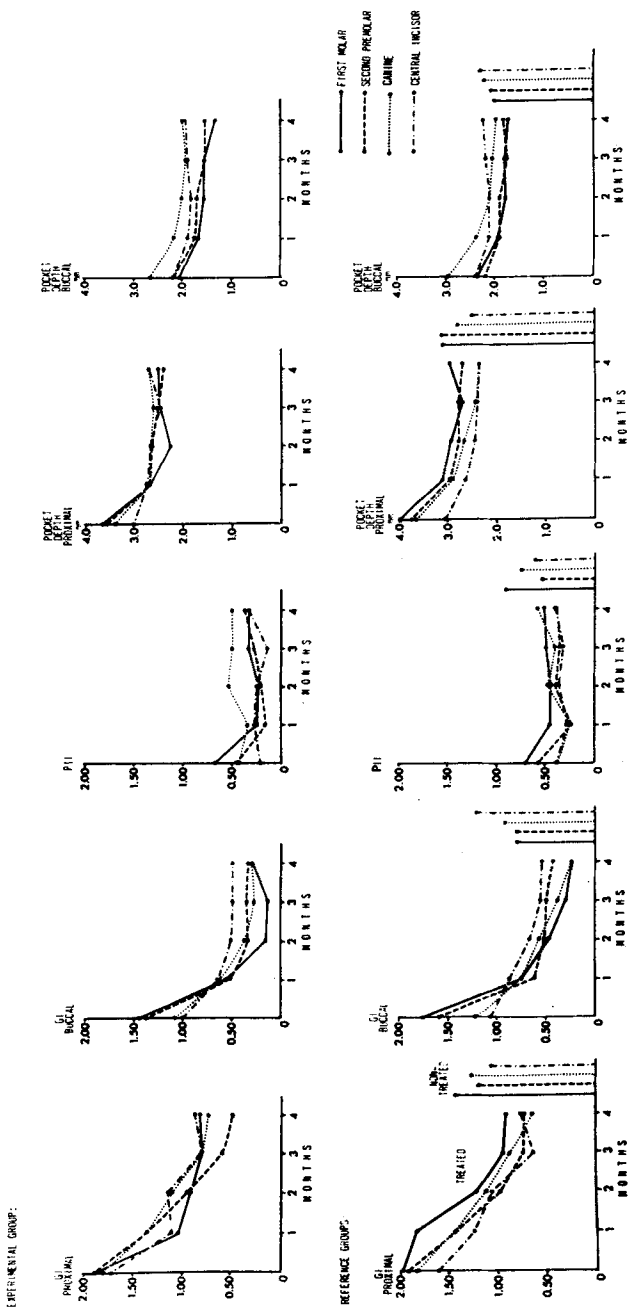

Fig. 1. Gingival healing pattern after removal of the orthodontic appliances.

Above: Mean scores for gingival condition, plaque accumulation and pocket depth for the individual teeth at each of the four monthly appointments following band removal in the experimental group.

Below: Corresponding mean scores in the two reference groups. Data for treated reference (TR) group at left and data for non-treated reference (NTR) group at right in each figure.

Table III.

Mean scores and standard errors for gingival condition, plaque accumulation and pocket depth for the individual teeth during the treatment period in the experimental and the two reference groups

		Gingival Index						Plaque Index			Pocket depth					
		Proximal			Buccal						Proximal			Buccal		
		Exp. group	TR group	NTR group	Exp. group	TR group	NTR group	Exp. group	TR group	NTR group	Exp. group	TR group	NTR group	Exp. group	TR group	NTR group
First molar	$\bar{x}$	1.89	1.80	1.42	1.56	1.72	0.78	0.54	0.68	0.88	3.49	3.74	3.04	2.30	2.47	1.94
	S.E.	0.05	0.05	0.07	0.11	0.07	0.11	0.10	0.07	0.11	0.17	0.11	0.07	0.10	0.07	0.07
Second premolar	$\bar{x}$	1.74	1.84	1.18	1.34	1.46	0.78	0.25	0.40	0.52	3.35	3.46	3.10	2.34	2.42	2.06
	S.E.	0.08	0.05	0.06	0.12	0.08	0.08	0.07	0.06	0.09	0.11	0.08	0.09	0.11	0.07	0.06
Canine	$\bar{x}$	1.65	1.81	1.25	1.03	1.08	0.91	0.35	0.30	0.72	3.16	3.24	2.77	2.57	2.82	2.20
	S.E.	0.09	0.04	0.08	0.11	0.07	0.11	0.08	0.05	0.10	0.10	0.07	0.06	0.17	0.13	0.09
Contral incisor	$\bar{x}$	1.57	1.66	1.05	0.96	1.05	0.20	0.19	0.33	0.60	2.92	2.98	2.49	2.19	2.47	2.30
	S.E.	0.07	0.06	0.07	0.08	0.03	0.08	0.08	0.05	0.09	0.11	0.08	0.08	0.14	0.12	0.08

The mean *GI scores* were slightly lower in the experimental group than in the TR group during the period of orthodontic treatment. The difference was greater on buccal than on proximal surfaces (Table II). The GI scores in both orthodontic groups were considerably higher than those in the NTR group. After removal of the orthodontic appliances, the GI scores decreased more rapidly in the experimental group than in the TR group (Table II, Fig. 1). However, four months after band removal, the mean GI scores in both groups were of the same order and notably lower than the corresponding scores in the NTR group (Table II).

Also the *PlI scores* were lover in the experimental group than in the TR group throughout the observation period (Table II). Both orthodontic groups had lower PlI scores than the NTR group (Table II).

The *pocket depths* were invariably lower in the experimental group than in the TR group throughout the observation period (Tables II & III), but the differences were generally not significant. When all teeth were grouped (Table II), only the difference in mean pocket depth on proximal surfaces at the time of band removal was statistically significant ($P<0.05$). The differences between the individual teeth (Table III) were not statistically significant, except for the buccal surfaces of the first molars at the time of band removal ($P<0.05$). Four months after the removal of the appliances, the differences between the experimental group and the TR group (Table II) was statistically significant on the buccal surfaces ($P<0.01$), but not on the proximal surfaces.

When the experimental group was compared with the NTR group, the mean figures during the period of orthodontic therapy (Table II) were significantly higher, both for the proximal ($P<0.001$) and buccal ($P<0.05$) surfaces, despite the fact that the buccal pockets of the central incisors were shallower in the experimental group (Table III).

Four months after band removal, the mean pocket depths were significantly lower in the experimental group (Table II), both on the proximal ($P<0,01$) and the buccal surfaces ($P<0,001$).

Other clinical results in this study were in accordance with the previous observations (*Zachrisson & Zachrisson*, 1972).

DISCUSSION

The present investigation has confirmed the observation of previous studies that the placement of fixed appliances results in generalized hyperplastic gingivitis within few months (*Skillen & Krivanek*, 1938; *Skillen*, 1940; *Kobayashi & Ash*, 1964, *Rateitschak et al.*, 1968; *Zachrisson & Zachrisson*,

1972) and that the inflammation persists throughout the orthodontic treatment period (*Spence*, 1955; *Huettner*, 1960; *Baer & Coccaro*, 1964; *Zachrisson & Zachrisson*, 1972). The tissue response is not elicited by the orthodontic forces *per se* (*Rateitschak et. al.*, 1968), but reflects the local irritation (*Kobayashi & Ash*, 1964; *Womack & Guay*, 1968). After removal of the bands rapid healing of the tissue takes place. The healing pattern in the present study corroborated some recent clinical investigations (*Bekeny & DeMarco*, 1971; *Zachrisson & Zachrisson*, 1972).

The prevalence and distribution of gingivitis about maxillary teeth was almost identical when treatment was limited to the maxilla and when appliances were used in both the maxilla and the mandible (Tables II & III, Fig. 1). With regard to severity of gingival inflammation, however, the results differed somewhat between the two orthodontic groups, both during treatment (Tables II & III) and after removal of the appliances (Fig. 1). These differences may be explained on the basis of the differences in the plaque scores (Table III), which demonstrated that the patients cleaned their teeth more adequately when partial orthodontic treatment was performed.

Undoubtely satisfactory cleaning of two full banded dental arches is particularly time-consuming and will require greater enthusiasm among the group of patients than if one arch is treated. On the other hand, the differences in gingival condition were not as large as might be expected from the caries incidence experiences (*Zachrisson & Zachrisson*, 1971 a, b). It may seem, therefore, that a close correlation existed between the patient's oral hygiene status and their consciousness in accomplishing the regular fluoride mouth rinsing.

Since the recording methods used are comparatively crude (*Glavind & Löe*, 1967; *Zachrisson & Zachrisson*, 1972), the present study cannot answer the question of whether any premature aging of the dentition had occurred concomitant with the orthodontic therapy. Inflammation in and about bone tends to induce resorption, and it might be that inflammatory changes at least in the more severe cases contribute to loss of bone in the alveolar crest region (*Oppenheim*, 1936; 1942; *Skillen & Krivanek*, 1938; *Stuteville*, 1938; *Skillen*, 1940). On the other hand, the presence of moderate gingivitis in children for a period corresponding to that used during orthodontic treatment has been reported not to give significant radiographic signs of periodontitis (*Hollender et al.*, 1966). Further clinical experiments using refined recording methods introduced recently for assessment of the level of gingival margin (*Holm-Pedersen & Löe*, 1971) and periodontal bone height, as well as histologic studies, are in progress in an attempt to elucidate the permanent influence upon the periodontal tissues by orthodontic treatment.

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