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Pain Perception in Patients Treated with Ligating/Self-Ligating Brackets Versus Patients Treated with Aligners

Farid Bourzgui, Rania Fastani, Salwa Khairat, Samir Diouny, Mohamed El Had, Zineb Serhier and Mohamed Bennani Othmani

Abstract

This study compared the perception of pain experienced by patients undergoing orthodontic treatment with conventional, self-ligating brackets and aligners, and investigated the impact that pain had on their daily lives. 346 consecutive patients were included in the study: 115 patients treated with conventional brackets, 112 Patients treated with self-ligating brackets, and 119 patients treated with aligners. The quantitative aspect of pain was assessed using the Visual Analogue Scale, while the qualitative aspect of pain was evaluated using the Moroccan Short Form of McGill Pain questionnaire. In all three groups experienced pain after activation tended to decrease in the following week. This pain was greater in patients with conventional braces and less in patients with aligners. Using the M-SF-MPQ to describe the qualitative aspect of the pain revealed that the “cramping مزير,” “aching تنبألم” aspect was most accentuated in the 3 groups. Medication intake was correlated with the intensity of pain experienced in all 3 systems. As for the impact of pain on daily activities, patients in groups of conventional and self-ligating braces showed more pain than those in the aligners group. Overall, aligners were less painful than conventional and self-ligating appliances. Patients did not suffer from an alteration in their quality of life due to orthodontic treatment.

Keywords: orthodontics, corrective, clear aligner appliances, facial pain, pain measurement, Morocco

1. Introduction

Pain is defined as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage.” (IASP) [1]; it: “is a mutually recognizable somatic experience that reflects a person’s apprehension of threat to their bodily or existential integrity” [2].

Orthodontic tooth movement requires the application of force to the tooth, which usually results in a painful sensation [3]. It is important to note that there are individual differences in pain sensitivity related to the subjective aspect of pain perception [4].

Recently, orthodontic practices have evolved considerably. In addition to conventional or self-ligating appliances, aligners represent an esthetic and comfortable alternative option for orthodontic treatment. Even though these methods have revolutionized orthodontics practices, practitioners are still confronted with the painful aspect of the treatment. Some patients perceive orthodontic pain as discomfort or inconvenience; others continue to be in so much pain that it can cause them to discontinue treatment [5]. This feeling of discomfort could impact the quality of life of patients and their cooperation. Also, for some patients, factors such as comfort and pain during orthodontic treatment are as important as esthetic considerations. In most cases, the quality of information given to patients about the likely discomfort during orthodontic treatment is somewhat satisfactory, though many patients complain that they are not well informed before the onset of treatment [5].

Previous studies have investigated orthodontics pain and its components for each system there is a dearth of studies that have compared the character and type of pain experienced in qualitative and descriptive terms between the different options used in orthodontics, i.e., conventional appliances, self-ligating appliances, and aligners.

Against this background, the aim of this study was two-fold: First, to compare the perception of pain experienced by patients treated with conventional brackets, self-ligating brackets, and those treated with aligners. Second, to investigate the impact that pain had on their daily lives.

2. The perception of pain experienced by patients treated with conventional braces, self-ligating braces, and those treated with aligners

2.1 Patients and methods

A cross-sectional study was performed to compare the perception of pain between patients treated with self-ligating fixed appliances and those treated with aligners treated at both the Department of Orthodontics at Casablanca Ibn Rochd University Hospital, and at a private orthodontic office. The study lasted 4 months (November 2019–February 2020). All the patients underwent orthodontic treatment for a period exceeding 2 months, the chief complaint was purely aesthetic and all patients were in class I dento-maxillary disharmony. In relation to our inclusion criteria, we have chosen patients in the process of treatment, avoiding patients at the beginning of treatment where adaptation is not yet established, as well as patients at the end of treatment, as they may be accustomed to their orthodontic appliances.

Exclusion criteria included patients under 8 years of age, those at the beginning of treatment or less than 2 months or at the end of treatment, and those with no medical contraindications or the presence of systemic diseases that influence pain perception (including nervous system disorders).

The study group consisted of 346 consecutive patients: 115 treated with conventional brackets. 112 were treated with self-ligating brackets and 119 were treated with aligners.

The data collection tool was a self-made questionnaire consisting of the socio-economic characteristics of patients, the type of appliance worn, and temporal characteristics of pain during the week of activation, qualitative factors influencing pain after activation, factors influencing pain during the week of activation, the impact of pain on the patient's daily, professional and school life, the patient's attitude to pain, the most distressing element during the treatment stages. The patients were informed about the purpose of the study, and verbal consent was obtained.

The quantitative aspect of the pain was assessed using the Visual Analogue Scale (VAS). The scale used is a graduated ruler whose extremities represent the absence of pain 0 and the maximum imaginable pain 10. The VAS scale was presented to the patients by the operator after explaining the instructions for use, in two stages: After the activation appointment and during the week that followed.

To evaluate the qualitative aspect of pain, we used the M-SF-MPQ “the Moroccan Short Form of McGill Pain questionnaire” [8], previously translated from English and culturally adapted and validated in Moroccan Arabic.

Data were analyzed using SPSS statistical 16.0 software. The comparison of pain perception between the different types of systems was done using the Chi-square test, or Fischer’s exact test when the theoretical numbers were low. The comparison of pain intensity according to the VAS score was carried out using the Kruskal Wallis test.

2.2 Results

Table 1 contains the age distribution of our sample. The dominant age range for each type of appliance was: 16–25 years, 58 patients (50.4%) for conventional brackets, 8–15 years, 62 patients (55.4%) for self-ligating brackets, and more than 25 years 71 patients (59.7%) for Aligners. The statistical association between age group and type of appliance was significant ($p < 0.001$). Of 346 patients, 137 (39.6%) were male and 209 were female (60.4%). We noted that the female gender was the most dominant in the three groups, respectively: 63 patients (54.8% with the conventional brace, 60 patients (53.6%) with self-ligating braces, and 86 patients (72.3%) with aligners: The statistical association between gender and the type of appliance was significant ($p < 0.001$) (**Table 2**).

The socio-economic level in the sample was high in 63%, medium in 24.6%, and low in 12.4%. The association between socioeconomic level and the type of appliance used was statistically significant ($p < 0.001$) (**Table 3**).

With respect to the duration of treatment, for 87 patients (25.1%) the beginning of treatment ranged between 2 and 8 months ago, and 259 patients (74.9%) started treatment more than 8 months ago. The comparison between the duration of treatment and the type of appliance used was statistically significant ($p < 0.001$).

The vulnerability to pain showed that 295 patients (85.3%) were able to tolerate pain, while 51 patients (14.7%) could not tolerate pain. The statistical correlation between pain vulnerability and the type of appliance used was significant, ($p < 0.001$) (**Table 4**).

As for pain conditioning, 262 patients (75.7%) already knew someone who had undergone orthodontic treatment, 176 (66.18%) of which reported that this person had experienced pain. Only 84 patients 24.3%. did not know a person, who had

Age group (years)	Conventional brackets		Self-ligating		Aligner		The whole	
	N	%	N	%	N	%	N	%
8–15	45	39.1	62	55.4	17	14.3	124	35.8
16–25	58	50.4	39	34.8	31	26.1	128	37
>25	12	10.4	11	9.8	71	59.7	94	27.2
$P < 0.001$								

Table 1.
Distribution of the sample by age group according to the type of appliance used.

Gender	Conventional brackets		Self-ligating		Aligner		The whole	
	N	%	N	%	N	%	N	%
Male	52	45.2	52	46.4	33	27.7	137	39.6
Female	63	54.8	60	53.6	86	72.3	209	60.4

P<0.001

Table 2.
Distribution of the sample by gender according to the type of appliance used.

Socio-economic status	Conventional brackets		Self-ligating		Aligner		The whole	
	N	%	N	%	N	%	N	%
High	35	30.4	94	83.9	89	74.8	218	63
Medium	43	37.4	16	14.3	26	21.8	85	24.6
Low	37	32.2	2	1.8	4	3.4	43	12.4

P<0.001

Table 3.
Distribution of the sample by the socio-economic status according to the type of appliance used.

Vulnerability to pain	Conventional brackets		Self-ligating		Aligner		The whole	
	N	%	N	%	N	%	N	%
Cannot tolerate	17	14.8	15	13.4	19	16	51	14.7
Can tolerate	98	85.2	97	86.6	100	84	295	85.3

P<0.001

Table 4.
Distribution of the sample according to vulnerability to pain by type of appliance.

received orthodontic treatment. The statistical correlation between the knowledge of a person who underwent orthodontic treatment and the type of appliance used was significant ($p<0.001$).

303 patients reported pain after orthodontic activation, representing 87.6% of the total sample. The statistical association between the presence of pain after activation and the type of appliance was significant ($p<0.001$) (Table 5). The intensity of this pain after activation had an average of 6 for conventional and self-ligating braces and 3 for aligners. Despite this intensity, 297 patients (85.8%) reported a reduction in pain the week following the activation. 106 patients (92.2%) with conventional braces, 101 patients (90.2%) with self-ligating braces, and 90 patients (75.6%) with aligners reported a decrease in pain the week following activation.

Pain	Conventional brackets		Self-ligating		Aligner		The whole	
	N	%	N	%	N	%	N	%
No	3	2.6	11	9.8	29	24.4	43	12.4
Yes	112	97.4	101	90.2	90	75.6	303	87.6

P<0.001

Table 5.
Distribution of the sample according to the presence of pain after activation.

Aspect of pain	Conventional brackets		Self-ligating		Aligner		The whole	
	N	%	N	%	N	%	N	%
THROBBING كيزدح								
No	49	42.6	71	63.4	92	77.3	212	61.3
Yes	66	57.4	41	36.6	27	22.7	134	38.7
SHOOTING كضرب بحال اوضو								
No	62	53.9	87	77.7	105	88.2	254	73.4
Yes	53	46.1	25	22.3	14	11.8	92	26.6
STABBING بحال الطعنة ديال الخنجر								
No	93	80.9	89	79.5	107	89.9	289	83.5
Yes	22	19.1	23	20.5	12	10.1	57	16.5
SHARP ماضي								
No	60	52.2	77	68.8	98	82.4	235	67.9
Yes	55	47.8	35	31.2	21	17.6	111	32.1
CRAMPING مزير								
No	7	6.1	12	10.7	13	10.9	32	9.2
Yes	108	93.9	100	89.3	106	89.1	314	90.8
GNAWING كياكل								
No	85	73.9	97	86.6	103	86.6	285	82.4
Yes	30	26.1	15	13.4	16	13.4	61	17.6
HOT BURNING تحرق بزاف								
No	60	52.2	85	75.9	110	92.4	255	73.7
Yes	55	47.8	27	24.1	9	7.6	91	26.3
ACHING تيالم								
No	28	24.3	27	24.1	63	52.9	118	34.1
Yes	87	75.7	85	75.9	56	47.1	228	65.9
HEAVY ثقيل								
No	78	67.8	76	67.9	88	73.9	242	69.9
Yes	37	32.2	36	32.1	31	26.1	104	30.1
TENDER خفيف								
No	72	62.6	61	54.5	68	57.1	201	58.1
Yes	43	37.4	51	45.5	51	42.9	145	41.9
SPLITTING تقطع								
No	78	67.8	77	68.8	94	79	249	72
Yes	37	32.2	35	31.2	25	21	97	28
TIRING-EXHAUSTING نهلك								
No	77	67	85	75.9	109	91.6	271	78.3
Yes	38	33	27	24.1	10	8.4	75	21.7
SICKENING كمرض								
No	83	72.2	75	67	90	75.6	248	71.7
Yes	32	27.8	37	33	29	24.4	98	28.3

FEARFUL كخلع								
No	101	87.8	95	84.8	117	98.3	313	90.5
Yes	14	12.2	17	15.2	2	1.7	33	9.5
PUNISHING-CRUEL تعذب بزاف								
No	64	55.7	74	66.1	107	89.9	245	70.8
Yes	51	44.3	38	33.9	12	10.1	101	29.2

P < 0.001

Table 6.
Distribution of the sample according to the qualitative aspect of pain.

Painful aspects	Conventional brackets		Self-ligating		Aligner		The whole	
	N	%	N	%	N	%	N	%
Pain								
No	51	44.30	54	48.20	99	83.20	204	59.00
Yes	64	55.70	58	51.80	20	16.80	142	41.00
Aesthetics								
No	94	81.70	85	75.90	93	78.20	272	78.60
Yes	21	18.30	27	24.10	26	21.80	74	21.40
Brushing								
No	87	75.70	81	72.30	95	79.80	263	76.00
Yes	28	24.30	31	27.70	24	20.20	83	24.00
Discomfort								
No	48	41.70	60	53.60	72	60.50	180	52.00
Yes	67	58.30	52	46.40	47	39.50	166	48.00
The volume of the appliance								
No	88	76.50	94	83.90	109	91.60	291	84.10
Yes	27	23.50	18	16.10	10	8.40	55	15.90
Bad taste								
No	103	89.60	101	90.20	111	93.30	315	91.00
Yes	12	10.40	11	9.80	8	6.70	31	9.00
Not being able to eat								
No	48	41.70	71	63.40	76	63.90	195	56.40
Yes	67	58.30	41	36.60	43	36.10	151	43.60

P<0.001

Table 7.
Distribution of the sample according to the most painful aspect during orthodontic treatment according to the type of appliance.

The statistical association between pain reduction in the week following the activation appointment and the type of appliance was significant ($p < 0.001$). During the second week, we found a median of 2, a minimum value of 0, and a maximum of 8 for conventional braces, a median of 0 and a maximum value of 8 for self-ligating, and a median of 0 and a maximum value of 7 for aligners.

The qualitative aspects of pain for the three types of orthodontic appliances are outlined in **Table 6**. The association of the different qualitative aspects of pain according to the type of appliance was statistically significant ($p < 0.001$).

Table 7 presents the distribution of the sample according to the most painful aspect during orthodontic treatment according to the type of appliance used. The statistical correlation between the most distressing aspect during orthodontic treatment and the type of appliance was significant ($p < 0.001$). Patients' reactions to pain after activation, at 24 hours, after 3 days, and at one week are reported in **Table 8**.

Patient's attitude	Conventional brackets		Self-ligating		Aligner		The whole	
	N	%	N	%	N	%	N	%
After activation								
Abstention	78	67.80	84	75.00	108	90.80	270	78.00
Self-medication	31	27.00	28	25.00	7	5.90	66	19.10
Consult your orthodontist	5	4.30	0	0.00	3	2.50	8	2.30
Consult another practitioner	1	0.90	0	0.00	1	0.80	2	0.60
P=0								
After 24 hours								
Abstention	105	91.30	106	94.60	116	97.50	327	94.50
Self-medication	8	7.00	6	5.40	2	1.70	16	4.60
Consult your orthodontist	2	1.70	0	0.00	1	0.80	3	0.90
Consult another practitioner	0	0.00	0	0.00	0	0.00	0	0.00
P=0.136								
After 3 days								
Abstention	113	98.30	112	100.00	117	98.30	342	98.80
Self-medication	1	0.90	0	0.00	1	0.80	2	0.60
Consult your orthodontist	1	0.90	0	0.00	1	0.80	2	0.60
Consult another practitioner	0	0.00	0	0.00	0	0.00	0	0.00
P=1								
After 7 days								
Abstention	114	99.10	112	100.00	119	100.00	345	99.70
Self-medication	0	0.00	0	0.00	0	0.00	0	0.00
Consult your orthodontist	1	0.90	0	0.00	0	0.00	1	0.30
Consult another practitioner	0	0.00	0	0.00	0	0.00	0	0.00
P=0.656								

Table 8.
Patients' reaction to pain according to the type of appliance used.

2.3 Discussion

The aim of this study was to compare the pain perception of patients treated during orthodontic alignment with three different orthodontic appliance types. The results showed that the aligner system was less painful than the vestibular fixed appliances. There were minor differences in the reported pain intensity between conventional and self-ligating systems. Analgesics were mostly used by patients who reported severe pain. Despite the pain experienced by different patients, there was no impact on their quality of life, except for eating and chewing, where the aligners group showed promising results.

Several studies have analyzed the pain levels experienced with different types of brackets. In most of these studies, it was estimated that appliance-related pain was higher for the first 24 hours–3 days of appliance activation, then decreased to low levels within 5–6 days [4]. Scheurer et al. [9] reported a trend of high pain within 2 days of appliance activation and a trend of pain relief after 5 days. This trend was confirmed in this study. The pain was higher after activation and significantly decreased within 3 days, then to zero within 7 days. Tecco et al. [3] suggested that regardless of the type of fixed appliance used (conventional or self-ligating), the highest intensity of pain was reported in the first two to three days after the initial activation of the appliance. Fleming et al. [10] confirmed that the subjective experience of pain at 4 hours, 24 hours, 3 days, and 7 days after placement of a fixed orthodontic appliance was independent of bracket type. Johal et al. [4] found a slight reduction in pain scores as the orthodontic therapy went on, although these differences were not statistically significant. Nevertheless, this suggests that orthodontic pain may decrease in intensity during treatment, or may reflect some degree of adaptation to discomfort.

White et al. [11] showed that discomfort after the first and second monthly adjustments was also consistently lower for the aligner than for conventional treatment. For both groups, the levels of discomfort reported at subsequent adjustments reached lower levels than after the initial placement, or when the aligner was first worn.

Patients treated with self-ligating brackets reported significantly less pain than those treated with conventional brackets. These results were consistent with a study conducted by Pringle et al. [12] who reported that the self-ligating appliance (Damon 3, Ormco) resulted in lower pain intensity, on average, compared to the conventional appliance (Tru Straight, Ormco Europe, Amersfoort, The Netherlands). However, Fleming et al. [10] found that significant discomfort was experienced during the insertion and removal of the archwire with the self-ligating device (SmartClip) compared to the conventional system (Victory). Other studies pointed out that there was no statistically significant difference in perceived discomfort levels between the two types of system, namely Damon3 and Synthesis [13] and SmartClip™ and Victory [14].

After activation, patients in the conventional brackets group reported more pain than those in the aligner group. This is in agreement with the results reported in White et al. [11] who maintained that conventional appliances produced significantly more discomfort than aligners. Fujiyama et al [15] noted that patients experienced less pain with Invisalign treatment than with conventional appliances during treatment. Shalish et al. [16] indicated that the results were opposite to those found previously. A greater proportion of patients treated with Invisalign aligners reported more severe pain than did vestibularly treated patients.

In this study, the pain experienced after wearing aligners was lower than that experienced by patients with self-ligating appliances. This finding was consistent with a study by Almasoud [17] who reported that during the first week of

orthodontic treatment, patients treated with Invisalign experienced less pain than those treated with a passive self-ligating system. Similarly, in a systematic review, Cardoso et al.; [7] concluded that patients treated with Invisalign seemed to experience lower levels of pain than those treated with fixed appliances during the first days of treatment, and no difference was reported in the next 3 months. In fact, patients treated with aligners reported lower pain levels for a longer period of time, as the fixed appliance was activated once a month and the aligners were changed every 15 days.

The M-SF-MPQ is a very reliable tool for measuring pain in its two sensory and affective components [9]. The use of this criterion makes it possible to establish a comparative profile of the quality of the pain experienced by each group. It was noted that in all 3 systems, the sensory description “cramping مزير” was most reported by all patients in all 3 groups. Comparisons revealed that sensory and affective descriptors were used more in patients in the conventional group, than in the self-ligating or aligner group. Overall, patients in the conventional group identified 6 sensory descriptors, and those in the following descending order: ‘cramping مزير’, ‘aching تيالم’, ‘throbbing كيزدح’, ‘sharp ماضي’, ‘hot burning تحرق بزاف’ and ‘shooting كضرب بحال اوضو’. In contrast, patients in the self-ligating and aligner system identified 3 sensory descriptors: ‘cramping مزير’ followed by ‘aching تيالم’ and ‘tender خفيف’. However, the proportion of subjects in each group who selected the descriptors was consistently lower in the aligner group than in the self-ligating group. For effective components, the self-ligating and aligner systems did not really raise this aspect of pain, while for the conventional system the most used description was “punishing-cruel تعذب بزاف”. Tecco et al. [3] reported that the other two pain descriptors “shooting” and “dull” were used to a lesser extent. Whereas in Bergius et al.’s study [19], the terms “shooting” and “dull” were never used to describe the pain of their patients.

This study showed that tooth brushing could cause pain in patients with fixed appliances. Although the pain was generally minimal, it was experienced by a greater proportion of the sample in the conventional group than in the self-ligating group. However, patients in the aligner group reported almost no discomfort when brushing. The results of the Rakhshan et al. study [19] indicated that tooth brushing mainly induced mild pain. This result was consistent with other studies which suggested that orthodontic pain may have a negative effect on oral hygiene [20, 21].

Pain intensity scores and their impact on daily work/school activities had a minimal effect that peaked at a 24-hour period. In the following days, the number of patients reporting such an effect decreased. Scheurer et al. [9] found that the insertion of fixed appliances seemed to have only a minor effect on the patients’ daily life. This is consistent with our results. Shalish et al. [16] noted that the levels of disturbance in oral symptoms and general activities with Invisalign were similar to those of patients with fixed appliances. In contrast, Miller et al. [22] found that the fixed appliance group reported more negative impact than the Invisalign group.

A correlation between pain intensity scores and analgesic use was also observed. In general, analgesics were mostly used by patients who reported more severe pain. In this study, a large proportion of patients did not use medication, as reported in Firestone [6] and Bergius’s studies [18]. During orthodontic treatment, analgesic consumption differs according to the period of treatment. Wu et al [23] noted that analgesics were used more frequently during the initial phases of treatment, when pain intensity was highest, supporting the hypothesis that the pain experienced later in orthodontic treatment was relatively low. In our study, after activation, 27% of the patients treated with conventional appliances, 25% of the patients treated with a self-ligating system, and 5.9% treated with aligners used medication after activation. A small percentage of patients used analgesics at 24 hours and 3 days.

These patients mainly took paracetamol and a few used non-steroidal anti-inflammatory drugs (ibuprofene) to relieve pain. Most patients used self-medication. Scheurer et al. [9] stated that perceived pain and analgesic consumption would decrease if the patient were effectively informed of the discomfort in advance.

At the end of this chapter, we are aware that our study was a descriptive study with significant selection bias with respect to the confounding factors of need for orthodontic treatment, stage of treatment, age, and undetectable susceptibility to pain and even to orthodontic treatment. A cohort study with three groups benefiting from the three therapeutic choices, taking into account age, gender, type of malocclusion, and facial typology, is the following step to move to observational studies for more epidemiological inference.

3. Conclusion

Orthodontic treatment creates pain at different stages, which seems to be particularly intense at the beginning of treatment and tends to diminish during the course of treatment. Its intensity and duration may be influenced by the type of appliance worn. The results of this study showed that the aligner system was less painful than fixed brackets. There were only minor differences in the reported pain intensity between the conventional and self-ligating appliances. This pain was characterized in all 3 systems by the descriptors “cramping مزير” and “Aching تنيالم”.

The daily quality of life of patients treated with aligners was, therefore, better than that of patients treated with fixed appliances. The consumption of analgesics, correlated with the intensity of the pain experienced. Depending on the patient's pain threshold and psychological profile, clinicians should consider prescribing analgesics to alleviate patients' unpleasant experiences.

These observations can be used in clinical situations by informing patients in advance of a specific complaint associated with a particular type of device and will give practitioners and patients additional information that can be used when choosing the type of device. This can help reduce negative experiences of therapy and increase patients' confidence in their orthodontist. Pain is not inevitable, it can be prevented and treated as well as possible.

Conflict of interest

Ethical clearance was obtained from the Ethics Committee of the Faculty of Dentistry, University of Hassan II University, and all participants and their respective teachers were informed about the aims of the study. Access to schools was granted by the Casablanca Regional Academy of Education and training. The parental consent and authorization of all students were also obtained. All authors stated that no conflict could influence their participation in this study.

Acronyms and abbreviations

IASP	International Association for the Study of Pain
VAS	Visual Analogue Scale
M-SF-MPQ	The Moroccan Short Form of McGill Pain questionnaire.

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Author details

Farid Bourzgui^{1*}, Rania Fastani², Salwa Khairat³, Samir Diouny⁴,
Mohamed El Had⁵, Zineb Serhier⁶ and Mohamed Bennani Othmani⁶

1 Department of Orthodontics, Dental School, University Hassan II, Casablanca, Morocco

2 Private Practice Rés. les collines, Casablanca, Morocco

3 Private Practice, Casablanca, Morocco

4 Neurolinguistics and Psychology of Language Hassan II University, Clinical Neuroscience and Mental Health Lab, Casablanca, Morocco

5 Orthodontist Private Practice, Casablanca, Morocco

6 Faculty of Medicine and Pharmacy, Laboratory of Medical Informatics, University Hassan II, Casablanca, Morocco

*Address all correspondence to: farid.bourzgui@etu.univh2c.ma

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