

Pain and discomfort perception among patients undergoing orthodontic treatment: Results from one month follow-up study

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SUMMARY

Objective. To explore pain and discomfort experience among patients undergoing orthodontic treatment with different appliances during one month after the appliance insertion, and to elucidate predicting role of patients' motivation for treatment and awareness of discomfort to the intensity of pain.

Material and methods. The study group consisted of 93 orthodontic patients treated with braces (48.4%), braces and head gear (9.7%), removable appliances (34.4%) and functional appliances (7.5%). The patients were asked about pain and discomfort (increased salivation, soft tissues lesion, etc.) they had experienced during one month after the appliance insertion and about motivation for treatment as well as awareness of probable discomfort.

Results. 72.0% of patients reported that they complained of pain after one day the appliance had been inserted, but the percentage of such respondents significantly decreased during one month. Patients experienced the highest scores of discomfort from 12 hours to 2 days after the appliance insertion. The change of pain intensity and scores of other discomforts depended on treatment method showing favourable trends for patients treated with braces and head gear, and functional appliances. Patients who were positively motivated for the treatment or were aware of possible pain and discomfort reported significantly decreasing pain during treatment.

Conclusions. The perception of pain and discomfort among orthodontic patients was variable during the first month after the appliance insertion regarding the type of appliance, patients' motivation for treatment and their awareness of probable discomfort.

Key words: orthodontic treatment, pain, discomfort, motivation, awareness.

INTRODUCTION

Pain and discomfort are common experiences during orthodontic treatment. Discomfort is expressed as unpleasant tactile sensations, feeling of constraint in the oral cavity, stretching of the soft tissues, pressure on the mucosa, displacement of the tongue, soreness of teeth and pain (1-4). During the orthodontic treatment patients frequently undergo a number of functional complaints and social discom-

fort and they are anxious about their appearance. Patients' self-confidence might be affected by visibility of the appliance and speech impairment, especially during social interactions when attention is focused on the face, eyes and mouth (5).

All orthodontic procedures such as separator placement, arch wire placement and activations, application of orthopedic forces and debonding produce pain in patients. Pain, induced by orthodontic treatment, generally could be categorized as mild and short lasting (6). However, some patients do experience severe pain, even to the extent that mastication of food and tooth brushing might be impaired (6). Orthodontic appliance induced pain is one of the main reasons that discourage patients from seeking orthodontic treatment and may negatively affect patient cooperation (5, 7).

Pain is a subjective response and shows large individual variations. It is dependent upon factors such

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as age, gender, individual pain threshold, the magnitude of the force applied, present emotional state and stress, cultural differences, and previous pain experiences (2, 8-11). In adolescent patient sample, low motivation for orthodontic treatment, elevated dental anxiety level, and low activity temperament characterized patients reporting more pain (12).

The association between the type of orthodontic appliance worn by the patient and his complaints remains a controversial issue (3). Thus, the first aim of the present study was to explore pain and discomfort experience among patients undergoing orthodontic treatment with different appliances during one month after appliance insertion.

Recent research data indicate that patients may adapt to continuous pain with the progression of treatment as the sensations cease or at least disappear from their focus of attention (2, 13-15). A clinician must precisely know and explain to patient how much time is needed for such adaptation to occur. Insufficient information about orthodontic treatment and lack of communication between the orthodontist and patient were the basis for premature termination of orthodontic treatment (16). Consequently, the second aim of our study was to elucidate roles of patients' motivation for orthodontic treatment and awareness of negative perceptions to the intensity of pain during orthodontic treatment.

MATERIAL AND METHODS

Subjects

The study group consisted of 93 patients – 34 males (36.6%) and 59 females (63.4%). The sample was obtained by approaching consecutive patients, who agreed to participate in the study, attending for orthodontic treatment at the Orthodontic Clinic, Lithuanian University of Health Sciences, Kaunas, from November 2009 till February 2011. Approval for the study was obtained from the university Ethics Centre (Be-SLF(N)-110).

The main criteria for including patients into the study group were no prior history of orthodontic treatment. Mean age of selected patients was 16.0 years (SD=5.1) and age range 8-30 years at the start of treatment: 65 patients under 18 years old (69.9%) and 28 (30.1%) – 18 years and older.

According to the orthodontic treatment method the study sample consisted of 4 groups: patients with braces (n=45; 48.4%), braces and head gear (n=9; 9.7%), removable appliances (n=32; 34.4%) and functional appliances (n=7; 7.5%).

Response rate to participation in the study was 93.0%.

Study variables

Patients were asked to complete a questionnaire and to answer questions about pain and discomfort they had experienced during one month after the appliance insertion. The questions about the intensity of pain contained three series of horizontal visual analogue scales (17) on which the patient marked the intensity of pain after 1 day, 1 week and 1 month. Also, patients were asked to indicate the level of discomfort (complaints of salivation, soft tissues lesion, impaired sleep and impaired nutrition) during the first day of treatment (after 2-3 h, 5-6 h, 10-12 h, 24 h), after 2 days, after 7 days and after 1 month. It was possible to choose answers to the questions on a 0-4 score scale as follows: "0" – no pain/discomfort, "1" – ld pain/discomfort, "2" – moderate pain/discomfort, "3" – severe pain/discomfort, "4" – very severe pain/discomfort.

In addition, patients were asked to indicate behavioural changes related with orthodontic treatment, e.g. avoidance of communication, less smiling, etc.

In order to access predicting role of patients' motivation for treatment and awareness of discomfort to the intensity of pain, patients were asked two questions: "Was it your personal desire to initiate the orthodontic treatment? (Motivation) and "Did you know about possible pain and discomfort associated with orthodontic treatment before you started it?" (Awareness).

The questionnaire form was given to the patients at the first appointment after insertion of the appliance and returned at the next appointment after 1 month.

Statistical analysis

Distributions of the pain and other complaints scores and the mean scores between patients' scores were not normally distributed, the statistical significances of the differences between the groups were evaluated using the non-parametric Mann-Whitney (for 2 groups) and Kruskal-Wallis (for more than 2 groups) tests. The paired means in time period analysis were statistically compared by using the Wilcoxon signed rank test. Chi-squared (χ^2) statistics was used to evaluate the statistical significance of the differences in prevalence between groups. P value of ≤ 0.05 was considered statistically significant. All statistical analyses were performed with SPSS for Windows version 15.0 (SPSS Inc., Chicago, IL, USA) statistical software package.

RESULTS

Pain

Patients experienced the highest scores of pain after one day after the appliance was inserted: 72.0%

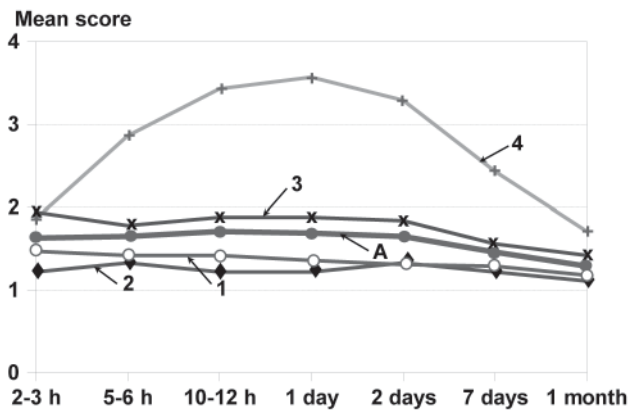


Fig. 1. The change of perception of salivation intensity (mean score) over treatment period by type of appliance: 1 – braces; 2 – braces and head gear; 3 – removable appliances; 4 – functional appliances; A – all patients.

of the subjects complained of pain at this time period. The pain intensity slightly decreased after one week and significantly after one month (Table 1).

There was no statistically significant dependence on pain intensity rate of neither respondents' gender nor age (Table 2). However, patients from different appliances groups experienced a different intensity of pain level. At the beginning of treatment, the biggest percentage of patients complaining of pain was in the braces group, and the smallest – in the removable appliances group. For both of these groups the intensity of pain during the treatment time periods decreased. Though, pain for the patients from the braces and head gear group, and functional appliances group did not decrease but also had tendency to be more frequent and more intensive.

Increased salivation

On the average, every fifth patient (20.4% after one day) complained of moderate and severe salivation; males more likely than females (29.4% and 15.3%; $p=0.103$ after one day); patients under 18 years of age significantly more frequently than senior patients (26.2% and 7.1%; $p=0.037$). Figure 1 shows the changes of mean scores in perception of salivation

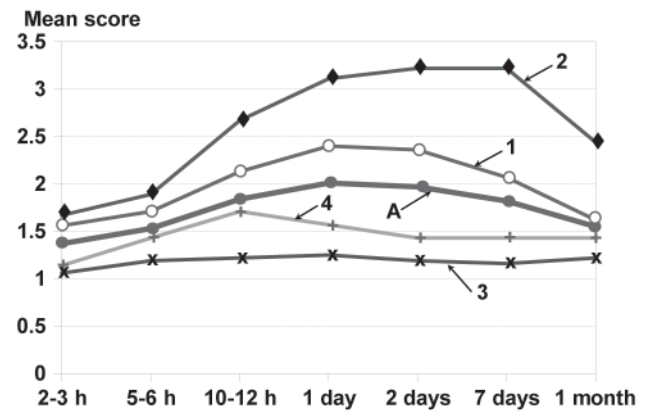


Fig. 2. The change of oral mucosa scratching (mean score) over treatment period by type of appliance: 1 – braces; 2 – braces and head gear; 3 – removable appliances; 4 – functional appliances; A – all patients.

discomfort reported for each type of appliance over the different time periods. Salivation discomfort was notably rare for patients treated with braces or with braces and head gear. Increased salivation manifested very often after 10-12 hours, after one and two days for the patients with functional appliances ($p<0.001$ in contrast with the other types of appliances), but it disappeared after one week.

Soft tissue lesion

Every third respondent signed moderate and severe complaints of oral mucosa scratching after 1-7 days (32.3% after one day). This feeling was neither related to sex, nor to age. This type of discomfort was mostly experienced patients wearing braces, especially braces with head gear, who complained of oral mucosa scratching notably more often ($p<0.05$) than remaining patients even one month after appliance insertion (Fig. 2).

Impaired nutrition

Moderate and severe impaired nutrition complaints were being possessed by every third respondent (30.1% after one day) and they were more likely for females and patients older than 18 years.

Table 1. Patient age, gender, height bone residual of posterior maxilla, location of implants, number and type of implants and Albrektsson criteria for implant success

Score	Pain intensity	After 1 day		After 1 week		After 1 month	
		n	(%)	n	(%)	n	(%)
0	No pain	26	(28.0)	36	(38.7)	57	(61.3)
1	Mild pain	25	(26.9)	27	(29.0)	26	(28.0)
2	Moderate pain	23	(24.7)	19	(20.4)	8	(8.6)
3	Severe pain	13	(14.0)	10	(10.8)	2	(2.2)
4	Very severe pain	6	(6.5)	1	(1.1)		

Chi-squared test to compare with pain intensity distribution after 1 day $\chi^2=6.033; df=4; p=0.197$ $\chi^2=32.92; df=4; p<0.001$

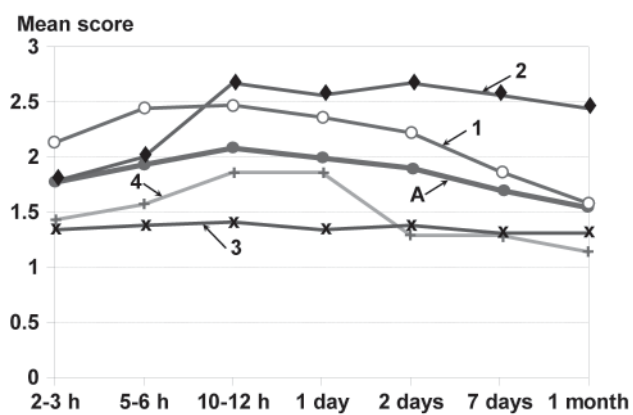


Fig. 3. The change of impaired nutrition (mean score) over treatment period by type of appliance: 1 – braces; 2 – braces and head gear; 3 – removable appliances; 4 – functional appliances; A – all patients.

Patients wearing removable and functional appliances particularly seldom complained of impaired nutrition, while patients with braces and head gear complained of impaired nutrition even one month after appliance had been fitted (Fig.3). A statistically significant ($p < 0.001$) difference in intensity of impaired nutrition between the above mentioned groups of patients was observed over all period of observation.

Impaired sleep

Almost half (46.2%) of patients did not report any sleep disturbances throughout the period of observation. The others had experienced impaired

sleep that was categorized as mild (30.1%), moderate (16.1%) or severe (7.5%). The rate of sleep disorders has decreased after one month. However, some problems (e.g. metal appliance parts scratching oral mucosa or withdrawing appliance during sleep) recurred with sufficient frequency and had no tendency to diminish (Table 3).

Our study revealed that the rate of sleep disturbances depends significantly ($p = 0.030$) on the type of appliances. Impaired sleep the most rarely occurred for patients treated with removable appliances (40.6%) and braces (51.1%) and the most frequently for patients treated with functional appliances (85.7%) and braces, and head gears (88.9%). Patients after the insertion of a functional appliance were afraid of falling out of appliance or choking with it, so they tended to take out the appliance during the sleep. They, in contrast to others, tended to appeal more often the pain during sleep and scratching of the metal parts.

Social discomfort

In addition to somatic complaints, patients noticed changes in their behaviour: avoid communication (10.8%), smile less (32.3%), feel uncomfortable in public (30.1%) or undergo discomfort due to impaired speech (26.8%). Some patients admitted suffering derision (12.9%) and noticed the interest of other people in their appliance (9.7%). These behavioural changes were more frequent for patients with

Table 2. Pain intensity mean score at different time periods after the appliance insertion according to sex, age and treatment method

	n	After 1 day		After 1 week		After 1 month	
		Mean score	(SE)	Mean score	(SE)	Mean score	(SE)
Total	93	1.44	(0.13)	1.06	(0.11)*	0.52	(0.08)***
Gender:							
Male	34	1.21	(0.18)	1.18	(0.19)	0.71	(0.19)*
Female	59	1.58	(0.17)	1.00	(0.14)	0.41	(0.14)**
Mann-Withney test		p=0.199		p=0.426		p=0.130	
Age:							
Under 18 years age	65	1.28	(0.14)	1.05	(0.13)	0.57	(0.10)**
18 years age and older	28	1.82	(0.27)	1.11	(0.21)	0.39	(0.12)**
Mann-Withney test		p=0.096		p=0.881		p=0.350	
Treatment method:							
Braces	45	2.11	(0.18)	1.13	(0.16)	0.33	(0.09)**
Braces and head gear	9	0.79	(0.22)	2.11	(0.42)	1.33	(0.33)
Removable appliances	32	0.78	(0.17)	0.53	(0.12)	0.44	(0.11)*
Functional appliances	7	1.00	(0.22)	1.71	(0.36)	1.00	(0.38)
Kruskal-Wallis test		p<0.001		p<0.001		p<0.001	

SE – standard error. * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$ comparing with pain intensity after 1 day (Wilcoxon test).

braces and head gear or functional appliances than for remaining groups of patients ($p=0.003$).

Patients' motivation for treatment and awareness of possible discomfort

About three quarters of patients (77.4%) showed positive motivation for seeking the orthodontic treatment as well as 65.6% of patients reported being aware of possible discomfort caused by orthodontic appliances. The association between these characteristics was significant (Pearson correlation $r=0.583$; $p<0.01$).

Analysis of changes in the pain mean scores over period of the study showed significant difference between groups of patients being positively and negatively motivated for the treatment (Table 4). At the beginning of observation (after one day), there were significantly higher pain intensity scores among patients with positive motivation than among patients with negative motivation. Over the follow up period these estimations changed noticeably. In the first group pain intensity scores decreased in average by 0.74 after a week and by 1.33 after a month as an appliance was inserted ($p<0.001$). In the second group pain intensity scores did not decrease as it

was observed with the first group, but they increased instead (in average by 0.86 after one week, $p=0.003$; and by 0.38 after one month, $p=0.085$).

The changes of pain intensity in groups of patients by awareness of possible pain and discomfort had a similar shape as in groups of patients by motivation for treatment (Table 4). Thereby, during the treatment period patients, who were positively motivated for treatment or were aware of possible pain and discomfort, complained of significantly lower pain than patients from the alternative groups.

DISCUSSION

According to the literature, 70.0-95.0% of orthodontic patients experience pain during treatment (1, 7, 18). About 11.0% of patients maintain that treatment is constantly painful (1). As stated by Krukemeyer *et al.* (19), 59.0% of patients indicated that they had experienced pain for a few days after their appointment. In our study 72.0 % of the subjects complained of pain and they had the highest scores after 1 day of the appliance insertion. 61.3% of patients did not complain of any pain after one

Table 3. Sleep disturbances and its rate at different time periods after the appliance insertion

	Number of patients who reported the sleep disturbances							
	After 1 day		After 2 days		After 1 week		After 1 month	
	n	(%)	n	(%)	n	(%)	n	(%)
Fear of appliance falling out	12	(12.9)	13	(14.0)	9	(9.7)	7	(7.5)
Fear of choking appliance	11	(11.8)	10	(10.8)	9	(9.7)	4	(4.3)*
Pain during sleep	25	(26.9)	25	(26.9)	20	(21.5)	9	(9.7)**
Metal appliance parts scratching oral mucosa	15	(16.1)	18	(19.4)	21	(22.6)	14	(15.1)
Insomnia	20	(21.5)	19	(20.4)	15	(16.1)	10	(10.8)**
Withdrawing appliance during sleep	10	(10.8)	13	(14.0)	15	(16.1)	11	(12.9)

* $p<0.05$; ** $p<0.01$ comparing with the rate after 1 day (Wilcoxon test).

Table 4. Mean score of pain intensity at different time periods after the appliance insertion in groups of patients by their motivation for treatment and awareness of possible discomfort

Groups of patients	After 1 day		After 1 week		After 1 month	
	Mean	(SE)	Mean	(SE)	Mean	(SE)
Motivation for treatment:						
positive	1.64	(0.15)	0.90	(0.12)*	0.33	(0.08)*
negative	0.76	(0.17) #	1.62	(0.21)* #	1.14	(0.16)#
Awareness of possible pain and discomfort:						
aware	1.70	(0.16)	0.89	(0.12)*	0.28	(0.08)*
not aware	0.94	(0.18) #	1.41	(0.19)* #	0.97	(0.14)*

SE – standard error. * $p<0.05$ in comparison with pain level after 1 day (Wilcoxon test); # $p<0.05$ comparing groups of patients with positive and negative motivation (Kruskal-Wallis test).

month. These results agree with the previous studies' results: initial pain is perceived at 2-4 hours, peak occurs at 24 hours and decreases by day 3 (2, 13, 14). According to Mu Chena *et al.* (20), the oral health-related quality of life after 1 month the appliance had been inserted was similar to pre-treatment quality of life.

Pain is dependent upon many factors. Scheurer *et al.* (10) found that girls reported more discomfort/pain than boys during fixed appliance treatment. In our study no significant difference was found between the pain and gender, which was in agreement with the findings of Ngan *et al.* (2), Erdinç and Dinçer (13).

Scheurer *et al.* (10) reported that patients younger than 13 years experienced pain significantly less frequently than older patients did. Jones and Richmond (21) found that adults reported more pain than adolescents did undergoing orthodontic treatment. However, the results of the present study did not show any significant age dependence on pain intensity. In a study by Ngan *et al.* (2), also no significant difference was found in the level of discomfort of patients more than 16 years of age compared with those 16 years and under.

The type of appliance may have an effect on the intensity of discomfort experienced by the patient. Oliver and Knapman (7) did not find any difference in the level of discomfort produced by fixed or removable appliances. Though Serogl *et al.* (3) disproved this finding and stated that fixed and functional appliances produced a higher intensity of pain than removable appliances. Scheurer *et al.* (10) observed, that patients wearing fixed appliances reported higher values for intensities of pressure, tension, pain, and sensitivity to teeth. In our study, fixed and functional appliances also produced higher intensity of pain.

Although pain remains the major part of discomfort that patients experience during orthodontic treatment, other functional and social problems are also significant.

Every fifth (20.4% after one day) patient of our study complained of moderate and severe salivation. Increased salivation discomfort was notably more frequent for patients wearing removable and functional appliances. Unfortunately, there wasn't any study found about increased salivation discomfort. Though, according to Li Y's *et al.* (22) findings, saliva flow rate increases at early stage when placing fixed orthodontic appliances, which is considered due to increased mechano-sensation.

According to Kvam's *et al.* (1) findings, small wounds caused by the fixed appliance were reported

by 75.8% of the patients, and 2.5% had suffered badly from ulceration caused by the fixed appliances. We also found that this type of discomfort was mostly experienced by the patients wearing braces, especially braces with head gear.

Krukemeyer *et al.* reported (19) that 21.9% of the patients suffering of the pain due to the braces changed their diet. In this study we could notice that patients wearing removable and functional appliances particularly seldom complained of impaired nutrition, while patients with braces and head gear complained of impaired nutrition even one month after appliance had been fitted.

According to Rawji's *et al.* (23) findings, there was no difference in sleep quality with or without the overnight use of head gear or functional appliances after they had been worn for a minimum of 3 months. Kvam *et al.* (1) reported that 75.0% of the patients sleeping habits were not influenced. These statements were not certified by our study, because over half of patients (53.8%) indicated sleep disturbances throughout the period of observation; most frequently, impaired sleep occurred for patients treated with functional appliances (85.7%) and braces with head gear (88.9%).

Stewart *et al.* (24) stated that swallowing and speech was more difficult with removable appliances and these problems persisted to some degree. In our study 26.8% of patients underwent discomfort due to impaired speech, and it was more frequent for patients with braces and head gear or functional appliances.

This study revealed that fixed and functional appliances produced higher intensity of pain and discomfort (soft tissues lesion, impaired nutrition, social discomfort) than removable appliances. This difference might be explained by fundamental differences between fixed and removable appliances. Fixed appliances induce constant forces and pain is mainly based on adverse sensations in the periodontal ligament and surrounding structures. Moreover, the metal parts of fixed appliances usually scratch mucosa. Induced force of removable appliances is more intermittent and discomfort is more linked with appliance size and pressure for mucosa. Unfavourable effects of functional appliances are more likely to arise from pressure and tension in muscles and mucosa.

According to Stewart's (24) findings, the embarrassment caused by wearing the appliance in public was similar whether it was fixed or removable. Behavioural changes were more frequent reported by patients with braces and head gear or functional appliances in our study.

It has been suggested that psychological factors may influence patients' adaptation to pain and discomfort during orthodontic treatment (25, 26). Sergl *et al.* (3) pointed out that patients, who were aware of the severity of their orthodontic irregularities, perceived lower intense feeling of discomfort. Unfortunately, motivation for orthodontic treatment usually is very weak, especially in young children. Daniels *et al.* (27) found that parents reported greater motivation for their children to have orthodontic treatment than did the children.

In agreement with previous studies, we found that pain perception was significantly associated with patients' motivation for treatment and their awareness of probable discomfort. Patients who were positively motivated for treatment or were aware of potential pain and discomfort after one week complained of significantly less acute pain than patients from alternative group, however, the figure was reverse after one day of appliance insertion. Apparently, deeper analysis would be needed to gain more insight into these relationships.

Study limitations. The current study was limited in relatively disproportional study groups according to the treatment methods: braces group (n=45), braces and head gear group (n=9), removable appliances group (n=32) and functional appliances group (n=7). However, we were not able to combine these groups for several reasons. First, the different orthodontic treatment methods have obvi-

ously distinct treatment purposes and effects. Next, the statistical findings showed that treatment with braces, braces and head gear, removable appliances and functional appliances has very unequal influence on the dynamic of pain and discomfort. Therefore, two small study groups (braces-head gear group and functional appliances group) helped to determine only the trend of the pain and discomfort variation during one month follow-up.

In summary, the results of our study imply that pain and discomfort control is not fully guaranteed during orthodontic treatment. In order to solve these problems, cooperation between orthodontist and patient is essential. Sufficient time should be spared to explain the possible discomfort during treatment and the treatment need should be used as a motivating stimulus. That will be useful in helping patients overcome the negative effect of therapy and expand their confidence in their doctor.

CONCLUSIONS

The perception of pain and discomfort among orthodontic patients was variable during the first month after the appliance insertion regarding the type of appliance, patients' motivation for treatment and their awareness of probable discomfort. Patients who were positively motivated for the treatment or were aware of probable pain and discomfort reported significantly decreasing pain.

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