



## Evaluation of a prevention programme efficiency for patients with fixed orthodontic appliances

### Procena efikasnosti preventivnog programa za pacijente sa fiksnim ortodontskim aparatima

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#### Abstract

**Background/Aim.** Orthodontic treatment enables the establishment of functional occlusion and improvement of oral health, however, it increases the risk of periodontal disease development. The aim of this paper was to examine the efficiency of the applied programme for the prevention of gingivitis in children undergoing the fixed orthodontic appliance therapy and to determine the most efficient devices and techniques for maintaining oral hygiene during orthodontic treatment. **Methods.** The study included 80 patients of both genders – 60 patients comprised the experimental group and 20 patients comprised the control group. All of them were patients of the Clinic for Orthodontics at the School of Dentistry in Belgrade, aged between 13 and 18. The Silness-Löe Plaque Index (PI) was utilised for the assessment of oral hygiene quality and Silness-Löe Gingival Index (GI) and Mühlemann Papilla Bleeding Index (PBI) were utilised for the assessment of gingival state. Checkups were conducted as a single-blind study at the beginning and after the first, the third and the sixth month of the preventive and prophylactic programme. **Results.** During the observed period, a statistically significant change in PI, GI and PBI values was noticed ( $p < 0.005$ ), as well as the difference in the dynamics of value changes during the periods between the observed groups. **Conclusion.** The preventive programme, applied to children undergoing the fixed orthodontic appliance therapy, had a positive effect both on oral hygiene quality and gingival state. The values of the examined parameters of the patients from the experimental group were significantly lower in comparison with those of the patients from the control group. The most efficient combination of devices for oral hygiene during orthodontic treatment was: a Curaprox CP5460 toothbrush, CD Ortho 60 orthodontic toothbrush and Curaprox CPS 14 interdental brush.

**Key words:** orthodontic appliances; preventive dentistry; oral hygiene; periodontal index; dental plaque index; adolescent.

#### Apstrakt

**Uvod/Cilj.** Ortodontsko lečenje omogućava uspostavljanje funkcionalne okluzije, poboljšanje oralnog zdravlja, ali nosi i povećan rizik od nastanka parodontalnih oboljenja. Cilj rada bio je da se ispita efikasnost primenjenog programa za prevenciju gingivitisa kod dece koja su pod terapijom fiksnim ortodontskim aparatima i da se utvrdi koja su najefikasnija sredstva i tehnike za održavanje oralne higijene tokom ortodontskog tretmana. **Metode.** Ispitivanjem je obuhvaćeno 80 ispitanika oba pola, od kojih je 60 činilo eksperimentalnu, a 20 kontrolnu grupu. Svi ispitanici bili su pacijenti Klinike za ortopediju vilica, Stomatološkog fakulteta Univerziteta u Beogradu, uzrasta od 13 do 18 godina. Za procenu oralne higijene primenjivan je plak indeks (PI) prema Silness-Löe-u, a za procenu stanja zdravlja gingive primenjivani su gingivalni indeks (GI) prema Löe-Silness-u i indeks krvarenja gingive (IKG) prema Milemanu. Pregledi ispitanika rađeni su kao jednostruko slepo istraživanje. Pregledi su obavljani na početku, posle prvog, trećeg i šestog meseca preventivno-profilaktičkog programa. **Rezultati.** Utvrđena je statistički značajna promena vrednosti PI, GI i IKG ( $p < 0,005$ ) tokom posmatranog vremenskog perioda, kao i razlika u dinamici promena vrednosti tokom vremena između posmatranih grupa. **Zaključak.** Primenjeni preventivni program kod dece koja su pod terapijskim fiksnim ortodontskim aparatima pozitivno je uticao na kvalitet izvođenja oralne higijene, kao i na stanje zdravlja gingive. Smanjenje vrednosti ispitivanih parametara ispitanika eksperimentalne grupe bilo je značajno u odnosu na ispitanike kontrolne grupe. Kombinacija sredstava za izvođenje oralne higijene tokom ortodontskog tretmana koja je dala najbolje rezultate je: četkica za zube Curaprox CP5460, ortodontska četkica CD Ortho 60 i interdentalna četkica Curaprox CPS14.

**Ključne reči:** ortodontski aparati; stomatologija, preventivna; higijena, oralna; periodontalni indeks; zub, indeks plaka; adolescenti.

## Introduction

Orthodontic treatment is widely acknowledged and accepted in everyday dental practice due to the positive effects it has on dentofacial complex. With fixed orthodontic appliances, clinicians can offer patients the establishment of functional occlusion, improvement of oral health and aesthetic improvement of dentofacial complex. Anomalies in development of the face and jaws, as well as orthodontic treatment, can influence oral health. Deviations from an ideal arrangement and position of teeth (lack of space, tooth rotation or open bite, a deep bite and cross-bite) facilitate dental plaque accumulation. It has to be pointed out that malocclusion is not a primary etiological factor, but an auxiliary factor which facilitates dental plaque accumulation. The main principle of orthodontic therapy is to correct tooth and jaw position and thus indirectly improve the health of parodontium and durability of teeth<sup>1</sup>.

By accepting an orthodontic treatment, a patient makes a firm commitment to maintain oral hygiene regularly and thus prevent potential iatrogenic damages which may occur during therapy. Numerous studies show a significant increase in the quantity of dental plaque as well as in the occurrence of gingivitis in patients with fixed orthodontic appliances because they make removal of dental plaque difficult<sup>2</sup>. Fixed orthodontic appliances, such as orthodontic braces, arches and rings, increase the number of retention places for dental plaque accumulation. All these factors make it even more difficult to maintain oral hygiene<sup>3</sup>. Self-cleaning is also more difficult because of the reduced effect of mechanical chewing and rinsing the food residues off by saliva<sup>4</sup>. All preventive programmes referring to prevention and treatment of an gingivitis and parodontopathy include regular removal of dental plaque as a part of an adequate daily oral hygiene.

The following factors are necessary for adequate oral hygiene: adequate devices (equipment), correct technique of using those devices, regular toothbrushing and sufficient length of brushing every single tooth. Recommendations for adequate devices for oral hygiene maintenance include the following factors: specific needs of patients (disease predisposition or state of the mouth) and individual characteristics (age, affinities, manual dexterity or lifestyle). All these factors should be adjusted to individual patients in order to enable perfect oral hygiene at home. Individual preventive programmes should be implemented for patients with fixed orthodontic appliances and they should, apart from health education, include education about the importance of regular and correct oral hygiene maintenance and checkups. Patients need to be demonstrated the correct technique and frequency of toothbrushing. They also need to learn about the right toothbrushes, interdental and orthodontic brushes, as well as about auxiliary devices for oral hygiene maintenance (adequate toothpaste and mouthwash)<sup>5</sup>.

During a fixed orthodontic appliance therapy, the technique and duration of toothbrushing and constant motivation of patients are key factors of oral hygiene maintenance. Before the beginning of treatment, patients should be informed about the increased risk of caries and parodontium and they

should be instructed about the necessity of regular oral hygiene maintenance in order to minimise the risks<sup>6</sup>. The choice of patients, education and training about a regular and correct oral hygiene maintenance together with preventive and prophylactic measures and patients' motivation will increase the comfort of patients undergoing orthodontic therapy and contribute to the functional and aesthetic success of it. A regular oral hygiene maintenance is of great importance for the preservation of gingival health until the end of orthodontic therapy as well as after its ending. Apart from having a regular dental arch, the habit of regular oral hygiene will help preserve the health of gingiva and contribute to lifelong oral health.

The aim of this paper was to examine the efficiency of the applied programme for the prevention of gingivitis in children undergoing the fixed orthodontic appliance therapy and determine the most efficient devices and techniques for maintaining oral hygiene during orthodontic treatment.

## Methods

The study included 80 patients of both genders – 60 patients comprised the experimental group and 20 ones the control group. The experimental group was subdivided into three groups consisting of 20 patients each and they received different devices for oral hygiene maintenance. For oral hygiene maintenance, the patients from the experimental group 1 used Curaprox CP5460 toothbrush and Curasept ADS 205 mouthwash, patients from experimental group 2 used Curaprox CP5460 toothbrush, CD Ortho 60 orthodontic toothbrush and Curaprox CPS14 interdental brush and the patients from the experimental group 3 used Curaprox CP5460 toothbrush, Curaprox CPS14 interdental brush and Curasept ADS 205 mouthwash. All of them were patients of the Clinic for Orthodontics at the School of Dentistry in Belgrade, aged between 13 and 18. Random sampling was applied as a method. All the patients had the written consent of their parents and all of them had been previously fully informed, both orally and in a written form, about the objectives of the research. During the research, 10% of the whole sample (8 patients) were re-examined in a four-hour interval and the compared data were processed. The acquired Kappa value of 0.84 denotes excellent concordance and verifies the fact that individual error of the examiner is within the acceptable limitations<sup>7</sup>.

The Silness-Löe Plaque Index (PI) was utilised for the assessment of oral hygiene quality. The Silness-Löe Gingival Index (GI) and Mühlemann Papilla Bleeding Index (PBI) were utilised for the assessment of gingival state.

PI values were assessed from 0 to 3 according to the following criteria:

0 – There is no dental plaque on the gingival third of the tooth crown. The research was conducted by pulling the tip of the probe over the tooth surface at the entry into the gingival sulcus after a tooth had been adequately dried. The surface of the tooth is considered clean if no materia alba is adherent to the tip of the probe;

1 – Dental plaque cannot be recognised with a naked eye on the examined surface of a tooth, but it becomes visible on the tip of the probe after it has been pulled over the tooth surface at the entry into the gingival sulcus. In these situations, solutions for the visualisation of plaque can be used;

2 – A gingival third of the tooth crown is covered with a thin or moderately thick layer of dental plaque. Plaque deposit is visible to the naked eye;

3 – There is an abundance of dental plaque which is 1–2 mm thick and covers the gingival edge and the surface of the neighbouring tooth and fills the gingival sulcus, i.e. the pocket. Interdental area is filled with debris.

An average PI was calculated by adding individual PI for every single tooth and dividing the acquired sum by the number of examined teeth. The acquired value is divided by four because four surfaces of a tooth are examined: vestibular, oral, mesial and distal.

This index is mostly used for the assessment of gingival state and examination of those parts of the tooth where the PI has been determined. The assessment is based on the change in color and consistency and gingival swelling. GI values were assessed in the following way:

0 – Healthy gingiva;

1 – Mild inflammation – gingival edge is slightly redder than normally, there is a mild oedema and an increased secretion of gingival exsudates from the sulcus and gingiva does not bleed when provoked by a blunt probe;

2 – Moderate inflammation – gingiva is red, there is a pronounced oedema and enlargement of free gingiva and gingiva bleeds when a blunt probe is gently pressed against it;

3 – strong inflammation – gingiva is very red and enlarged, there is a strong tendency towards spontaneous bleeding and there are gingival ulcers.

A total GI is acquired by adding all values of the gingival state from vestibular, mesial, oral and distal surfaces of examined teeth and by dividing the acquired sum by four and then by the number of examined teeth. Mild gingival inflammation refers to GI values 0.5–1.0, whereas moderate gingival inflammation refers to GI values 1.1–2.0. In case mean GI values range from 2.1 to 3.0, gingival inflammation is assessed as serious.

Clinical assessment of color, form and surface structure of gingiva is based on the subjective assessment of an examiner, whereas gingival bleeding is an objective diagnostic sign of inflammation linked to several periodontal diseases. In this study, Mühlemann PBI from gingival sulcus was used as a precursor and the first sign of gingival inflammation. Gingival bleeding is the earliest sign of inflammation occurring even before the change in form and colour. Bleeding index is determined by gingival bleeding provoked by a blunt periodontal probe. The probe first examines distal and then mesial surface of the sulcus, from the base of interdental papilla to its top. Intensity of bleeding is assessed in the following way:

0 – There is no bleeding 20–30 seconds after using a probe;

1 – After using a probe, there is bleeding at only one place;

2 – There are several traces of blood from a papilla in the form of spots and threads;

3 – Interdental area is filled with blood immediately after a probe has been used (blood from papilla in the form of drops);

4 – Bleeding is profuse after a probe has been used. Interdental area is immediately filled with blood which flows over into gingival sulcus and out of it.

Mühlemann PBI is a reliable indicator of gingival state and it is utilised in a relatively fast and simple way. While determining the index, a patient alone can monitor the intensity of bleeding (i.e. the degree of gingival inflammation), which can motivate him/her to maintain a regular and appropriate oral hygiene. Bleeding provoked by a probe is the first sign of gingivitis because the beginning of inflammation is connected with the sulcus side of gingiva invisible to the examiner.

Checkups were conducted as a single-blind study. During checkups, PI, GI and PBI values acquired by an examination with a periodontal probe and a dental mirror with artificial light were recorded first, whereas the technique of conducting oral hygiene and remotivation were monitored later. Checkups were conducted at the beginning and after the first, third and sixth month of the preventive and prophylactic programme. During checkups, PI, GI and PBI were recorded into special study reports in accordance with the described methodology. In the control group, checkups were conducted and values acquired by measuring anticipated indexes in determined time intervals were recorded. The patients from the control group were not included in the preventive and prophylactic programme. Instead, they were advised on methods of maintaining oral hygiene and on proper nutrition by orthodontists who had installed the fixed appliances on their teeth. They also used a standard orthodontic toothbrush for maintaining oral hygiene.

The patients who met all criteria for inclusion into the study were included into the experimental model of the preventive programme after the first checkup and they became a part of the experimental group. After they had been thoroughly acquainted with the causes of the disease of gingiva and the supporting apparatus of teeth through health and education work, they were instructed how to prevent or slow down such diseases. They were explained that the key factor for preventing gingival disease is the control of dental plaque. The patients from all three experimental groups received Curaprox CP5460 ultrasoft toothbrushes. They demonstrated how they brushed their teeth and then their toothbrushing technique was assessed. Afterwards, the Bass technique of toothbrushing was demonstrated and practised (a technique which enables removal of dental plaque from gingival thirds of teeth). Techniques of some patients were corrected in terms of adapting movements during toothbrushing in certain areas due to the specific position of teeth and the fixed orthodontic appliances. The patients from the experimental groups 2 and 3 got Curaprox CPS 14 interdental toothbrushes. The procedure for using this toothbrush was demonstrated and practised – this toothbrush is intended for brushing the area around braces and between orthodontic braces, arches and vestibular surfaces of teeth. Apart

from getting toothbrushes and interdental toothbrushes, the patients from the experimental group 2 were instructed to use properly a CD Ortho 60 orthodontic toothbrush. They were told about its role in maintaining braces and the area around orthodontic braces clean. The patients from the experimental groups 1 and 3 got Curasept ADS 205 mouthwash for a longterm use, containing 0.05% of fluoride and 0.05% of chlorhexidine, and accompanied by written instructions for use. The importance of using mouthwash and its role in preventing plaque accumulation were explained, as well as the fact that chemical agents can never replace toothbrushing<sup>8</sup>. All patients got tablets of erythrosine for dental plaque colouring and visualisation so that they could check at home whether they had brushed their teeth properly and correct their brushing techniques in case plaque was not removed from all surfaces.

During the next checkup, clinical parameters (PI, GI and PBI values) were measured and recorded. The patients spoke about their impressions in terms of toothbrushing techniques and potential difficulties during brushing. Afterwards, dental plaque was identified (by erythrosine) and the toothbrushing technique was monitored. The toothbrushing technique was practised again, as well as the position of an arm and head while brushing inaccessible surfaces due to the specific position of the tooth. The patients from experimental groups 2 and 3 were monitored while using interdental brushes and the techniques were corrected when necessary.

Considering different levels of manual dexterity of patients of this age range and their previous toothbrushing skills, some of them should be given more time for practice until they learn to use properly mechanical devices for oral hygiene maintenance. The patients were motivated by repeated lecture from the previous visit on preserving oral health – the health of teeth and gingiva and duration of the fixed orthodontic appliance therapy depend on how much patients adhere to the given advice on maintaining oral hygiene and proper nutrition. During the third checkup, clinical parameters (PI, GI and PBI values) were measured and the level of oral hygiene was monitored just like in previous visits. Since the level of oral hygiene decreases in time, even with the best trained children, patients were remotivated and the toothbrushing technique was re-

vised. During the fourth checkup conducted six months after the beginning of the programme, the values of monitored clinical indexes were recorded.

Statistical package SPSS was used for the statistical analysis of data which included the calculation of descriptive statistical parameters (mean values with dispersion measures), as well as the statistical check of hypotheses established during the research. The single-factor and a double-factor analyses of variance were utilised for analysis of both, PI and GI, whereas Mann-Whitney and Kruskal-Wallis tests were utilised for analysis of the PBI. Each value  $p < 0.05$  was regarded as a statistically significant difference.

## Results

During the observed 6-month period, a statistically significant change in PI, GI and PBI values was noticed after conducting a double-factor analysis of variance, as well as the difference in the dynamics of changes in value during the periods in-between the observed groups.

Table 1 shows the results of comparison of PI between the observed groups during a 6-month period of monitoring.

Arithmetic mean values of PI at the beginning of measuring were significantly different (single-factor analysis of variance,  $p = 0.022$ ). There was also a statistically significant difference in the second period of measuring which took place a month later (single-factor analysis of variance,  $p = 0.001$ ). Arithmetic mean values of PI in all three experimental groups decreased, whereas PI values of the control group indicated a slight growth. The trend carried on even three and six months later (single-factor analysis of variance,  $p = 0.000$ ). Compared with the other two experimental groups, the experimental group 2 indicated the lowest values of arithmetic mean of PI. Three months later, the control group maintained the similar level as one month later, whereas six months later there was a slight decrease in the values of arithmetic mean of PI.

The results of comparison of GI values are presented in table 2.

**Table 1**  
Comparison of plaque index (PI) values of the observed groups during a 6-month period of monitoring

Time (months)	CG ( $\bar{x} \pm SD$ )	EXP1 ( $\bar{x} \pm SD$ )	EXP2 ( $\bar{x} \pm SD$ )	EXP3 ( $\bar{x} \pm SD$ )	<i>p</i>
0	0.416 ± 0.159	0.635 ± 0.322	0.494 ± 0.144	0.501 ± 0.213	0.022
1	0.545 ± 0.189	0.458 ± 0.216	0.301 ± 0.117	0.407 ± 0.173	0.001
3	0.579 ± 0.174	0.326 ± 0.155	0.193 ± 0.094	0.307 ± 0.119	0.000
6	0.501 ± 0.185	0.218 ± 0.118	0.086 ± 0.062	0.208 ± 0.057	0.000

CG – the control group; EXP 1 – the experimental group 1; EXP 2 – the experimental group 2;  
EXP 3 – the experimental group 3;  $\bar{x}$  – mean value; SD – standard deviation

**Table 2**  
Gingival index (GI) values of the observed groups during a 6-month period of monitoring

Time (months)	CG ( $\bar{x} \pm SD$ )	EXP1 ( $\bar{x} \pm SD$ )	EXP2 ( $\bar{x} \pm SD$ )	EXP3 ( $\bar{x} \pm SD$ )	<i>p</i>
0	0.506 ± 0.152	0.776 ± 0.379	0.567 ± 0.154	0.622 ± 0.221	0.006
1	0.641 ± 0.189	0.602 ± 0.278	0.414 ± 0.125	0.508 ± 0.187	0.003
3	0.668 ± 0.158	0.436 ± 0.180	0.303 ± 0.092	0.396 ± 0.125	0.003
6	0.577 ± 0.186	0.307 ± 0.133	0.161 ± 0.090	0.260 ± 0.081	0.000

CG – the control group; EXP 1 – the experimental group 1; EXP 2 – the experimental group 2;  
EXP 3 – the experimental group 3;  $\bar{x}$  – mean value; SD – standard deviation

A single-factor analysis of variance at the beginning of the research does not indicate any statistically significant differences in GI values among the examined groups:  $p = 0.006$ . After a month, there was a statistically significant difference in GI values among examined groups (a single-factor analysis of variance,  $p = 0.003$ ). Arithmetic mean values of GI for all the three experimental groups indicate a decrease, whereas GI values for the control group indicate a growth. After three months, there was a statistically significant difference in GI values among the examined groups (a single-factor analysis of variance,  $p = 0.000$ ). The values of arithmetic mean for the experimental groups were decreased – the experimental group 2 had the lowest values, next came the experimental group 3 and finally the experimental group 1. After three months, GI values for the control group indicated growth, whereas after six months they indicated a slight decrease.

The obtained PBI values for both groups within a 6-month period are compared and presented in Table 3.

experimental group 2 indicated a bigger and statistically more significant difference from the experimental group 1 than from the experimental group 3. For oral hygiene maintenance, the patients from the experimental group 3 used a Curaprox CP5460 toothbrush, Curaprox CPS 14 interdental brush and Curasept ADS 205 mouthwash, whereas the patients from the experimental group 1 used a Curaprox CP5460 toothbrush and Curasept ADS 205 mouthwash. The results are in accordance with the research conducted by Kilicoglu et al. <sup>9</sup>, where they compared oral hygiene of patients undergoing the fixed orthodontic appliance therapy using two different types of toothbrushes. PI and PBI values were measured at the beginning of the research and after a month and it was concluded that utilising several types of mechanical devices (classical, orthodontic and interdental toothbrushes) for maintaining oral hygiene was more effective in removing dental plaque.

Bulajić <sup>10</sup> conducted a six-month research with 32 patients and she got the following results: during the first three

Table 3

Papilla bleeding index (PBI) values during a 6-month period of monitoring

Time (months)	CG ( $\bar{x} \pm SD$ )	EXP1 ( $\bar{x} \pm SD$ )	EXP2 ( $\bar{x} \pm SD$ )	EXP3 ( $\bar{x} \pm SD$ )	<i>p</i>
0	0.219 ± 0,103	0.326 ± 0,176	0.249 ± 0,101	0.289 ± 0,132	0.155
1	0.278 ± 0,128	0.204 ± 0,123	0.148 ± 0,051	0.199 ± 0,102	0.003
3	0.258 ± 0,113	0.144 ± 0,077	0.047 ± 0,053	0.134 ± 0,065	0.000
6	0.188 ± 0,104	0.093 ± 0,055	0.019 ± 0,030	0.086 ± 0,030	0.000

CG – the control group; EXP 1 – the experimental group 1; EXP 2 – the experimental group 2; EXP 3 – the experimental group 3;  $\bar{x}$  – mean value; SD – standard deviation

After comparing PBI values among the groups, it was determined that arithmetic mean values at the beginning of registration were not significantly different in statistical terms (Kruskall-Wallis test,  $p = 0.155$ ). Arithmetic mean of PBI value was the lowest at the beginning of measuring for the control group. After one month, PBI values were significantly different in statistical terms (Kruskall-Wallis test,  $p = 0.003$ ). At the beginning, PBI values for the control group indicated a growth and after three months they indicated a decrease which was continued even after six months. PBI values for the experimental groups indicated a decrease during all checkups. After a month, PBI values of the experimental group 2 were lower than PBI values of all the other groups and the trend carried on until the last checkup, *i.e.* after six months. Arithmetic mean values of PBI were significantly different in statistical terms after three and six months ( $p = 0.000$ ).

## Discussion

The experimental model of the preventive programme, whose elements have been mentioned in the methodology, has shown positive effects on the removal of dental plaque and prevention of its reaccumulation. The patients from the experimental group 2 had the lowest values of dental plaque, which can be explained by the fact that they had used three different types of toothbrushes which had helped them remove dental plaque from the least accessible surfaces. The

months after the fixed appliance had been installed, PI values tended to grow; after that they stabilised and finally they started decreasing towards the end of a sixth-month period. These findings are in accordance with the results of the current research as far as the control group is concerned. Regardless of the type of fixed orthodontic technique (ring or braces), adolescents experience much higher plaque accumulation and more serious gingival inflammation than adults before, during and after the orthodontic treatment.

The results are also in accordance with the research conducted by Wang et al. <sup>11</sup>, which included 57 patients with fixed orthodontic appliances. The patients from the experimental group were a part of the preventive programme which included health and education work, identification of plaque with plaque-colouring devices and the training about using orthodontic, single-tuft and interdental brushes as well as dental floss for oral hygiene maintenance. Both, PI and GI were examined during checkups, which were conducted every three weeks in the course of six months. The patients were remotivated and instructed how to perform oral hygiene properly. At the beginning of the research, there were no statistically significant differences in PI and GI values between the control and the experimental groups. After the checkups, however, there was a statistically significant difference in PI and GI values between the groups, which goes to say that the preventive programme was fruitful. The authors conclude that the state of oral health of patients undergoing the fixed orthodontic appliance therapy can be improved by imple-

menting measures such as health education and practising, revising and monitoring techniques of oral hygiene maintenance, along with permanent motivation of patients. Good oral hygiene and appropriate devices for its maintenance produce good results in terms of oral health, but the importance of instructions and trainings should not be overlooked either.

Ay et al.<sup>12</sup> have proven the thesis that oral instructions are insufficient for achieving a satisfactory level of oral hygiene – orthodontists and dental hygienists must make a point of improving the level of oral hygiene of orthodontic patients. They conducted the study with 150 orthodontic patients divided into five groups and they compared the efficiency of verbal motivational methods for oral hygiene maintenance with auxiliary devices or without them under the supervision of dentists. After four weeks, there were significant differences in GI values among experimental groups.

It takes a lot of patience, effort and time for the patients with fixed orthodontic appliances to master a quality technique of toothbrushing. At the beginning, it takes up to 15 or 20 minutes to brush teeth if three different brushes are used. In time, when patients master the technique of performing oral hygiene, the duration of toothbrushing shortens. According to this research, results of the preventive programme in the experimental group (lower PI, GI and PBI values) show that a good preventive programme, based on motivation, health education and good trainings about performing oral hygiene, enables preservation of periodontal tissue health, which is in accordance with researches of other

authors who have studied effects of preventive programmes including motivation, trainings about oral hygiene maintenance and health and education work<sup>13</sup>.

### Conclusion

During the research, there were statistically significant decreases in PI, GI and PBI values of the patients from all the three experimental groups, which proves that the applied programme for the prevention of gingivitis in children undergoing the fixed orthodontic appliance therapy had a positive effect on the quality of performing oral hygiene, as well as on the gingival state. The values of the examined parameters of patients from the experimental group were significantly lower in comparison with the examined parameters of the patients from the control group. The most efficient combination of devices for oral hygiene during orthodontic treatment was: Curaprox CP5460 toothbrush, CD Ortho 60 orthodontic toothbrush and Curaprox CPS14 interdental brush. Good oral hygiene can be achieved by using a Curaprox CP5460 toothbrush, Curaprox CPS14 interdental brush and Curasept ADS 205 mouthwash for a longterm use.

Motivation, adherence to all measures proposed by the preventive programme and their implementation, patience, persistence, practice and mastering the techniques of performing oral hygiene prevent gingival diseases and enable successful implementation of acquired knowledge and skills regarding oral hygiene maintenance both after the orthodontic treatment and throughout life.

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Received on November 30, 2009.

Revised on February 16, 2010.

Accepted on February 22, 2010.