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Effectiveness of periodontal therapies on the treatment of different aetiological factors induced gingival overgrowth in puberty

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Abstract: *Objectives:* The aim of the present study was to compare oral improvement achieved by different periodontal therapies (surgical and non-surgical) for different aetiological factors induced gingival overgrowth in 60 subjects (mean age ± SD = 12.33 ± 1.05 years; age range = 12–15 years). *Methods:* Subjects received oral hygiene instructions, scaling, surgical treatment (if necessary) and periodontal maintenance therapy. Clinical parameters were taken at baseline, after initial treatment and after periodontal surgery. *Results:* The decrease in the clinical index values after all treatments compared to the initial values is found to be statistically significant ($P < 0.05$). Although there was a statistically significant difference in all aspects of the clinical index values of the study groups after initial treatments, for drug-induced gingival overgrowth subjects full improvement was seen only after periodontal surgery. *Conclusion:* Attention to plaque control and removal of local irritants is very important for the gingival health of the patients in puberty. In puberty, plaque-induced gingival overgrowth can be treated with plaque removal. However, these approaches alone do not prevent drug-induced gingival overgrowth and surgical therapy often becomes the treatment of choice.

Key words: aetiological periodontal treatment; cyclosporine adverse effects; gingival inflammation; gingival overgrowth; puberty

Introduction

Gingival overgrowth (GO), increase in size, is a common feature of gingival diseases. There are many types of GO which vary

according to the aetiological factors and pathological processes that produce them (1). However, a greater incidence of GO is seen in puberty and the severity of gingivitis is more intense in children than in adults with similar amounts of dental plaque (2). Epidemiological studies report a low prevalence of gingivitis during preschool age, followed by a gradual increase in prevalence reaching a peak around puberty. This may be related to changes in the bacterial composition of the dental plaque, the inflammatory cell response and hormonal changes (3).

The importance of the bacterial biofilm in the aetiology of GO has been extensively studied. Nevertheless, no clear correlation between plaque-induced GO and development of drug-induced GO has been established (4–6). However, there are only a few options for treatment of GO and they do vary with the causes. Treatment for GO should begin with rigorous home care and frequent appointments for scaling and professional plaque removal. Although the oral plaque control programme, combined with rigorous professional maintenance, often leads to improvement of the clinical aspects of all GOs, surgery is often necessary to correct the problem especially for the drug-induced GO (1).

In addition, several authors have observed a positive association between an oral hygiene programme, scaling and improvement of GO (7–9), while others failed to confirm this (10–12).

Therefore, the aim of the present study was to compare GO scores achieved by different periodontal therapies, surgical and non-surgical periodontal treatment modalities, for different aetiological factors induced GO in puberty.

Materials and methods

Study population and clinical parameters of periodontal conditions

Sixty patients (male: female, 36:24) with an average age of 12.33 ± 1.05 (range 12–15) were treated in the Periodontology Clinic at the Faculty of Dentistry, Atatürk University, Erzurum, Turkey for their gingival problems. All subjects were non-smokers, did not receive any periodontal treatment, were not on any antibiotic treatment for at least 6 months prior to the study and did not have any systemic disease reported to cause GO. Subjects and parents were informed about the study, and were required to fill out a consent form and a medical history questionnaire. Moreover, the study was approved by the ethics review board of Atatürk University.

The subjects were divided into two groups: group I included 30 subjects with dental plaque-induced gingival overgrowth and group II included 30 subjects with drug-induced gingival overgrowth (cyclosporine A induced).

Clinical evaluation

Clinical evaluation of periodontal status was performed before and after treatment, using the Löe-Silness plaque index (PI), the Silness-Löe gingival index (GI), periodontal probing depths (PPD) and gingival overgrowth index (GOI) (13) of the teeth. The PI, GI and PPD scores were recorded at four sites per tooth (mesial, distal, buccal, and lingual) by using a Williams probe (Hu-Friedy Manufacturing Inc., Chicago, IL, USA). The scores for the plaque index were defined as follows: 0, no plaque in the gingival area; 1, a film of plaque adhering to the free gingival margin and adjacent area of the tooth, the plaque can be recognized only by running a probe across the tooth surface; 2, moderate accumulation of soft deposits within the gingival pocket and on the gingival margin and/or adjacent tooth surface that can be seen by the naked eye and 3, abundance of soft matter within the gingival pocket and/or on the gingival margin and adjacent tooth surface. The scores for the gingival index were defined as follows: 0, normal gingival; 1, mild inflammation, slight change in colour, slight oedema no bleeding on palpation; 2, moderate inflammation, redness, oedema and glazing, bleeding on probing and 3, severe inflammation, marked redness and oedema, ulceration, tendency to spontaneous bleeding. The numerical scores of the plaque index and gingival index were obtained according to the formula: Per person = sum of individual scores/number of teeth present for each patients, and subsequently group score was calculated by adding together the individual scores and dividing the total into the number of patients included.

For GOI, the upper and lower anterior segments were each divided into five gingival units both buccally and lingually. The degree of gingival thickening on both labial and lingual aspects was graded as follows: 0, normal; 1, 0.1–2 mm of thickening and 2, >2 mm thickening. The extent of encroachment of the gingival tissues on to the adjacent crowns was graded as follows: 0, normal; 1, up to 1/6 of the lateral surface of tooth crown encroached; 2, 1/6 to 2/6 of lateral surface of crown encroached and 3, encroached over the labial surface of the crown to midpoint (2/6 to 3/6). Then the two scores (thickening and gingival encroachments) were added, thus giving a hyperplasia score for each gingival unit.

Plaque control programme and surgical treatment

At the beginning of the study, after recording baseline parameters, patients underwent oral hygiene instructions, supra and subgingival scaling with ultrasonic and hand instruments. For oral hygiene instruction, the aetiology and microorganisms of periodontal diseases were described and the effects of periodontal diseases on alveolar bone and teeth were demonstrated on a study model. All of these issues were shown to patients in power point computer program by professional physician together with a public health nurse. Our aim of choosing this method was to instruct our effective oral hygiene education and motivation method in a short and intermediate time period. Patients were taught how to brush their teeth correctly (at least twice a day) and the brushing technique of each patient was modified. Bass brushing technique was advised, and a short brochure describing the bass brushing technique was given. All of the education and motivation sessions were made face to face.

The initial periodontal treatments took approximately 1 month. Following the initial therapy, if there was a need for reshaping the gingival tissues, patients were treated with surgery (gingivectomy and gingivoplasty). And then, all patients were placed on a recall maintenance programme and monitored for 6 months by the same periodontist (CK) for maintenance of adequate oral hygiene and periodontal variables were recorded. Only for drug-induced gingival overgrowth patients, all treatments were carried out under antibiotic coverage (amoxicillin 2 g 1 h preoperatively) because of patients' increased susceptibility to infections (14).

Statistical analysis

Statistical analysis was performed using SPSS 11.5 for Windows (SPSS Inc., Chicago, IL, USA). Statistical significance of data for all clinical parameters within a group was determined with the paired *t*-test. Significant differences between the two groups were determined with the Student's *t*-test. The relationship between clinical parameters and drug variables was determined with correlation analysis. Changes was considered significant at the $P < 0.05$ levels.

Results

The investigation was carried out on 60 patients. The demographic characteristics, periodontal details and pharmacological characteristics are shown in Table 1. There was a statistically significant difference in mean age between the two groups ($P < 0.05$) and no statistically significant difference between male and female patients ($P > 0.05$). GOI showed significant differences between male and female patients for two groups ($P < 0.05$).

The relationship between clinical values and drug variable is shown in Tables 2 and 3. Cyclosporine doses were identified as a significant risk factor for GO scores at baseline. However,

Table 1. **Demographic details, periodontal and epileptic drug variables of the patients**

	Male	Female	Total	*P* (Male-female)
Number of patients				
Group I	19	11	30	
Group II	17	13	30	
Age				
Group I	12.44 ± 1.09†	12.61 ± 1.12†	12.50 ± 1.07†	NS
Group II	12.15 ± 1.18†	12.26 ± 1.42†	12.21 ± 1.35†	NS
GO Score				
Group I				
3>	2	3	5	
>3	17	8	25	
Group II				
3>	7	9	16	
>3	10	4	14	
GO Index				
Group I	3.60 ± 0.39†	3.42 ± 0.44†	3.51 ± 0.12†	*0.020
Group II	3.08 ± 0.26†	2.92 ± 0.39†	3.01 ± 0.07†	*0.012
Drug dosage (mg kg^{-1} day^{-1})				
Cyclosporine	3.64 ± 1.65	3.06 ± 1.31	3.40 ± 1.56	*0.000

GO, gingival overgrowth.
Values are expressed as a group mean ± SD.
*$P < 0.05$ significant difference; NS, not statistically significant.
†Significant difference between groups.

Table 2. **The relationship between severity of gingival overgrowth and clinical values for group I subjects**

	PI	GI	GOI
PI	1		
GI	0.811*	1	
GOI	0.572*	0.719*	1

*Correlation is significant at the 0.05 level.

Table 3. **The relationship between clinical values and cyclosporine variables for group II subjects**

	PI	GI	GOI	CsA dose
PI	1			
GI	0.519*	1		
GOI	0.521*	0.441	1	
CsA dose	0.337	0.311	0.515*	1

*Correlation is significant at the 0.05 level.

at baseline, there was a statistically significant relationship between PI-GI values and the GO scores for group I patients and between PI-cyclosporine dose values and GOI scores for group II patients ($P < 0.05$).

At baseline, plaque-induced gingival overgrowth cases were observed localized or generalized and the enlarged gingival contours due to oedema, colour transition to a red hue were seen. The severity of overgrowths was related to the amount of dental plaque formation. Drug-induced gingival over growth cases occurred more often in anterior gingiva and facial surfaces. The overgrowths were fibrotic and first observed at the interdental papilla. It was seen that the presence of plaque played an important role in the severity of the drug-induced gingival overgrowths. For some cases, these overgrowths developed into a massive tissue fold covering a considerable portion of the crowns and effected the occlusion and phonation. And also at baseline, all groups of patients presented with no loss of clinical attachment.

For all groups, the decrease in the clinical index values after all treatments in comparison to the initial values are found to be statistically significant ($P < 0.05$) (Table 4). However only for the comparison of group I PI values between initial treatments and periodontal surgeries was not statistically significant ($P > 0.05$) (Table 4). All the participants responded well to the periondontal treatment. The initial clinical index values of the different study groups were also found to be statistically different and this was due to the group II subjects (Table 4). Even though there was a statistically significant difference in PPD and GO values of the study groups after initial treatments, these were not statistically different after periodontal surgery (Table 4). At 6 months after periodontal treatment, the decrease in all clinical index values was statistically significant with respect to baseline ($P < 0.05$) (Table 4).

Improvements in numerical evaluations are shown in Table 5, and the distribution of subjective improvement is shown in Table 6. After all the treatment procedures for GO, the type of improvement experienced by each subject was investigated. Although after initial treatment full improvement was observed in 83% of group I subjects, only after periodontal surgery full improvement was observed in 97% of group II subjects.

Table 4. **Clinical parameters of study groups' patients assessed at baseline (T_0), after initial treatment (T_1), after periodontal surgery (T_2) and at 6 months after periodontal surgery (T_6).**

	T_0	P (T_0–T_1)	T_1	P (T_0–T_2)	T_2	P (T_1–T_2)	T_6	P (T_2–T_6)
PI								
Group I	2.01 ± 0.16†		0.29 ± 0.08‡		0.23 ± 0.06‡	NS	0.26 ± 0.08‡	
Group II	1.75 ± 0.24†		0.28 ± 0.15‡		0.21 ± 0.16‡	0.009*	0.27 ± 0.20‡	
GI								
Group I	2.15 ± 0.32†	<0.001*	0.15 ± 0.02‡	<0.001*	0.11 ± 0.06‡	0.012*	0.15 ± 0.09‡	NS
Group II	1.55 ± 0.51†		0.17 ± 0.05‡		0.09 ± 0.04‡	<0.001*	0.11 ± 0.11‡	
PPD								
Group I	3.18 ± 0.54†		1.21 ± 0.08†		1.05 ± 0.04‡	<0.001*	1.01 ± 0.01†	
Group II	2.31 ± 0.08†		2.11 ± 0.17†		1.01 ± 0.01‡		1.16 ± 0.06†	
GOI								
Group I	3.51 ± 0.12†		0.79 ± 0.10†		0.05 ± 0.01‡		0.02 ± 0.01†	
Group II	3.01 ± 0.07†		1.87 ± 0.08†		0.03 ± 0.02‡		0.21 ± 0.07†	

PI, plaque index; GI, gingival index; PPD, periodontal probing depths; GOI, gingival overgrowth index.
Values are expressed as a group mean ± SD.
*$P < 0.05$ significant difference; NS, not statistically significant.
†Significant difference between groups.
‡No significant difference between groups.

Table 5. **Numerical scale indicating degree of improvement of gingival overgrowth in the patients by using gingival overgrowth index**

Evaluation	Decrease in degree of gingival overgrowth scores				
Full improvement	5 → 0	4 → 0	3 → 0	2 → 0	1 → 0
Slight improvement	5 → 4	4 → 3	3 → 2	2 → 1	
No improvement	5 → 5	4 → 4	3 → 3	2 → 2	1 → 1

Degree 5, maximum value of gingival overgrowth.
Degree 0, healthy gingiva.

Table 6. **Statistical analysis of gingival overgrowth scores obtained before and after treatment procedures**

Level of improvement	Total relief (%)					
	Group I		Group II		Total	
	T_1	T_2	T_1	T_2	T_1	T_2
Full improvement	25 (83)	30 (100)	3 (10)	29 (97)	28 (47)	59 (98)
Slight improvement	5 (17)	0	23 (77)	1 (3)	28 (47)	1 (2)
No improvement	0	0	4 (13)	0	4 (6)	0

T_1, after initial treatment.
T_2, after periodontal surgery.

Discussion

The effects of periodontal treatments on gingival overgrowth in children were evaluated using clinical parameters.

Gingival overgrowth is a common problem in the periodontology clinics and is very important for the therapy of gingival diseases (1, 15). The studies about the pathogenesis and aetiological factors of gingival overgrowth show that it is related with systemic diseases, local factors and side effects produced by some medications. Some genetic and metabolic diseases, inflammatory periodontal diseases and some medications can change the normal structure of the gingival tissue (1, 16, 17).

There are several research studies that have investigated the role of the humoral and cellular immune response and the hormones that stimulate the immune system on the pathogenesis of periodontal disease (2, 18). Puberty, menstrual cycles, pregnancy, oral contraceptives and menopause make biological changes on the periodontal tissues. Steroid sex hormones can affect the subgingival flora, gingival vascular structures, periodontal immune system and the cells of periodontium. The alterations in the hormone levels change the composition of the normal gingival flora in both direct and indirect ways (1, 2, 18–20).

Matsson and Goldberg (21) emphasized that there was a real difference in the tendency to develop gingivitis between preschool children and adults by comparing gingival units with similar plaque accumulation and all clinical effects of these were seen usually on marginal gingival with gingival overgrowth.

Moreover, Seymour et al. (22) clarified that age had been considered an important risk factor for drug-induced gingival overgrowth with particular reference to phenytoin and cyclosporin. They showed some form of gingival changes and the number of children with clinically significant gingival overgrowth were higher when compared with adults. Indeed it has been suggested that the differences in the prevalence of the overgrowth induced by the different drugs reflect the different age groups at which they are targeted (23); phenytoin being targeted mainly at the young, calcium-channel blockers at the post-middle aged and cyclosporine across a broad range of ages. Their one possible explanation for this association may reside with an interaction between circulating androgens and gingival fibroblasts.

Daley et al. (24) showed that the most consistent observation concerning the development of cyclosporine-induced gingival hyperplasia was the correlation with age and adolescents were at greatest risk of developing gingival enlargement. Moreover, they associated this situation with the result of growth hormone potential of fibroblastic response.

For these purpose, the patients at puberty that the hormonal changes are mostly seen, the oral tissues are more influenced and oral changes can be seen easily, were included in our study.

Epidemiological studies in many parts of the world have demonstrated a strong positive association between dental plaque and the prevalence and severity of periodontal disease. Although dental plaque is the essential etiological agent in periodontal disease, various local and systemic factors (risk factors) can modify the host's response to plaque accumulation and influence the development and progression of gingivitis and/or periodontitis. However, epidemiological studies have shown that over 90% of the variance observed in populations can be accounted for by age and oral hygiene variables alone (25). For the treatment of periodontal diseases, first plaque control programme and periodontal therapy (supra- and subgingival scaling with hand and ultrasonic instruments) must be applied. Although especially for the plaque induced gingival overgrowth, this conservative approach decreases the need for surgical therapy, sometimes this is not sufficient and surgical treatment may be needed. Surgical treatment should be evaluated in accordance with individual functional and aesthetic requirements.

Moreover in our study, for group I patients, the decrease in the clinical index values after the conventional therapies in comparison to the initial values was found to be statistically significant ($P < 0.001$).

Aimetti et al. (26), in their study which was aimed to evaluate the clinical effects of aetiological periodontal treatment in a group of transplant patients medicated with cysclosporin A who exhibited severe gingival overgrowth, found that aetiological periodontal treatment and regular maintenance therapy were effective in resolving the inflammation and eliminating the need for surgical treatment in patients receiving cysclosporin A.

Ekni (27), in his doctorate thesis, showed that attention to plaque control and the removal of local irritants were of some benefit for the gingival health of cyclosporin-treated adult renal transplant patients, but these treatments alone did not prevent gingival overgrowth and effective oral hygiene procedures were more difficult to accomplish in the presence of distorted gingival contours and for the treatment of drug-induced gingival overgrowth surgical treatment should be needed. However, he also emphasized that recurrence of gingival overgrowth in patients treated by surgical therapy might appear within a few months following surgery when carrying on medication.

Pilloni et al. (28), compared the effects of different surgical treatment methods (flap and gingivectomy) in the treatment of cyclosporin A and nifedipine-induced gingival overgrowth and found that the overgrowth reduction achieved by the periodontal flap might be sustained for longer periods of time than by the gingivectomy technique. However they also reported that recurrence of gingival overgrowth might appear after surgery.

In our study, for the group II patients, although the decrease in the PI and GI values after the conventional treatments in comparison to the initial values was found to be significant, the decrease in the gingival overgrowth values was not good enough as the decrease in the group I subjects and only after surgical therapy a significant reduction in PPD and GOI values was determined.

Modeer and Dahllof (29), Tyldesley ve Rotter (30) explained the importance of plaque control programme on the initial treatment of phenytoin-induced gingival overgrowth. They also clarified that this procedure did not prevent the gingival overgrowth, only reduced its severity.

Somacarrera et al. (4) assessed the incidence, severity and evolution of cyclosporin-induced gingival enlargement in 100 heart, liver and kidney transplant patients and investigated the most significant factors contributing to this overgrowth, in the 6 months following transplant surgery. Gingival overgrowth, plaque and gingivitis indices, in addition to cyclosporin blood concentration, were assessed monthly. They determined that while plaque and gingivitis decreased significantly after oral hygiene and motivation programme, there was no change on the gingival overgrowth values. They suggested that the basic factor influencing gingival overgrowth was cyclosporine blood concentration, followed by plaque/gingivitis level. However, they recommended an oral hygiene program prior to the transplant surgery.

It is concluded that attention to plaque control and removal of local irritants is very important for the gingival health of the patients in puberty. In puberty, plaque-induced gingival overgrowth can be reversible with plaque removal and after the adequate oral hygiene is ensured, surgical treatment especially gingivoplasty is used to reshape gingival tissues for aesthetic appearance. However, these approaches alone do not prevent drug-induced gingival overgrowth. The ideal therapy is the discontinuation or substitution of the causative agent. But for all cases the causative agent cannot be discontinued. For this reason, resective surgical therapy (gingivectomy or flap operation) often becomes the treatment of choice. However studies about the effects of other drugs (phenytoin, calcium-channel blockers, etc.) on the oral mucosa and about the treatment methods for these drugs' side-effects would be highly beneficial in this area.

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