

Orthodontic Pain in Maxilla and Mandible during the First Week of Orthodontic Treatment

SUMMARY

Background/Aim: This investigation aimed to evaluate the intensity of self-reported pain and frequency of self-medication with analgesics during the initial phase of orthodontic treatment with fixed appliances and to compare possible differences between the maxillary and mandibular teeth. **Material and Methods:** In this observational clinical trial 68 patients had similar orthodontic forces (the same bracket-slot and prescription, archwire size and material, and treatment plan) applied on maxillary and mandibular teeth. The patients recorded pain intensity and use of analgesics for the first seven days of treatment. Comparisons between maxillary and mandibular teeth regarding the pain intensity and self-medication frequency were performed by Wilcoxon Signed Ranks Test and McNamara Test for Matched Pairs, respectively. **Results:** The patients reported moderate pain in both jaws which decreased significantly with each day of treatment. Still, during the initial three days of treatment intensity of pain for maxillary teeth was significantly lower compared to the mandibular teeth. Patients reported analgesics consumption for both jaws, without a statistically significant difference between them. **Conclusions:** The patients have reported orthodontic pain of higher intensity in the mandibular arch compared to the maxillary arch during the initial phase of orthodontic treatment with fixed appliances.

Keywords: Orthodontic Pain, Pain Intensity, Fixed Orthodontic Appliances, Analgesics, Self-Medication

Jovana Juloski, Dina Vasović, Ljiljana Vučić,
Tina Pajević, Branislav Glišić

¹ University of Belgrade, School of Dental
Medicine, Department of Orthodontics,
Belgrade, Serbia

ORIGINAL PAPER (OP)
Balk J Dent Med, 2022;33-40

Introduction

It has been reported that almost every patient feels a certain amount of pain during orthodontic therapy¹. Orthodontic pain is one of the most cited negative side effects of orthodontic treatment, and it is one of the major reasons for discontinuing treatment and missing appointments². Literature data and clinical experience suggest that fixed orthodontic appliances cause the higher intensity of pain and discomfort to patients, and lower quality of life compared to the removable ones³⁻⁶. The intensity of pain caused by orthodontic forces delivered by fixed appliances is described as moderate. The pain and discomfort are reported to start 4 to 6 hours after initial archwire placement and to reach the highest intensity after

24 hours^{1,4,7}. The pain slowly decreases after 5-7 days. However, one out of four patients still feel discomfort even after 7 days of orthodontic treatment^{1,4,7}.

Empirically, patients often claim that pain intensity is greater in mandibular teeth compared to the maxillary teeth after bonding fixed orthodontic appliances. However, scientific evidence is still lacking, and the current literature reports conflicting information. Scheurer *et al.*¹ reported no significant differences in pain scores between bonded appliances in one or both jaws. Fernandes *et al.*⁸ noticed higher pain intensity in the mandibular teeth compared to the maxillary ones, whereas Jones and Chan⁹ did not find statistically significant differences in pain perception between the teeth in the upper and lower jaw.

Despite all the reported evidence, clinicians often tend to underestimate the intensity of pain caused by orthodontic treatment¹⁰. However, the orthodontist should provide sufficient information about the kind and the intensity of pain or discomfort patients could expect following the commencement of orthodontic treatment. Patients should also be informed about the possible management of orthodontic pain by pharmacological and non-pharmacological methods¹¹. Pharmacological methods include self-medication and a variety of analgesics that show positive results in suppressing orthodontic pain¹¹.

To the best of our knowledge, there are no studies that have specifically investigated the difference in self-reported pain intensity during the initial phase of orthodontic treatment between the maxillary and mandibular teeth. Therefore, this study aimed to investigate the self-reported pain intensity and the frequency of self-medication with analgesics during the initial phase of orthodontic treatment with fixed orthodontic appliances and to compare for possible differences between the maxillary and mandibular teeth. The first null hypothesis was that there is no significant difference in the intensity of self-reported pain between the teeth in the upper and the lower jaw; the second null hypothesis is that there is no difference in the frequency of self-medication with analgesics between the upper and the lower jaw during the initial phase of orthodontic treatment.

Material and Methods

The study protocol for this clinical trial has been approved by the Institutional Ethical board (approval number 36/15). All participants or their parent/legal guardian signed the informed consent for the participation in the study after receiving detailed descriptions about the study design.

All patients accepted necessary comprehensive orthodontic treatment with buccal fixed orthodontic appliances, after shared decision making. The brackets for maxillary and mandibular teeth were bonded on two separate appointments. The treatment plan regarding extractions, bracket prescription, slot size, and the size of initial archwire was determined by the treating orthodontist according to the patients' needs. Baseline data for each patient included demographic characteristics, degree of crowding, bonding date, fixed orthodontic appliance prescription and slot size, archwire size, and tooth extractions before orthodontic treatment.

The inclusion criteria for this investigation were: patients aged 11 to 25 years, healthy patients scheduled to receive fixed orthodontic appliance, patients that have signed informed consent, patients who were scheduled

to receive the upper appliance followed by the lower appliance in 6-8 weeks interval, patients with the same degree of crowding and therefore the same treatment plan regarding extractions in both jaws, patients scheduled to receive the same orthodontic appliance regarding slot size and prescription in both jaws, and patients scheduled to receive the same sized archwire in the upper and the lower jaw. Exclusion criteria in this clinical trial were: patients with cleft lip and/or palate, patients with syndromes, and patients whose treatment included extra-oral appliances, palatal arches, or quad-helix appliances during the experimental period.

After implementing inclusion and exclusion criteria 100 patients were included in the trial. Once the fixed appliances were bonded, the patients were asked to keep a diary concerning the teeth in the bonded jaw. All patients received verbal instructions on how to complete the diary. They were instructed to complete them at home, preferably each day at the same time, starting from 24 h after bonding until the 7th day of treatment. The pain diaries were collected from the patients on the following appointment. In each of the diaries, patients were asked to record their pain experience, using a Visual Numerical Scale (VNS)^{12,13}, starting on day 1 through day 7, as well as any use of analgesics. Question 1: Which number describes the best the pain you have experienced? Circle the number on this scale from 0 to 10, if 0 means no pain and 10 means extreme pain. Question 2: Did you take any analgesics today? Circle "yes" or "no". The patients were allowed to take analgesics if they felt it was necessary. The analgesics were not prescribed by the orthodontists.

Statistical analysis

Mann-Whitney U test was used to analyze and compare the data on the intensity of pain recorded on VNS for each day of the first week during the initial phase of treatment between genders, patients with extraction and non-extraction treatment, and two different slot sizes. Kruskal-Wallis test was used to compare the pain intensity between different archwire sizes and brackets prescriptions in the maxilla and the mandible, separately.

Wilcoxon Signed Ranks Test for related samples was used to compare the intensity of pain recorded on VNS between the maxillary and the mandibular teeth for each day of the first week of treatment, as well as for comparing the pain level/score between every two consecutive days of treatment for the maxillary teeth, as well as for the mandibular teeth. McNamara Test for Matched Pairs was used to investigate whether the frequency of self-medication with analgesics differed between the teeth in the upper and lower jaw. Mann-Whitney U test was used to analyze whether the VNS score differed between the patients who consumed analgesics and those who did not. The exploration was done separately for each jaw.

Study size calculation was based upon the outcome of the pilot study, which gave a required sample of 52 patients, for detecting a mean of differences of 1 between the pairs, assuming the standard deviation of the differences to be 2.5.

Statistical analysis was done in IBM SPSS Statistics Data Editor (IBM SPSS version 21, Armonk, New York, USA), with a level of statistical significance of $P < .05$.

Results

The final sample consisted of sixty-eight patients who met the inclusion criteria and have returned fully

completed pain diaries for both upper and lower jaw. The study comprised 26 (38%) male and 42 (62%) female patients, with a mean age of 18.19 ± 5.688 years. The self-reported intensity of pain did not differ between male and female participants (tested for each day of the initial week of treatment, separately for the upper and the lower jaw, Suppl. 1). The type of therapy did not influence the intensity of the pain (Suppl. 1). Furthermore, statistical tests showed that slot size, brackets prescription and initial archwire size did not alter significantly the self-reported intensity of pain during the initial week of treatment either in the maxilla or in the mandible (Suppl. 1). For these reasons, the sample was considered to be homogenous, and further statistical analyses were performed.

Supplement 1. The comparison of self-reported pain intensity related to gender, treatment plan, slot size, slot prescription, and initial archwire size.

P values	Gender		Treatment plan		Slot size		Slot prescription		Initial archwire size	
	Mann Whitney test		Mann Whitney test		Mann Whitney test		Kruskal-Wallis test		Kruskal-Wallis test	
	Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible	Maxilla	Mandible
Day 1	.589	.624	.864	.771	.779	.241	.305	.107	.421	.487
Day 2	1.000	.589	.478	.995	.334	.526	.328	.074	.704	.430
Day 3	.995	.328	.969	.869	.716	.777	.112	.092	.625	.788
Day 4	.688	.319	.532	.979	.147	.544	.065	.205	.222	.704
Day 5	.909	.538	.371	.514	.102	.495	.131	.362	.159	.641
Day 6	.393	.983	.091	.330	.324	.925	.240	.627	.260	.553
Day 7	.620	.655	.213	.280	.228	.368	.074	.457	.073	.429

Day 1-Day 7 - days of the first week of orthodontic treatment with fixed orthodontic appliances.

Table 1. The comparison of self-reported pain intensity between the days of the first week of orthodontic treatment

	Maxillary teeth					Mandibular teeth				
	VNS (median)	n of patients that reported			p value for Wilcoxon Signed Rank test	VNS (median)	n of patients that reported			p value for Wilcoxon Signed Rank test
		higher pain on day A	higher pain on day B	the same pain for both days			higher pain on day A	higher pain on day B	the same pain for both days	
Day 1 (A)	4	35	21	12	.013*	5	37	8	23	.000***
Day 2 (B)	3					4				
Day 2 (A)	3	34	4	30	.000***	4	41	0	27	.000***
Day 3 (B)	2					3				
Day 3 (A)	2	34	3	31	.000***	3	34	2	32	.000***
Day 4 (B)	1					2				
Day 4 (A)	1	28	4	36	.000***	2	26	4	38	.000***
Day 5 (B)	1					1				
Day 5 (A)	1	27	2	39	.000***	1	30	1	37	.000***
Day 6 (B)	0					0				
Day 6 (A)	0	17	1	50	.000***	0	17	1	50	.000***
Day 7 (B)	0					0				

VNS - Visual Numerical Scale, Day 1-Day 7 - days of the first week of orthodontic treatment with fixed orthodontic appliances, n - number, * - $p < .05$, ** - $p < 0.01$, *** - $p < .001$.

The patients reported moderate pain in both jaws (Fig. 1) which decreased significantly with each day of treatment (Table 1). Still, during the initial three days of orthodontic treatment intensity of pain for maxillary teeth was significantly lower compared to the mandibular teeth.

During the first two days after bonding, the number of patients reporting higher pain intensity in the lower jaw was twice as high as those that reported more pain in the upper jaw (Table 2). This ratio decreased throughout the experimental period.

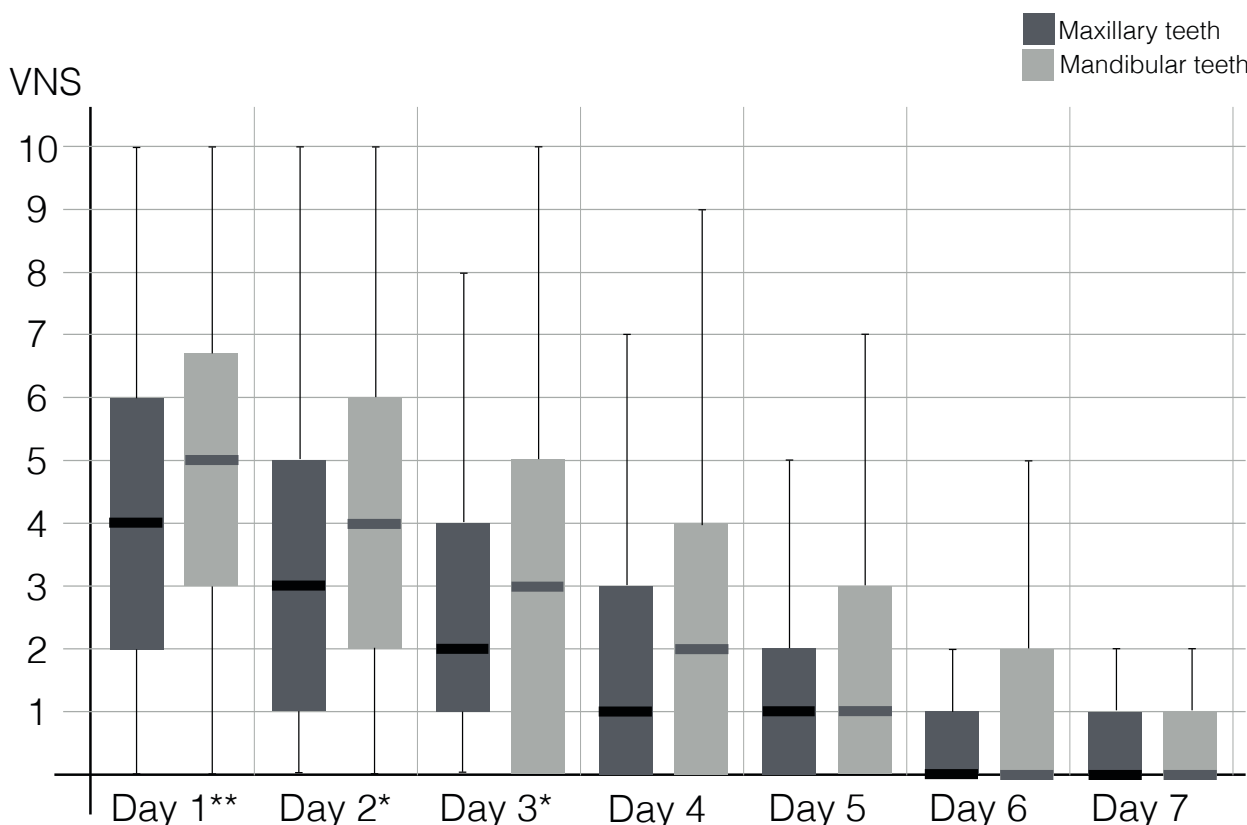


Figure 1. Pain intensity box plot for maxilla and mandible, calculated with Wilcoxon Signed Rank test

VNS - Visual Numerical Scale, Day 1-Day 7 - days of the first week of orthodontic treatment with fixed orthodontic appliances, n - number of patients, * - $p < .05$, ** - $p < 0.01$.

Table 2. The comparison of pain intensity between the maxillary and mandibular teeth reported by 68 orthodontically treated patients

VNS	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
VNS maxilla (median)	4	3	2	1	1	0	0
VNS mandible (median)	5	4	3	2	1	0	0
n of patients that reported higher pain in the maxilla	14	15	16	16	11	12	11
n of patients that reported higher pain in the mandible	30	32	29	20	18	16	18
n of patients that reported the same pain in both jaws	24	21	23	32	39	40	39
p value for Wilcoxon Signed Rank test	.004**	.012*	.034*	.066	.058	.118	.104

VNS - Visual Numerical Scale, Day 1-Day 7 - days of the first week of orthodontic treatment with fixed orthodontic appliances, n - number, * - $p < .05$, ** - $p < 0.01$.

Table 3. The frequency of self-medication with analgesics in the maxillary and the mandibular arch

			Mandible		p value for McNamara test for matched pairs
			self-medicated with analgesics - n (%)	no analgesics- n (%)	
Day 1	Maxilla		30 (44%)	38 (56%)	0.057
	self-medicated with analgesics - n (%)	22 (32%)	19	3	
	no analgesics- n (%)	46 (68%)	11	35	
Day 2	Maxilla		15 (22%)	53 (78%)	1.000
	self-medicated with analgesics - n (%)	16 (24%)	10	6	
	no analgesics- n (%)	52 (76%)	5	47	
Day 3	Maxilla		6 (9%)	62 (91%)	1.000
	self-medicated with analgesics - n (%)	5 (7%)	4	1	
	no analgesics- n (%)	63 (93%)	2	61	
Day 4	Maxilla		4 (6%)	64 (94%)	.250
	self-medicated with analgesics - n (%)	1 (1%)	1	0	
	no analgesics- n (%)	67 (99%)	3	64	
Day 5	Maxilla		0 (0%)	68 (100%)	1.000
	self-medicated with analgesics - n (%)	1 (1%)	0	1	
	no analgesics- n (%)	67 (99%)	0	67	
Day 6	Maxilla		2 (3%)	66 (97%)	1.000
	self-medicated with analgesics - n (%)	1 (1%)	1	0	
	no analgesics- n (%)	67 (99%)	1	66	
Day 7	Maxilla		0 (0%)	68 (100%)	/
	self-medicated with analgesics - n (%)	0 (0%)	0	0	
	no analgesics- n (%)	68 (100%)	0	68	

Day 1-Day 7 - days of the first week of orthodontic treatment with fixed orthodontic appliances, n - number of patients.

Table 4. The self-reported intensities of pain in relation to self-medication with analgesics

			Maxilla		Mandible		
			VNS (median)	p value for Mann Whitney U-test	VNS (median)	p value for Mann Whitney U-test	
Day 1	self-medicated with analgesics - n (%)	22 (32%)	6	.002**	30 (44%)	5.5	.022*
	no analgesics- n (%)	46 (68%)	3		38 (56%)	4.5	
Day 2	self-medicated with analgesics - n (%)	16 (24%)	7	.001**	15 (22%)	6	.003**
	no analgesics- n (%)	52 (76%)	2		53 (78%)	3	
Day 3	self-medicated with analgesics - n (%)	5 (7%)	5	.038*	6 (9%)	7.5	.004**
	no analgesics- n (%)	63 (93%)	2		62 (91%)	2.5	
Day 4	self-medicated with analgesics - n (%)	1 (1%)	4	.324	4 (6%)	7	.023*
	no analgesics- n (%)	67 (99%)	1		64 (94%)	2	
Day 5	self-medicated with analgesics - n (%)	1 (1%)	4	.206	0 (0%)	/	/
	no analgesics- n (%)	67 (99%)	1		68 (100%)	1	
Day 6	self-medicated with analgesics - n (%)	1 (1%)	3	.176	2 (3%)	6	.008**
	no analgesics- n (%)	67 (99%)	0		66 (97%)	0	
Day 7	self-medicated with analgesics - n (%)	0 (0%)	/	/	0 (0%)	/	/
	no analgesics- n (%)	68 (100%)	0		68 (100%)	0	

VNS - Visual Numerical Scale, Day 1-Day 7 - days of the first week of orthodontic treatment with fixed orthodontic appliances, n - number of patients, * - $p < .05$, ** - $p < 0.01$.

Self-medication with analgesics after bonding was reported for both maxillary and mandibular teeth, starting with 32% and 44% of patients on day 1, respectively. The number decreased the next day to 24% and 22%, respectively, and continued to decrease for the rest of the experimental period (Table 3). The difference in self-medication between the maxillary and mandibular teeth was not statistically significant. Statistical tests showed that patients who took analgesics, reported significantly higher intensity of pain, in both jaws (Table 4).

Discussion

The intensity of pain reported by patients differed between the maxillary and the mandibular teeth during the initial phase of orthodontic treatment, and it was significantly higher in the mandibular teeth. Nevertheless, the frequency of self-medication with analgesics did not differ between the jaws. Therefore, the first null hypothesis was rejected, while the second one was accepted.

The results of this study confirm the empirical claims that during the initial phase of orthodontic treatment the intensity of pain is higher in the mandibular arch compared to the maxillary arch. This finding is in agreement with the findings of Fernandes *et al.*⁸, and in conflict with the Jones and Chan⁹ study. Other parameters, such as pain intensity, duration of pain, and expected decrease of pain intensity during the first week of treatment recorded in this investigation are in accordance with the published reviews^{2,14}. Fernandes *et al.*⁸ were investigating the difference in pain intensity between different archwire materials, and have noticed the higher intensity of pain in patients with mandibular appliances during the first day of treatment (for both types of initial archwires)⁸. Jones and Chan⁹ investigated the pain caused by two different archwire materials as well as pain in different stages of treatment (after extraction, following the first and the second archwire placement). They reported no difference in pain intensity between the arches in patients that had two different types of initial archwires⁹. The former studies mostly investigated patients with orthodontic appliances either in the lower or the upper jaw. It should be emphasized that our study was done primarily to investigate the difference in pain intensity reported by the patients between the maxillary and mandibular teeth. The subjects with the same treatment plan (extraction or non-extraction treatment), same fixed appliances (bracket-slot and prescription) and the same archwires (size and material) in both jaws, served as their own controls, presuming that similar orthodontic forces were applied to maxillary and mandibular teeth and eliminating possible subjectivity. Therefore, the differences in pain intensity between

maxillary and mandibular teeth could be precisely detected. Also, it is important to notice that each patient was treated according to the attending orthodontist's treatment plan, without any influence from the research group.

The explanation for higher pain intensity in the mandibular teeth could be found in smaller inter-bracket distances and smaller root surfaces in the teeth of the lower jaw. Since mandibular teeth are narrower, inter-bracket distances are shorter. Therefore, the effective length of the archwire between brackets is being reduced, the springiness of the archwire and range of action is decreased, and the load-deflection rates are higher¹⁵. Previously it has been established that anterior teeth hurt more, compared to posterior teeth, and that was explained with higher forces being delivered to smaller root surfaces^{1,7,16,17}. This could be extrapolated to mandibular teeth that have smaller roots compared to the maxillary teeth.

The difference in self-medication between the jaws was not statistically significant. Still, 11 of those patients who did not use self-medication for the upper jaw had to take analgesics for the first day of treatment in the lower jaw (Table 3). The increased need for self-medication could be explained by the higher pain intensity in the mandibular teeth. Another possible explanation is that orthodontic patients tend to take analgesics more frequently after bonding of the lower appliances. They might anticipate the pain having in mind the pain experienced with a previously bonded maxillary appliance. The anticipated pain reported by patients was found to be higher than actual pain experienced during orthodontic treatment¹⁸. In our study the intensity of pain of the patients who used analgesics was significantly higher compared to those who did not use self-medication. These results were found for both jaws, confirming that higher pain intensity leads to more frequent self-medication. The frequency of self-medication with analgesics in this sample was comparable to previous studies¹⁹⁻²¹.

The subjective component of pain and pain management is also very important and includes considerable individual variations among patients²². Even though, the inflammatory nature of orthodontic pain makes non-steroidal anti-inflammatory drugs a first-line choice for orthodontic pain control²³. In our study, patients were self-medicated with analgesics of their own choice. The authors of the text were not investigating the efficiency of different kinds of analgesics, merely the need for self-medication.

The strength of this investigation is in the homogenous study group and the possibility to consider maxillary and mandibular teeth as paired samples. It was reported that different archwire sizes^{16, 24}, bracket type or slot size²⁵⁻²⁷, as well as extractions²⁸ do not influence the pain intensity during the initial orthodontic treatment. Our

study confirmed that there are no significant differences in the intensity of pain concerning a treatment plan, slot size, slot prescription, archwire size, and gender. Still, inclusion criteria were implemented to have identical conditions in teeth of both arches and each patient represented his/her control. The limitation of this study is the subjective nature of pain. The subjective component makes it difficult to evaluate and compare, however, using VNS is considered to be appropriate for research purposes^{12,13}. The order of appliance insertion (upper followed by lower) could have an impact on pain perception¹⁸. This should be further investigated. Having in mind all these results, the orthodontist should inform their patients to expect greater pain after bonding the lower fixed appliances and to console them with the fact that pain will decrease with each day of treatment.

Conclusions

During the initial phase of orthodontic treatment with buccal fixed orthodontic appliances, the self-reported pain intensity was significantly higher in the mandibular teeth compared to the maxillary teeth. In both arches, pain intensity significantly decreased with each day and disappeared within the first week of treatment, as well as the need for self-medication with analgesics. The need for self-medication with analgesics did not differ between the maxillary and mandibular arch. Higher pain intensity caused more frequent self-medication with analgesics.

Acknowledgements: The authors would like to thank Professor Vaska Vandevska-Radunovic for editing a draft of this article.

References

- Scheurer PA, Firestone AR, Burgin WB. Perception of pain as a result of orthodontic treatment with fixed appliances. *Eur J Orthod*, 1996;18:349-357.
- Krishnan V. Orthodontic pain: from causes to management--a review. *Eur J Orthod*, 2007;29:170-179.
- Sergl HG, Klages U, Zentner A. Pain and discomfort during orthodontic treatment: causative factors and effects on compliance. *Am J Orthod Dentofacial Orthop*, 1998;114:684-691.
- Wiedel AP, Bondemark L. A randomized controlled trial of self-perceived pain, discomfort, and impairment of jaw function in children undergoing orthodontic treatment with fixed or removable appliances. *Angle Orthod*, 2016;86:324-330.
- Johal A, Fleming PS, Al Jawad FA. A prospective longitudinal controlled assessment of pain experience and oral health-related quality of life in adolescents undergoing fixed appliance treatment. *Orthod Craniofac Res*, 2014;17:178-186.
- Matic SNP. Perception of pain, social, and functional discomfort during orthodontic treatment. *Srp Arh Celok Lek*, 2017;145:65-69.
- Ngan P, Kess B, Wilson S. Perception of discomfort by patients undergoing orthodontic treatment. *Am J Orthod Dentofacial Orthop*, 1989;96:47-53.
- Fernandes LM, Ogaard B, Skoglund L. Pain and discomfort experienced after placement of a conventional or a superelastic NiTi aligning archwire. A randomized clinical trial. *J Orofac Orthop*, 1998;59:331-339.
- Jones M, Chan C. The pain and discomfort experienced during orthodontic treatment: a randomized controlled clinical trial of two initial aligning arch wires. *Am J Orthod Dentofacial Orthop*, 1992;102:373-381.
- Krukemeyer AM, Arruda AO, Inglehart MR. Pain and orthodontic treatment. *Angle Orthod*, 2009;79:1175-1181.
- Topolski F, Moro A, Correr GM, Schimim SC. Optimal management of orthodontic pain. *J Pain Res*, 2018;11:589-598.
- Williamson A, Hoggart B. Pain: a review of three commonly used pain rating scales. *J Clin Nurs*, 2005;14:798-804.
- Lamart E, Santagata M, Tartaro G, D'Amato S, Colella G. Orofacial pain evaluation in children. *Eur J Paediatr Dent*, 2019;20:151-154.
- Long H, Wang Y, Jian F, Liao LN, Yang X, Lai WL. Current advances in orthodontic pain. *Int J Oral Sci*, 2016;8:67-75.
- Proffit WR, Fields HV, Sarver DM. *Contemporary Orthodontics*. 6th ed. St. Louis: Mo: Mosby Elsevier; 2007.
- Erdinc AM, Dincer B. Perception of pain during orthodontic treatment with fixed appliances. *Eur J Orthod*, 2004;26:79-85.
- Feldmann I, List T, Bondemark L. Orthodontic anchoring techniques and its influence on pain, discomfort, and jaw function--a randomized controlled trial. *Eur J Orthod*, 2012;34:102-108.
- Kafle D, Rajbhandari A. Anticipated pain and pain experience among orthodontic patients: is there any difference? *Kathmandu Univ Med J (KUMJ)*, 2012;10:71-73.
- Markovic E, Fercec J, Scepan I, Glisic B, Nedeljkovic N, Juloski J, et al. The correlation between pain perception among patients with six different orthodontic archwires and the degree of dental crowding. *Srp Arh Celok Lek*, 2015;143:134-140.
- Casteluci C, Oltramari PVP, Conti PCR, Bonjardim LR, de Almeida-Pedrin RR, Fernandes TMF, et al. Evaluation of pain intensity in patients treated with aligners and conventional fixed appliances: Randomized clinical trial. *Orthod Craniofac Res*, 2021;24:268-276.
- Cozzani M, Ragazzini G, Delucchi A, Barreca C, Rinchuse DJ, Servetto R, et al. Self-reported pain after orthodontic treatments: a randomized controlled study on the effects of two follow-up procedures. *Eur J Orthod*, 2016;38:266-271.
- Wishney M. Potential risks of orthodontic therapy: a critical review and conceptual framework. *Aust Dent J*, 2017;62:86-96.
- Polat O, Karaman AI. Pain control during fixed orthodontic appliance therapy. *Angle Orthod*, 2005;75:214-219.
- Jian F, Lai W, Furness S, McIntyre GT, Millett DT, Hickman J, et al. Initial arch wires for tooth alignment during orthodontic treatment with fixed appliances. *Cochrane Database Syst Rev*, 2013:CD007859.

25. Scott P, Sherriff M, Dibiase AT, Cobourne MT. Perception of discomfort during initial orthodontic tooth alignment using a self-ligating or conventional bracket system: a randomized clinical trial. *Eur J Orthod*, 2008;30:227-232.
26. El-Angbawi AM, Yassir YA, McIntyre GT, Revie GF, Bearn DR. A randomized clinical trial of the effectiveness of 0.018-inch and 0.022-inch slot orthodontic bracket systems: part 3-biological side-effects of treatment. *Eur J Orthod*, 2019;41:154-164.
27. Fleming PS, Dibiase AT, Sarri G, Lee RT. Pain experience during initial alignment with a self-ligating and a conventional fixed orthodontic appliance system. A randomized controlled clinical trial. *Angle Orthod*, 2009;79:46-50.
28. Sayar G. Pain and chewing sensitivity during fixed orthodontic treatment in extraction and non-extraction patients. *J Istanbul Univ Fac Dent*, 2017;51:23-28.

Conflict of Interests: Nothing to declare.

Financial Disclosure Statement: Nothing to declare.

Human Rights Statement: All the procedures on humans were conducted in accordance with the Helsinki Declaration of 1975, as revised 2000. Consent was obtained from the patient/s and approved for the current study by national ethical committee.

Animal Rights Statement: None required.

Received on March 24, 2021.

Revised on Jun 12, 2021.

Accepted on September 24, 2021.

Correspondence

Jovana Juloski
University of Belgrade, School of Dental Medicine,
Department of Orthodontics, Belgrade, Serbia
Belgrade, Serbia
e-mail: jovana.juloski@stomf.bg.ac.rs