

A COMPARATIVE STUDY BETWEEN PERIODONTAL STATUS BEFORE AND AFTER ORTHODONTIC TREATMENT

Stefana Nanu¹, Ancuta Goriuc^{2*}, Oana Bejan^{3*}, Ioana Vata⁴, Maria-Alexandra Martu⁵,
Simone Testa³, Darius Sandu³, Oana Butnaru⁶, Ionut Luchian⁵

¹Phd student "Grigore T. Popa" University of Medicine and Pharmacy Iasi-Romania, Faculty of Dental Medicine.

²"Grigore T. Popa" University of Medicine and Pharmacy Iasi-Romania, Faculty of Dental Medicine, Department of Biochemistry.

³Student "Grigore T. Popa" University of Medicine and Pharmacy Iasi Romania, Faculty of Dental Medicine.

⁴Senior Orthodontist, DMD, PhD, Iasi-Romania.

⁵"Grigore T. Popa" University of Medicine and Pharmacy Iasi-Romania, Faculty of Dental Medicine, Department of Periodontology.

⁶"Grigore T. Popa" University of Medicine and Pharmacy Iasi Romania, Faculty of Dental Medicine, Department of Biophysics.

Corresponding author: ancuta.goriuc@umfiasi.ro, bejanoana@gmail.com

#All authors have contributed equally as the first author

ABSTRACT

Introduction. Studies of periodontal biodynamics in patients with orthodontic appliances play an important role in the interdisciplinary ortho-periodontal cooperation. **Material and method.** The aim of the present research was to carry out an etiological, prospective and longitudinal incidence follow-up study. The study population consisted in 495 patients who benefited from orthodontic and periodontal care in the period 2010-2019. They were selected from three private practices in Iași, Rădăuți and Pașcani, being treated interdisciplinary by the same team of doctors, one orthodontist and one periodontologist. The data were analysed using SPSS V.21 software. (IBM). The statistical study addressed two aspects: descriptive statistics and analytical statistics. **Results.** The study population consisted in 495 patients, of which 169 were men and 326 were women, mostly children (66%), while teenagers (13%) and adults (20%), with temporary dentition 1.52%, mixed 74.39 % and permanent 24%. In the study population, class I anomalies were found in 54.14% of cases, class II/1 in 21.62%, class II/2 in 15.15% and class III in 9.09%. A statistically significant correlation is observed between the type of periodontal involvement and age, in the sense that periodontal pockets and gingival recessions are predominant in adults, which demonstrates the worsening of the periodontal condition in the absence of orthodontic treatment performed in adolescence. **Conclusions.** Periodontal involvement following orthodontic treatment decreased on average by 5%, and by age group, a decrease in the number of periodontal pockets, but also an increase in the number of recessions, was observed in adults.

Keywords: *periodontal biodynamics, orthodontic treatment, periodontal health*

INTRODUCTION

Studies of periodontal biodynamics in patients with orthodontic appliances play an important role in the interdisciplinary ortho-periodontal cooperation. This research represents a descriptive, retrospective

clinical-statistical study on a study population of 495 patients with various types of dento-maxillary anomalies, who were orthodontically treated at different age stages, with various types of orthodontic devices. In these patients, we evaluated the

oral hygiene, as well as the periodontal status before, during and after orthodontic treatment.

Periodontal health is an important factor that can be used to evaluate the success of orthodontic therapy, the most common side effects of orthodontic treatment being related to periodontal complications: gingivitis, periodontitis, gingival recessions, gingival hypertrophies, bone lysis, dehiscence, fenestrations, black triangles and root resorptions. Beyond systemic variables, genetic inheritance, age or cooperation of the patient, a correct and complete diagnosis, as well as a good treatment management, the most important factor for the success of orthodontic and periodontal therapy, remains the oral hygiene of the patient. [1-6]

MATERIAL AND METHOD

The aim of this research was to carry out an etiological, prospective and longitudinal incidence follow-up study.

The group of patients consisted 495 patients who benefited from orthodontic and periodontal care in the period 2010-2014. They were selected from private practices in Iași, Rădăuți and Pașcani, being treated interdisciplinary by the same team of doctors, one orthodontist and one periodontologist.

The data were analysed using SPSS V.21 software. (IBM). The statistical study addressed two aspects: descriptive statistics and analytical statistics.

The differences between the parameters analysed according to treatment (independent variables) were tested using the ANOVA test (Analysis Of Variance) used only for normal frequency distributions. Otherwise, the non-parametric Kruskal-Wallis test, based on

the analysis of the "assigned" ranks, was used with good results.

If the data shows a normal distribution at the population level, then we will use the parametric inferential method - namely ANOVA with a single between-group factor (OneWay Anova), and if the assumption regarding the normality of the distribution is not met, we will use non-parametric inferential methods, namely the generalised U test, also called Kruskal – Walis or the extended median test – the option depending on the particularities of the data.

The homogeneity of the studied parameters, assessed from the point of view of dispersion (normal distributions), was demonstrated by the results of the Levene test ($p > 0.05$, 95% CI). For the comparative analysis, the One Way Anova test (95% CI), also known as dispersion analysis or analysis of variance, was applied.

The significance level (p-value) (maximum error probability) was considered 0.05 (5%), this being sufficiently precise, the probability (confidence level - confidence intervals) of 95% showing that the decision is just.

The Chi-square test was applied in the case of the non-parametric analysis. The Pearson test is the most widely used type of χ^2 significance test (often missing the name "Pearson") and looks at the association of the columns and rows of a table with two entries, cross frequencies regarding discrete or discretised variables.

The Yates correction (also known as the continuity corrected chi-square) is applied when there are cells with less than 5 elements. Through the Yates correction a better approximation of the binomial distribution is obtained, the result is conservative in the sense that the

significance is obtained more difficultly than when applying the χ^2 test directly.

RESULTS

The study population consisted in 495 patients, of which 169 men and 326 women, mostly children (66%), while teenagers

(13%) and adults (20%), in temporary dentition 1.52%, mixed 74.39 % and permanent 24%.

ANOMALIES IN THE STUDY POPULATION (ANGLE CLASS)

Table 1. Distribution of cases in the study population according to Angle class

Study population – Angle class anomalies	n	%
Class I	268	54.14%
Class II/1	107	21.62%
Class II/2	75	15.15%
Class III	45	9.09%
Study population total	495	

In the study population, class I anomalies were found in 54.14% of cases, class II/1 in 21.62%, class II/2 in 15.15% and class III in 9.09%.

Table 2. Estimated parameters in testing the association of age and Angle class

df=6	Chi-square χ^2	P 95% confidence interval
Pearson Chi-square - χ^2	4.712182	p=.58122
M-L Chi-square	4.783821	p=.57183
Correlation coefficient (Gamma)	.0446448	p=.32156

Class I anomalies are predominant in the study population, regardless of age. With increasing age, the addressability of patients with classes II and III increases, whether we refer to adolescents or adults. The distribution of cases according to age and Angle class demonstrates the absence of a significant association between these two aspects ($\chi^2=4.71$, $p=0.581$, 95%CI). A

slightly increased frequency of class II and III is noted in adults, while in children and adolescents the values corresponding to class I are slightly higher.

PERIODONTAL INVOLVEMENT PRE-ORTHODONTIC TREATMENT

Periodontal involvement was evaluated in the study group for the groups represented by adolescents and adults (167 cases total).

Table 3. Distribution of cases in the study population according to pre-treatment periodontal involvement

Study population – Type of periodontal disease	n	%
Absent	34	20.36%
Present	133	79.64%
gingivitis	57	34.13%
gingivitis + gingival recessions	8	4.79%

gingivite + periodontal pockets	14	8.38%
gingivitis + gingival recessions + periodontal pockets	8	4.79%
periodontal pockets	22	13.17%
periodontal pockets + gingival recessions	8	4.79%
juvenile / aggressive / chronic periodontitis	2	1.20%
gingival recessions	13	7.78%
Study population total	167	

Pre-orthodontic treatment, in the examined group, represented by adolescent and adult subgroups, we found an extremely high periodontal involvement, approximately 80% of cases, manifested in particular by

Table 4. *Distribution of cases according to age and periodontal involvement in the study population*

Age group	Periodontal disease		
	Absent	Present	Total
adolescents	27 42.19%	37 57.81%	64
adults	7 6.80%	96 93.20%	103
Total	34	133	167

the presence of simple gingivitis in 34.13% of cases, periodontal pockets in 13.17 % of cases and of the combination of gingivitis plus pouches in 8.38% of cases.

The statistical analysis reveals the importance of the age of the patients relative to the type of periodontal involvement, the majority of adults presenting various forms

Table 5. *Estimated parameters in testing the association of age and periodontal impairment in the study population*

df=1	Chi-square χ^2	p- 95% confidence interval
Pearson Chi-square - χ^2	30.49286	p=.00000
M-L Chi-square	30.47405	p=.00000
Correlation coefficient (Gamma)	.8183094	p=.00000

of periodontal destruction before orthodontic treatment, compared to teenagers who are affected in a proportion of approximately 60%.

It is, therefore, worth noting a statistically significant association between the age group and the presence of periodontal disease, with a high frequency of cases that presented periodontal disease in adults (93.2%) ($\chi^2=30.49$, $p<<0.01$, 95% BUT).

Table 6. *Distribution of cases according to age and type of periodontal disease*

Study population	Periodontal disease		
	gingivitis	periodontal pockets	gingival recessions
adolescents	33	4	2

	51.56%	6.25%	3.13%
adults	54	48	35
	52.43%	46.60%	33.98%
Total	87	52	37
Chi-square χ^2	$\chi^2=0183224$	$\chi^2=21.78994$	$\chi^2=29.97515$
p -95% confidence interval	p=0.89233	p=0.000	p=0.000
r	r=-0.010475	r=0.8820468	r=.8580645

Moreover, a statistically significant correlation is observed between the type of periodontal disease and age, in the sense that periodontal pockets and gingival recessions predominate in adults, which demonstrates the worsening of the

periodontal condition in the absence of orthodontic treatment performed in adolescence.

EVALUATION OF ORAL HYGIENE STATUS

Table 7. Distribution of cases according to age and oral hygiene status

Age group	Oral hygiene		Total
	Correct	Incorrect	
children	83 25.30%	245 74.70%	328
adolescents	36 56.25%	28 43.75%	64
adults	41 39.81%	62 60.19%	103
Total	77	90	167

The evaluation of the state of oral hygiene prior to orthodontic treatment was carried out in all three age groups, finding that in children and adults the hygiene is mostly

incorrect before treatment, while in the teenagers in the group we found an improvement in the hygienization manner as compared to the other two age groups.

Table 8. The estimated parameters in testing the association of age and oral hygiene status in the study population

df=1	Chi-square χ^2	p 95% confidence interval
Pearson Chi-square - χ^2	4.295608	p=.03821
M-L Chi-square	4.301341	p=.03808
Correlation coefficient (Gamma)	.3207101	p=.03841

A statistically significant association between age group and correct oral hygiene is noted, highlighting a high frequency of cases that presented correct oral hygiene in adolescents (56.26%) ($\chi^2=30.49$, $p < 0.01$, 95%CI).

ORAL HYGIENE PRIOR TO TREATMENT IN RELATION TO TO THE TYPE OF ABNORMALITY**Table 9.** *Distribution of cases according to oral hygiene and Angle class*

Oral hygiene	Angle class anomalies				Total
	Class I	Class II/1	Class II/2	Class III	
correct	107	27	13	13	160
	66.88%	16.88%	8.13%	8.13%	
incorrect	161	80	62	32	335
	48.06%	23.88%	18.51%	9.55%	
Total	268	107	75	45	495

Table 10. *Estimated parameters testing the association of oral hygiene and Angle class*

df=3	Chi-square χ^2	P 95% confidence interval
Pearson Chi-square - χ^2	17.48523	p=.00056
M-L Chi-square	18.25803	p=.00039
Correlation coefficient (Gamma)	.3077506	p=.00016

However, the state of oral hygiene presented a statistically significant association with the type of anomaly assessed - Angle class ($\chi^2=17.48$, $p=0.00056$, 95% CI). Thus, in Angle classes II/1 and II/2 it was found that patients' hygiene was predominantly incorrect, and in class I Angle it was predominantly correct.

PERIODONTAL AFFECTATION PRIOR TO TREATMENT RELATED TO THE TYPE OF ANOMALITY**Table 11.** *Distribution of cases according to periodontal involvement and Angle class*

Periodontal disease	Angle class anomalies				Total
	Class I	Class II/1	Class II/2	Class III	
Absent	208	76	49	29	362
	57.46%	20.99%	13.54%	8.01%	
Present	60	31	26	16	133
	45.11%	23.31%	19.55%	12.03%	
Total	268	107	75	45	495

Table 12. *Estimated parameters in testing the association of periodontal involvement and Angle class*

df=3	Chi-square χ^2	P 95% confidence interval
Pearson Chi-square - χ^2	17.028262	p=.037101
M-L Chi-square	16.912944	p=.037473
Correlation coefficient (Gamma)	.2137337	p=.00840

Periodontal disease presented a statistically significant association with the

type of anomaly evaluated - Angle class ($\chi^2=17.02$, $p=0.037$, 95%CI), in the sense

that it is present more frequently in classes II and III compared to Angle I classes.

In the study population, a statistically significant association was found between the periodontal involvement before orthodontic treatment and the age of patients, the type of Angle class.

In the study population, 75.15% of the cases benefited from non-extraction orthodontic treatment and 24.85% from extraction treatment. Fixed appliances were applied to 54.14% of cases, while mobile devices to 45.45%.

ORTHODONTIC TREATMENT APPLIED TO THE STUDY POPULATION

Table 13. Orthodontic treatment in the study population

Study population –orthodontic treatment	n	%
Extraction cases	123	24.85%
Non-extraction cases	372	75.15%
Fixed appliance	268	54.14%
Mobile appliance	225	45.45%
Orthodontic surgical treatment	16	3.23%
Study population total	495	

Table 14. Distribution of cases in the study population according to pre- and post-treatment periodontal involvement

Study population – Type of periodontal disease	Pre-treatment		Post-treatment	
	n	%	n	%
Absent	34	20.36%	45	
Present	133	79.64%	122	
Gingivitis (G)	57	34.13%	39	
gingivitis + gingival recessions (GR)	8	4.79%	3	
gingivitis + periodontal pockets (GP)	14	8.38%	13	
gingivitis + gingival recessions + periodontal pockets (GRP)	8	4.79%	16	
eriodontal pockets (P)	22	13.17%	43	
periodontal pockets + gingival recessions (PR)	8	4.79%	3	
juvenile / agresive / chronic periodontitis (Pj)	2	1.20%	-	
gingival recessions (R)	13	7.78%	5	
Study population total	167			

Periodontal disease pre- and post-orthodontic treatment was studied comparatively by types of periodontal changes. We found a reduction in the number of gingival recessions, gingivitis,

but also combinations of gingivitis-pockets and gingivitis-recessions, but also an increase in the number of periodontal pockets.

Table 15. Periodontal disease pre- post-treatment vs. age

Pre-treatment periodontal disease										
	ABS	R	G	GR	GP	GRP	P	PR	Pj	Total
adolescents	30	0	17	0	0	1	15	1		64
	46.88%	0%	26.56%	0%	0%	1.56%	23.44%	1.56%		
adults	15	5	22	3	13	15	28	2		103
	14.56%	4.85%	21.36%	2.91%	12.62%	14.56%	27.18%	1.94%		
Total	45	5	39	3	13	16	43	3		167
Post-treatment periodontal disease										
adolescents	27	0	31	0	1	1	1	1	2	64
	42.19%	0%	48.44%	0%	1.56%	1.56%	1.56%	1.56%	3.13%	
adults	8	13	26	8	13	7	21	7	0	103
	7.77%	12.62%	25.24%	7.77%	12.62%	6.80%	20.39%	6.80%	0.00%	
Total	35	13	57	8	14	8	22	8	2	167

Periodontal disease following orthodontic treatment decreased on average by 5%. By age group, we found a decrease in the number of periodontal pockets in adults, but also an increase in the number of recessions and gingivitis, while in teenagers we noticed an increase in the cases of gingivitis, counting twice as many compared to the initial situation, and increasing more than in adults, but also a slight increase in the number of initially unaffected cases that acquired disease along the way.

DISCUSSIONS

Mucogingival problems are found in both adolescents and adults, with the following causes: inadequate keratinized gingiva, minimally attached gingiva, frenulums and alveolo-jugal folds with coronal, low insertion, dental malpositions, fenestrations or alveolar bone dehiscences. [7-11] In the analysed group, we most frequently identified gingival recessions at the level of the lower incisors.

During orthodontic treatment, some teeth with a normal amount of attached gingiva may show localised vestibular recessions, most likely caused by excessive forces that may push the tooth out of the alveolar

cortex. These recessions, following dental displacements, are often areas where inflammation is absent, which explains why the orthodontic displacement had a direction towards areas presenting attachment deficiency or was excessive, as is observed in some cases after orthognathic surgery or post maxillary disjunction. Against this background, a chronic marginal gingivitis can easily destroy alveolar bone and gingival attachment, even when light orthodontic forces are applied. [12-17]

Supportive periodontal therapy is of indisputable importance for the long-term preservation of the results of orthodontic therapy in cases with periodontal susceptibility or involvement. [18-22]

Oral hygiene was correct prior to treatment in 56.25% of adolescents and 39.81% of adults. The statistical results show that before the orthodontic treatment oral hygiene was most frequently incorrect in patients who presented dental crowding located on both arches. We found inadequate pre-treatment oral hygiene in 335 of the 495 analysed patients, of whom 48% had Angle Class I anomalies, 24% Angle Class II/1, 18.5% Angle Class II/2 and 9.5% Angle Class III. We also found

that, in the studied group, oral hygiene was incorrect prior to treatment in 505 of the cases with normal overjet as well as in 23.88% of the cases with normal overbite. Periodontal involvement before orthodontic treatment was studied on 167 cases, representing the adolescents and adults in the group. We found pre-treatment involvement in 80% of the analysed cases, predominantly through gingivitis 34%. The distribution by age showed periodontal involvement in adolescents in a proportion of 57.81% of cases, predominantly through gingivitis, and in adults in 93.2% of cases, predominantly through gingivitis, pockets and recessions. In relation to the degree of dental crowding, pre-treatment periodontal involvement is more frequently present in cases with bimaxillary crowding, while dental spacing correlates with periodontal involvement especially if it is located in the upper jaw. [22-29]

In the study population, we found that the periodontium is affected pre-treatment in 45% of patients with Angle class I abnormalities, 23% of patients with Angle class II/1, approximately 20% patients with Angle class II/2 and 12% Angle class III. We also found that pre-treatment periodontal involvement is present in 60% of cases with normal overjet and 30% of cases with normal overbite, but has increased proportions in cases with increased overbite.

The periodontal involvement after orthodontic treatment is influenced by: the type of anomaly, the periodontal deterioration occurs most frequently in classes III, then in classes I, and then in classes II/2, while the improvement of the periodontal condition occurs most frequently in classes III, then in classes II/2 and age, the post-treatment deterioration of the periodontium occurred mostly in adults, compared to adolescents, while the

improvement of the periodontal status was found in significantly equal percentages in both adults and adolescents. [30-32]

The present research demonstrated that, in the studied group, periodontal involvement decreased from 79% pre-treatment to 73% post-orthodontic treatment, especially for cases with recessions, pockets and gingivitis. Depending on age, post-treatment periodontal involvement was characterised by a statistically significant decrease in the number of periodontal pockets in adolescents, but also by an increase in the number of gingivitis, while in adults we observed an increase in the number of recessions and gingivitis, but also a decrease in the number of periodontal pockets.

Age, in itself, is not a contraindication to orthodontic treatment. With age, cellular activity decreases and periodontal tissues become richer in collagen, the therapeutic response to the action of orthodontic forces becoming slower, compared to children and adolescents. [33-34]

CONCLUSIONS

In patients with periodontal disease, bone lysis involves a reduction in the surface of the periodontal ligament, so the same force applied at the coronal level will produce a greater pressure on the periodontal ligament of a compromised tooth compared to a healthy one, which implies the use of very light forces on a compromised periodontal ground.

The state of oral hygiene before orthodontic treatment of the patients in the analysed group correlates statistically significantly with the age of the patients and the type of Angle class.

Periodontal involvement after orthodontic treatment decreased on average by 5%. By age group, we found in adults a decrease in

the number of periodontal pockets, but also an increase in the number of recessions.

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