Original Article

Evaluation Of Pain Perception During Micro-Osteoperforation Assisted Maxillary En-Masse Retraction: A Randomized Controlled Trial

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Abstract

Objective: The aim of this study was to evaluate and compare pain level during anterior segment retraction with and without micro-osteoperforation in patients requiring extraction of upper first premolars. (Class I with bi-alveolar dental protrusions or class II division 1).

Material and Methods: 26 patients were randomized into 2 equal groups (n=26). In group 1 (intervention group) the MOPs were repeated every 28 days on the labial of the anterior teeth during the trial period while group 2 (control group) conventional en-masse retraction was initiated. Pain assessment was done using a numeric pain rating scale. **Results:** the micro-osteoperforation group showed severe pain on the 1st day that gradually faded by the end of the 1st week. **Conclusion:** Micro-osteoperforation resulted in higher pain levels on the same day of the procedure but gradually faded within one week.

KEY WORDS: Micro-osteoperforation, En-masse retraction, Numeric pain rating scales.

INTRODUCTION

Micro-osteoperforation is a micro-invasive procedure that is safe, could be done with minimal chair side time and no recovery time is needed [1]. Micro-osteoperforation harnesses the body's own biology to accelerate bone remodeling by increasing the local levels of cytokine activity around the tooth [2], so that it could be moved to close spaces in a more predictable and faster manner [3] .

However, performing micro-osteoperforation during En-masse retraction of the six anterior teeth lack definite protocols, therefore assessment of the associated pain levels remains unexplored and in turn their role in reducing pain associated with orthodontics in still uncertain.

MATERIAL AND METHODS

The study was approved by the Research Ethics Committee of the Faculty of Dentistry, Cairo University. Twenty-six female patients with an age range between 16-30 years signed informed consent to participate in the study. For inclusion in the study, subjects had malocclusion that required bilateral extraction of the maxillary first premolars and anterior retraction with maximum anchorage (Angle Class II division 1 or Angle Class I with bimaxillary dentoalveolar protrusion). They had full permanent dentition (except of the third molars). They had good oral hygiene and were caries free.

I. Preparatory phase

Ready–made stainless steel bands were properly selected, fitted and cemented on the previously separated first permanent molars and a straight wire appliance was used with 0.022 Roth prescription brackets[1] on the upper and lower arches.

In bimaxillary protrusion cases, lower anterior segment retraction was initiated 3 months ahead of upper anterior teeth retraction to avoid any possible anterior teeth contact, while in class II division 1 cases bite opening was also assured, so that all cases showed clearance of occlusion prior to upper anterior retraction.

Self-drilling TADs[2] were placed between the upper second premolars and first molars (just before extraction of the first premolars, the anterior and posterior segments were stabilized with 0.012 ligature wire on the 0.016 x 0.022 NiTi wire reached at that time and the patient was sent for extraction. Afterwards, 0.017 x 0.025 stainless steel arch wires were inserted after manually adjusting them so that center point of the wire was always 2mm higher than bracket slot. Retraction of the anterior segment commenced one week from the completion of extraction of the first premolars (the extraction of the premolars were done on two consequent days)

II. Micro-osteoperforation procedure

This procedure was done for the intervention group only, according to the protocol applied by [4] for performing MOP, the clinical steps were as follows:

Before the commencement of the MOP procedure, the areas of interest were assessed for root length and proximity. After disinfecting the area, topical anesthesia was followed by administration of few drops of local anesthesia (2% lidocaine with 1: 100,000 epinephrine) into the gingival tissue and periosteum.

On the labial side: Three MOPs were performed interdentally, mesial and distal to the canines and between the anterior teeth with exception to the central incisors (to avoid injury of anatomical structures). MOP's were made using a small sized surgical bur [5] (0.5 mm in diameter) that was mounted on a low speed contra angle hand piece[3] to pass gently through the mucosa, until reaching the bone surface applying extra force to penetrate through the cortical plate. The MOPs were made interdentally with a separating distance between perforations from 1.5-2 mm, but if the last gingival perforation was found to reach the unattached free gingiva, the separating distance was reduced to 1 mm to avoid gingival laceration

III. Activation

Crimpable hooks were placed between the lateral incisors and canines and were adjusted to be at the same level of TADs. NiTi coil springs were used to provide the desired retraction force (150 gm per side adjusted

[1] AO Mini Master Series.
[2] HUBIT CO, Cross-head Mini Screw
[3] T4 line B 40, high torque, 40.000 rpm, reference number: 64 01 827, Sirona, Germany.

by a force gauge[4] intraorally) with the direction of traction parallel to the occlusal plane throughout the study period. The main archwire was inserted after the MOP procedure and retraction commenced.

IV. Pain assessment

The pain assessment was done bilingually pertaining to demography. Pain assessment was done by giving the patient a written form on the day of retraction to both groups. This form comprised a numeric pain rating scale, which was completed by each patient and handed out to the operator on his first follow up visit after 28 days.

The Numeric Pain Rating Scale was explained to the patient in order to assess the pain intensity after insertion of the working archwire and adjusting the force level for the coil springs in the control group (Figure 1), while in the intervention group it was recorded on the same day of the MOP procedure, after 24 hours, 7 days and 28 days for the labial side [7] [8] (Figure 2).

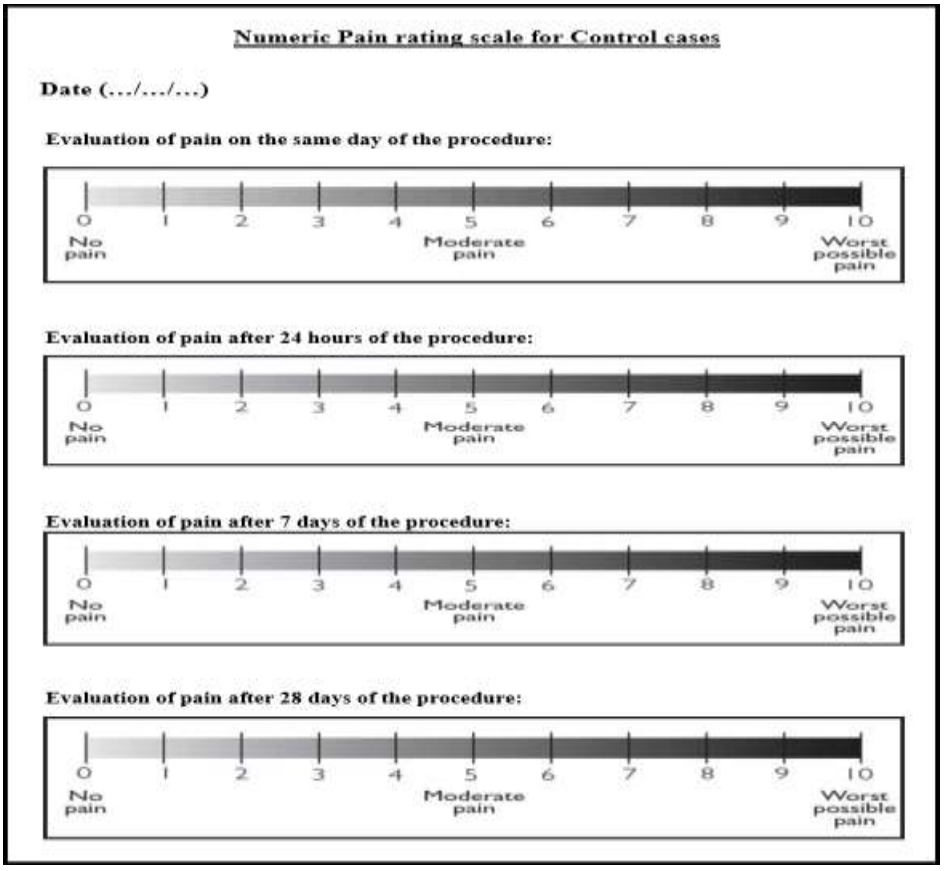


Figure 1: Pain scale for control group.

[4] Morelli Orthodontic Force Gauge.

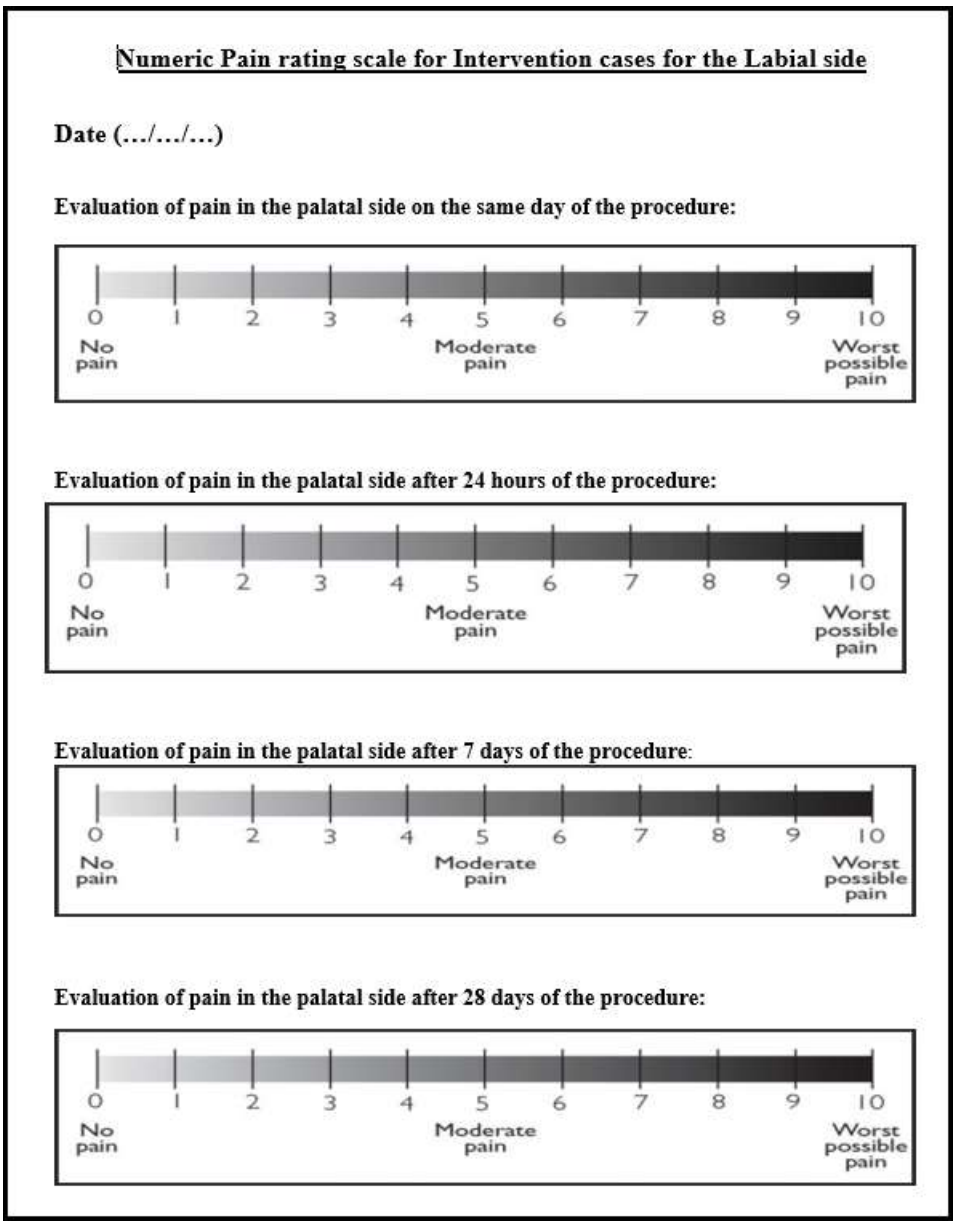


Figure 2: Pain scale for the intervention group.

V. Sample size

Using power 80% and 5% significance level we studied 11 in each group. This number was increased to a sample size of 13 to compensate for losses during follow up. Sample size calculation was achieved using PS: (Power and Sample Size) Calculation software Version 3.1.2 (Vanderbilt University, Nashville, Tennessee, USA).

VI. Statistical analyses

Data were analyzed using IBM SPSS advanced statistics (Statistical Package for Social Sciences), version 24 (SPSS Inc., Chicago, IL). Numerical data were described as mean and standard deviation or median and range. Categorical data was described as numbers and percentages. Data were explored for normality using Kolmogorov-Smirnov test and Shapiro-Wilk test. Comparisons between two groups for normally distributed numeric variables were done using the Student's t-test while for non-normally distributed numeric variables were done by Mann-Whitney test.

Results

I. Comparison of pain level at different time intervals within visits in the control group.

Pain at baseline, after 1day, 7 days and after 28 days at all visits of control group were presented in (Table 1) and (Figure 3). Comparison between different intervals revealed significant difference at all visits as $P < 0.05$ (baseline was significantly the highest in all visits). Also, comparison between different visits at each interval revealed only significant difference at baseline as $P < 0.05$ (at baseline of 5th visit was significantly the highest).

Table 1: Comparison of pain level at different time intervals in all visits in the control group

Control group	Baseline		After 1 day		After 7 days		After 28 days		P value
	M	SD	M	SD	M	SD	M	SD	
1st	4.27	2.80	2.45	2.38	0.00	0.00	0.00	0.00	<0.0001*
2nd	3.73	2.53	2.64	2.34	0.00	0.00	0.00	0.00	<0.0001*
3rd	3.91	2.63	3.09	2.51	0.00	0.00	0.00	0.00	<0.0001*
4th	4.36	2.01	3.18	2.40	0.00	0.00	0.00	0.00	<0.0001*
5th	5.27	2.57	3.73	2.53	0.00	0.00	0.00	0.00	<0.0001*
6th	4.55	2.77	3.36	2.54	0.00	0.00	0.00	0.00	<0.0001*
	0.04*		0.18		1.00		1.00		

M: Mean **SD**: Standard deviation ***** Probability level which is significant at $P \leq 0.05$

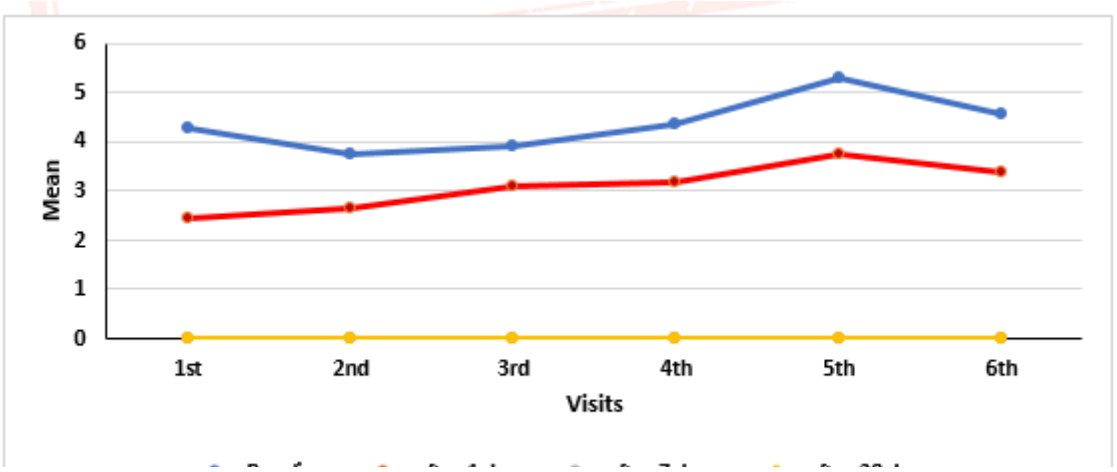


Figure 3: Line chart showing pain level at baseline, after 1day, after 7 days and after 28 days in all visits in the control group.

II. Comparison of pain level at different time intervals within visits in the intervention group.

Pain at baseline, after 1day, 7 days and after 28 days at all visits of labial side of intervention group were presented in (Table 2) and (Figure 4). Comparison between different intervals revealed significant difference at all visits as $P < 0.05$ (baseline was significantly the highest in all visits).

Table 2: Comparison of pain level at different time intervals in all visits regarding labial and palatal sides of the Intervention group:

Side	Visit	Baseline		After 1 day		After 7 days		After 28 days		P value
		M	SD	M	SD	M	SD	M	SD	
Labial side	1st	7.18	2.40	4.09	2.30	0.55	1.29	0.18	0.60	<0.0001*
	2nd	6.36	2.91	3.36	2.84	0.00	0.00	0.00	0.00	<0.0001*
	3rd	5.55	2.66	4.00	2.24	0.00	0.00	0.00	0.00	<0.0001*
	4th	6.36	1.96	3.73	2.10	0.00	0.00	0.00	0.00	<0.0001*
	5th	5.91	1.81	4.45	1.69	0.00	0.00	0.00	0.00	<0.0001*
	6th	6.27	1.95	3.18	2.18	0.00	0.00	0.00	0.00	<0.0001*
	P value	0.58		0.48		0.07		0.41		

M: Mean **SD**: Standard deviation * Probability level which is significant at $P \leq 0.05$

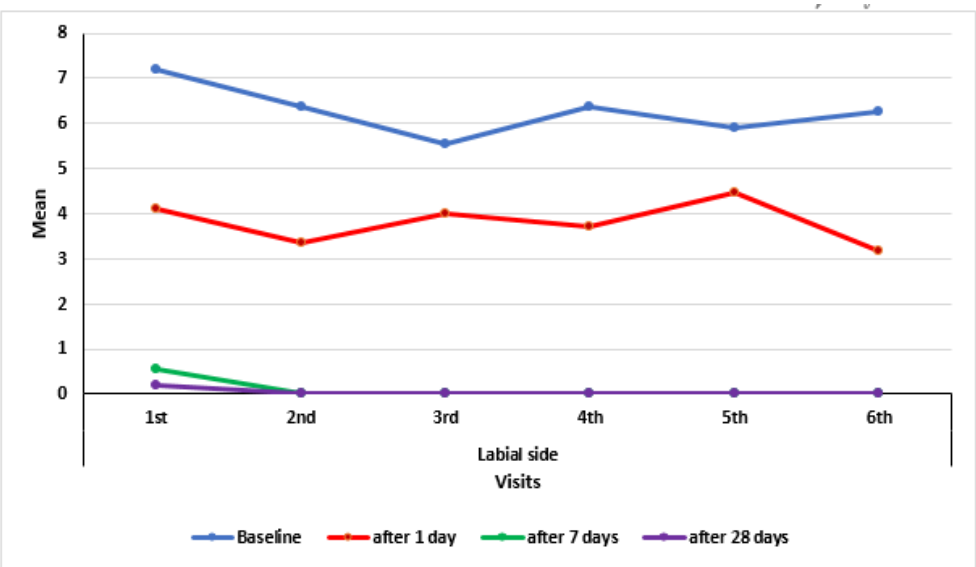


Figure 4: Line chart showing pain level at baseline, after 1day, after 7 days and after 28 days in all visits within labial side of the intervention group.

III. Comparison of pain level between control and intervention groups within each visit at different time intervals:

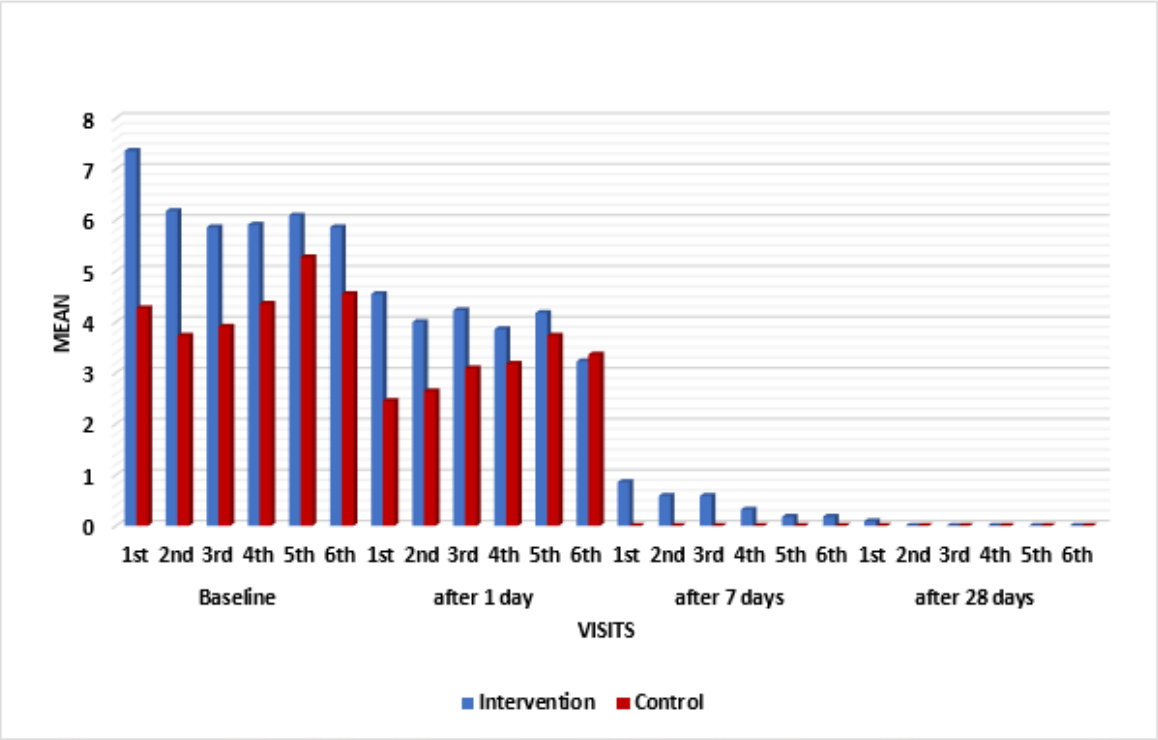
Comparison between control and intervention groups at baseline, after 1 day, after 7 days and after 28 days at different visits were presented in (Table 3) and (Figure 5). Comparison between them revealed insignificant difference in all intervals at all visits as $P > 0.05$ except baseline of 1st visit, after 1 day of 1st and 2nd and 3rd visits (intervention was significantly higher than control).

Table 3: Comparison between control and intervention group at different time intervals in all visits.

		Intervention		**Control**		**P value**
		M	SD	M	SD	
Baseline	1st	7.36	2.53	4.27	2.80	0.040*
	2nd	6.18	2.99	3.73	2.53	0.245
	3rd	5.86	2.59	3.91	2.63	0.307
	4th	5.91	1.99	4.36	2.01	0.666
	5th	6.09	1.80	5.27	2.57	0.843
	6th	5.86	2.42	4.55	2.77	0.921
after 1 day	1st	4.55	2.73	2.45	2.38	0.006*
	2nd	4.00	3.14	2.64	2.34	0.014*
	3rd	4.23	2.67	3.09	2.51	0.031*
	4th	3.86	2.43	3.18	2.40	0.148
	5th	4.18	2.04	3.73	2.53	0.317
	6th	3.23	2.52	3.36	2.54	0.317
after 7 days	1st	0.86	1.42	0.00	0.00	0.317
	2nd	0.59	0.74	0.00	0.00	1.000
	3rd	0.59	0.83	0.00	0.00	1.000
	4th	0.32	0.72	0.00	0.00	1.000
	5th	0.18	0.60	0.00	0.00	1.000
	6th	0.18	0.60	0.00	0.00	1.000
after 28 days	1st	0.09	0.30	0.00	0.00	1.000
	2nd	0.00	0.00	0.00	0.00	1.000
	3rd	0.00	0.00	0.00	0.00	1.000
	4th	0.00	0.00	0.00	0.00	1.000
	5th	0.00	0.00	0.00	0.00	1.000
	6th	0.00	0.00	0.00	0.00	1.000

M: Mean **SD**: Standard deviation * Probability level which is significant at $P \leq 0.05$

Figure 5: A histogram showing pain level at different intervals of all visits in both control and intervention groups



DISCUSSION

With the increased demand for achieving higher level of facial esthetics, the appearance of teeth with perfect shape, color and alignment is never to be under-estimated. This highlights the role of orthodontics but marks one of its limitations also, which is the "prolonged treatment duration" with its associated problems of increased possibility of root resorption, discomfort, pain, white spot lesions and periodontal diseases. This problem directs patients' attention to seek other restorative alternatives of shorter treatment time but with higher predisposition to dental caries, gingival problems, root resorption & psychological impacts on patients [9]. As to orthodontic professionals, decreased orthodontic treatment duration increases patient satisfaction and predicts treatment costs [10].

Micro-osteoperforation or alveocentesis are flapless, minimally invasive perforations that induce a local trauma to the bone thus increasing healing capacity, while maintaining the integrity and architecture of the hard and soft tissues. The use of MOPs in orthodontics is increasing but there are no definite and recognized protocols for their application until now, therefore the aim of the current trial was to evaluate and compare pain levels during anterior segment retraction with and without micro-osteoperforation using miniscrews as anchorage in patients requiring extraction of upper first premolars.

Patients reported severe pain on the day of the procedure that gradually decreased on the following day and extended to the 7th day. However, this pain was completely ended by the 28th day. Those findings were homogenous to several studies [11] [12]. Orthodontic treatment is considered an elective, conservative and non-invasive treatment. So when minimally invasive procedures as MOPs are suggested to patients, their feedback should not be under estimated.

Conclusion

1- In the control group pain was the highest on the same day of retraction.
2- In the intervention group, pain levels were very high in the labial side on the same day of the procedure.
3- On comparing both groups, pain was significantly higher in the intervention group especially on the day of the procedure.

The micro-osteoperforation group showed severe pain on the 1st day that gradually faded by the end of the 1st week.

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