Effects of Three Different Orthodontic Treatment Methods on the Stability of Mandibular Incisor Alignment

Hande Gorucu-Coskuner*/ Ezgi Atik**/ Ilken Kocadereli***

Objective: *To compare the effects of extraction, non-extraction and air-rotor stripping treatments on mandibular dental arch dimensions, lower incisor positions and evaluate their effects on the stability of the treatment.* ***Study design:*** *The sample consisted of 44 patients with Class I malocclusion and moderate crowding including 15 patients treated with extraction, 13 with air-rotor stripping (ARS), and 16 with non-extraction treatment. The records were taken at pretreatment (T0), end of active orthodontic treatment (T1), minimum 3 years post-treatment (T2). The model and cephalometric measurements were evaluated. For statistical analyses ANOVA and Welch test was applied.* ***Results:*** *At post-retention period Little's irregularity indices were increased to 1.96 mm, 2.38 mm and 3.59 mm for extraction, ARS and non-extraction groups respectively ($p<0.05$). At T1-T2, intercanine widths were decreased significantly at all groups ($p<0.05$). The arch length and arch depth decreased significantly at extraction group ($p<0.05$) from T0 to T1 and remained the same at T2 ($p>0.05$). The lower incisors were retroclined with treatment and slightly proclined at post-retention period in extraction group. In ARS and non-extraction group, lower incisors proclined with treatment and remained the same at post-retention.* ***Conclusion:*** *At all groups the irregularity indices relapsed but did not return to pretreatment values. Although significant increase at intercanine width was only observed in non-extraction treatment, at post-retention phase, intercanine widths were significantly decreased at all groups. The changes at lower incisor inclinations relapsed slightly in extraction group but remained the same in the other groups.*

Key words: *Relapse, Retention, Stability, Extraction vs. non-extraction*

INTRODUCTION

Without a doubt, maintaining favorable orthodontic treatment outcomes is as challenging as completing a successful orthodontic treatment. Even if an appropriate retention period is observed following the removal of active appliances, unwanted tooth movement could take place after the removal of retention appliances. At this point, suitable orthodontic treatment planning and the achievement of appropriate occlusal and soft tissue relationships at the debonding phase can help to minimize orthodontic relapse.[1]

From the Department of Orthodontics, Faculty of Dentistry, Hacettepe University, Ankara, Turkey.
* Hande Gorucu-Coskuner, DDS, PhD, Assistant Professor.
**Ezgi Atik, DDS, PhD, Assistant Professor.
***Ilken Kocadereli Professor, Department of Orthodontics.

Send all correspondence to:
Hande Gorucu Coskuner
Department of Orthodontics, Faculty of Dentistry, Hacettepe University, Sıhhıye, 6100, Ankara / Turkey
Phone : +90 312 305 22 90
E-mail: hande.gorucu@hotmail.com

It is known that increases in dental arch length and width with orthodontic treatment tend to relapse in the post-retention period,[2, 3] and the intercanine width of the original malocclusion can serve as an excellent indicator for the intercanine dimension that is expected at post-retention.[4] Also, the changes in antero-posterior positions of mandibular incisors are known to be unstable, as they have a tendency to relapse to their original positions.[1] Accordingly, to maintain the outcomes of orthodontic treatment, the mandibular arch width and length should be kept, for the most part, in their original dimensions.

When handling a patient with moderate crowding and Class I skeletal relationship, treatment plans may include extraction or non-extraction. Additionally, air-rotor stripping was introduced as an alternative for the treatment of moderate crowding.[5] The main purposes of the extraction and air-rotor stripping treatments are to gain the needed spaces by extracting or stripping the teeth, and to minimize the changes in dental arch width and incisor positions to obtain more stable treatment outcomes.

Although the effects of extraction and non-extraction treatments on the arch dimensions[6-8] and the stability of the treatment outcomes[8-11] have been reported in the literature, the comparison of the stability of these treatment modalities with the stability of air-rotor stripping treatment has not yet been documented, to our knowledge. Therefore, the aim of this retrospective study was to compare the effects of extraction, non-extraction and air-rotor stripping treatments on mandibular dental arch dimensions and lower incisor positions of Class I moderate crowding patients, and to evaluate their effects on the stability of the treatment. The null hypothesis tested was that there is not an expected difference in post-treatment parameters among the groups.

MATERIAL AND METHOD

The sample consisted of 44 patients who were selected from the archive of the Hacettepe University, Faculty of Dentistry, Department of Orthodontics. Ethical approval for this investigation was granted by the Hacettepe University Ethical Committee of Non-Invasive Clinical Research (GO15/587-17). 3 operators educated by the same academicians conducted the treatments at the university clinic. It was a retrospective study and all of the patients were selected according to the following inclusion criteria: All patients had skeletal Class I malocclusion with 3-6 mm crowding, and were treated with a full comprehensive multi-bracket 0.018-inch edgewise system. None of the patients had posterior cross-bites or maxillary transverse deficiency. In the retention period, all patients were instructed to wear removable retainers 24 hours a day for six months, and 12 hours a day for the following 12 months. None of the patients had fixed lingual retainers. The records were taken at three time points: during the pretreatment period (T0), at the end of the active orthodontic treatment (T1) and at a minimum three-year post-treatment period (T2). Then the treatment protocols were investigated from the patient records, and patients were placed to extraction, air-rotor stripping or non-extraction groups according to their treatment protocol. The groups were as following:

Extraction Group consisted of 15 patients (nine girls, six boys) treated with the extraction of the first four premolar teeth. At T0, the mean age was 13.89±5.69 years, and the mean Little's irregularity index was 8.03±3.00 mm. The mean treatment duration was 2.10±0.48 years, and post-treatment period was 3.65±0.96 years.

ARS Group consisted of 13 patients (eight girls, five boys) treated with air-rotor stripping of minimum six mandibular anterior teeth. The ARS amount was between 3 and 6 mm. At T0, the mean age was 13.51±1.73 years, and the mean Little's irregularity index was 6.23±2.70 mm. The mean treatment duration was 2.15±1.05 years and post-treatment period was 3.94±1.91 years.

Non-extraction Group consisted of 16 patients (thirteen girls, three boys) treated with non-extraction treatment. At T0, the mean age was 13.34±1.82 years, and the mean Little's irregularity index was 6.74±1.64 mm. The mean treatment duration was 1.67±0.63 years, and post-treatment period was 3.17±0.39 years.

Dental Arch Measurements

One investigator (H.G.C.) under the control of a second investigator (E.A.) measured the dental models. The measurements were made three times, and the average of the three values was used as the final value. A digital caliper was used for a precision measurement of dental casts to the nearest 0.01 mm. The following measurements were made (Figures 1 and 2):

1. Little's irregularity index[12]: The linear displacement of the adjacent anatomic contact points of the mandibular incisors was determined; the sum of five measurements represented the Irregularity Index value of the case.
2. Mandibular intercanine width: Distance between the crown tips of the right and left mandibular canines.
3. Mandibular interpremolar width: Distance between the central fossae of the right and left mandibular first premolars. In the extraction group, at T1 and T2, mandibular second premolars were used to determine interpremolar width.
4. Mandibular intermolar width: Distance between the mesiobuccal cusp tips of the right and left mandibular first molars.
5. Arch length: Distance along the midline from the interincisal midline to the mesial contact of the first molars.
6. Arch depth: Perpendicular length from the midpoint between the mandibular central incisors to the line drawn between the mesial anatomic contact points of the first molars.

Cephalometric Measurements

On the lateral cephalometric radiographs, eight cephalometric landmarks were located. Three angular measurements and one linear measurement were made. For the cephalometric measurements, the radiographs were scanned and loaded to the Quick Ceph program. The landmark digitization and tracing was done using the Quick Ceph program (Quick Ceph System 2014, San Diego, Calif.). One investigator (H.G.C.) digitized the cephalograms, and a second investigator (E.A.) controlled. When there was a controversy, two investigators reached a decision together. The cephalometric landmarks and planes, and the measurements made according to those planes, are shown in Figure 3:

1. IMPA (°): The angle between the mandibular incisor and the Mandibular Plane (Go-Me).
2. FMIA (°): The angle between the mandibular incisor and the Frankfurt Horizontal Plane (Po-Or).
3. L1-NB (°): The angle between the mandibular incisor and the line from Nasion to B point.
4. L1-NB (mm): The distance from the tip of the mandibular incisor to the line from Nasion to B point.

Statistical Analysis

The normality of the age of the patients, pretreatment Little's irregularity index, and treatment and retention duration values were evaluated with Shapiro-Wilk normality test. It was seen that all variables were distributed normally. Age and irregularity variables were homogenous according to Levene Variance Homogeneity test but treatment and retention durations were not. So, to test intergroup differences, ANOVA test was carried out for age and irregularity variables and Welch test was carried out for treatment and retention durations.

For the assessment of intragroup changes occurred with time, repeated measure ANOVA test was carried out because the repeated variables showed normal distribution according to Shapiro-Wilk

Figure 1: The dental cast measurements: 1; Little's irregularity index (A+B+C+D+E), 2; Mandibular intercanine width, 3; Mandibular interpremolar width, 4; Mandibular intermolar width.

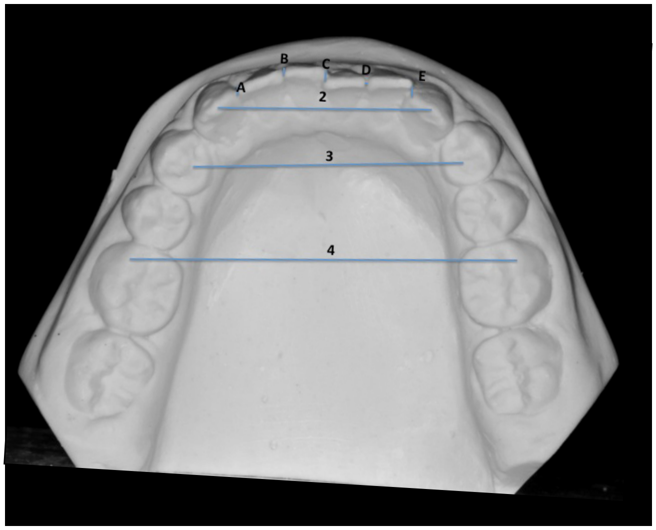
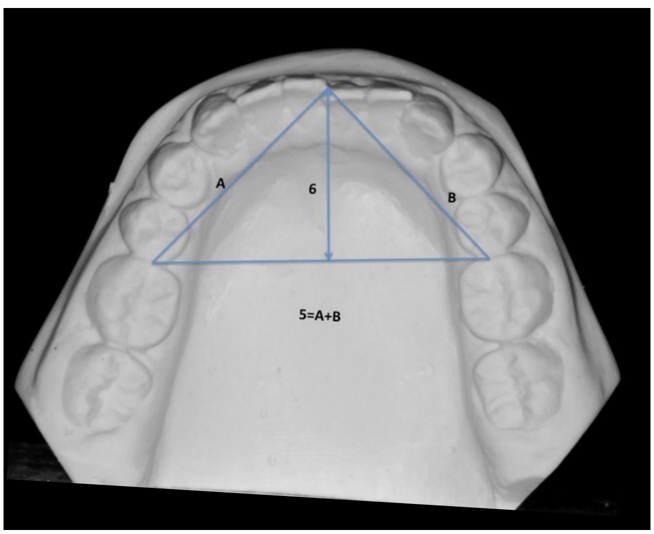


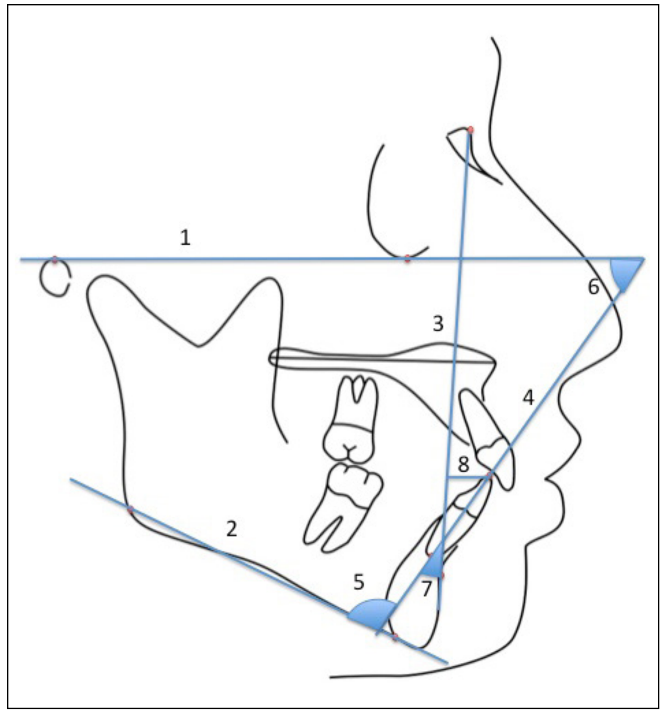
Figure 2: The dental cast measurements: 5; Arch length (A+B), 6; Arch depth.



normality test. When a change in the course of time was present, LSD as a post-hoc test was applied to measure which time interval was responsible for the difference within the groups.

For analyzing the differences between intergroup changes occurred with time, firstly the normality of the variables was tested with Shapiro-Wilk normality test. All of the variables were normally distributed so ANOVA test was applied for the assessment of intergroup differences. According to Levene Variance Homogenity test, intercanine distance (T0-T1), intermolar distance (T1-T2) and arch length (T0-T1) values were not homogenous so Welch ANOVA test was applied for those variables.

Figure 3: The planes and angles used at cephalometric measurements: 1; Frankfurt horizontal plane, 2; Mandibular plane, 3; N-B plane, 4; mandibular incisor long axis, 5; IMPA(°), 6;FMIA(°), 7; L1-NB(°), 8; L1-NB(mm).



ANOVA test was applied for analyzing the differences between intergroup changes. According to Levene Variance Homogenity test, intercanine distance (T0-T1), intermolar distance (T1-T2) and arch length (T0-T1) values were not homogenous so Welch ANOVA test was applied for those variables.

RESULTS

The intergroup comparison of the pretreatment age, Little's irregularity index, and the treatment and retention durations is shown in Table I. No statistically significant differences were observed between the groups for those variables ($p>0.05$).

The intragroup changes and the comparison of the changes in variables between the groups are shown in Table II and III.

For all groups, the Little's irregularity index decreased to 0 at the post-treatment period ($p<0.05$). During the post-retention period, significant 1.96 mm, 2.38 mm and 3.59 mm increases were observed for Groups I, II and III respectively ($p<0.05$), but despite the increase, Little's irregularity index scores did not reach pretreatment values with the most pronounced relapse in the non-extraction group, and the least relapse in the extraction group. When intergroup comparisons were analyzed, the changes were significant from T0 to T2 ($p<0.05$), and the difference resulted from the changes in extraction group.

The change in intercanine width with treatment was significant only for non-extraction group, with an increase of 1.50 mm ($p<0.05$). At the T1-T2 period, intercanine widths were significantly decreased across all groups ($p<0.05$) and the changes were similar between the groups ($p>0.05$) (Table II).

Table I. Intergroup comparison of pretreatment age, treatment and retention durations and pretreatment Little index values.

	Extraction Group (mean ±SD) [a]	ARS Group (mean ±SD) [a]	Non-Extraction Group (mean ±SD) [a]	P-Value
N (number of patients)	15 (9 girls, 6 boys)	13 (8 girls, 5 boys)	16 (13 girls, 3 boys)	
Age (T0)[b] (years)	13.89±5.69	13.51±1.73	13.34±1.82	0.912
Treatment duration (years)	2.10±0.48	2.15±1.05	1.67±0.63	0.110
Post-treatment period (years)	3.65±0.96	3.94±1.91	3.17±0.39	0.119
Little irregularity index (T0)[b] (mm)	8.03±3.00	6.23±2.70	6.74±1.64	0.152

[a] SD indicates standard deviation.

[b] T0 indicates pretreatment.

Table II. Intragroup and intergroup comparisons of the Little index, intercanine, interpremolar and intermolar widths, arch length and depth changes at T0-T1, T1-T2 and T0-T2 intervals.

Model Measurements		Extraction Group (mean, lower bound-upper bound)[a]	P^x-value	ARS Group (mean, lower bound-upper bound)[a]	P^x-value	Non-Extraction Group (mean, lower bound-upper bound)[a]	P^x-value
Little Index Score mm)	T0-T1	-8.03[a] (-9.69--6.37)	0.000*	-6.23[a] (-7.86--4.60)	0.000*	-6.75[a] (-7.62--5.87)	0.000*
	T1-T2	1.96[a] (1.09-2.83)	0.000*	2.38[a,b] (1.33-3.42)	0.000*	3.59[b] (2.49-4.70)	0.000*
	T0-T2	-6.07[a] (-7.54--4.59)	0.000*	-3.86[b] (-5.09--2.62)	0.000*	-3.15[b] (-4.40--1.91)	0.000*
Intercanine Width (mm)	T0-T1	0.80[a] (-3.94-1.99)	0.173	0.22[a] (-1.24-1.67)	0.749	1.50[a] (0.84-2.16)	0.000*
	T1-T2	-0.93[a] (-1.54--0.32)	0.006*	-0.66[a] (-1.21--0.12)	0.022*	-1.34[a] (-1.81--0.88)	0.000*
	T0-T2	-0.13[a] (-1.28-1.01)	0.807	-0.44[a] (-1.51-0.62)	0.384	0.16[a] (-0.55-0.87)	0.634
Interpremolar Width (mm)	T0-T1	2.60[a] (1.03-4.17)	0.003*	2.44[a] (0.97-3.91)	0.004*	2.77[a] (1.97-3.57)	0.000*
	T1-T2	-0.59[a] (-1.44-0.26)	0.158	-0.73[a] (-1.48-0.02)	0.055	-1.18[a] (-1.78--0.57)	0.001*
	T0-T2	2.01[a] (0.81-3.20)	0.003*	1.71[a] (0.74-2.67)	0.002*	1.60[a] (0.69-2.50)	0.002*
Intermolar Width (mm)	T0-T1	-2.03[a] (-3.67--0.38)	0.019*	1.86[b] (0.90-2.83)	0.001*	1.50[b] (0.70-2.30)	0.001*
	T1-T2	-0.31[a] (-1.14-0.52)	0.437	-3.66[a] (-10.70-3.38)	0.280	-1.12[a] (-1.98--0.25)	0.015*
	T0-T2	-2.33[a] (-3.33--1.34)	0.000*	-1.79[a] (-8.42-4.83)	0.566	0.38[a] (-0.71-1.47)	0.469
Arch Length (mm)	T0-T1	-9.68[a] (-11.51--7.85)	0.000*	1.99[b] (0.65-3.32)	0.007*	3.12[b] (2.34-3.91)	0.000*
	T1-T2	-0.15[a] (-0.86-0.56)	0.655	-0.89[a] (-1.45--0.34)	0.004*	-2.47[b] (-3.75--1.19)	0.001*
	T0-T2	-9.83[a] (-11.70--7.96)	0.000*	1.09[b] (-0.28-2.47)	0.109	0.65[b] (-0.57-1.88)	0.275

Model Measurements		Extraction Group (mean, lower bound-upper bound)[a]	P[x] -value	ARS Group (mean, lower bound-upper bound)[a]	P[x] -value	Non-Extraction Group (mean, lower bound-upper bound)[a]	P[x] -value
Arch Depth (mm)	T0-T1	-5.81[a] (-7.12--4.50)	0.000*	0.22[b] (-0.30-0.74)	0.382	1.37[b] (0.51-2.23)	0.004*
	T1-T2	0.26[a] (-0.46-0.98)	0.451	-0.12[a,b] (-0.69-0.46)	0.664	-1.14[b] (-2.09--0.19)	0.022*
	T0-T2	-5.55[a] (-6.70--4.39)	0.000*	0.10[b] (-0.75-0.95)	0.801	0.23[b] (-0.59-1.06)	0.559

(T0: pretreatment, T1: end of active orthodontic treatment, T2: minimum 3 years post-treatment)

[x]Lower and upper bounds were calculated at %95 confidence interval.

*p<0.05 was considered as statistically significant.

[a,b] *For the intergroup comparisons, within each row, different superscript letters indicate statistically significant difference (p<0.05)*

Table III. Intragroup and intergroup comparisons of the IMPA (°), FMIA (°), L1-NB (°) and L1-NB (mm) changes at T0-T1, T1-T2 and T0-T2 intervals.

Cephalometric Measurements		Extraction Group (mean, lower bound-upper bound)[a]	P[x] -value	ARS Group (mean, lower bound-upper bound)[a]	P[x]-value	Non-Extraction Group (mean, lower bound-upper bound)a	P[x] -value
IMPA (°)	T0-T1	-4.08[a] (-8.09--0.07)	0.047*	4.13[b] (0.18-8.08)	0.042*	6.14[b] (3.69-8.59)	0.000*
	T1-T2	3.61[a] (1.62-5.61)	0.002*	0.45[a] (-2.65-3.56)	0.756	1.24[a] (-0.76-3.23)	0.206
	T0-T2	-0.47[a] (-3.92-2.99)	0.776	4.58[b] (1.67-7.49)	0.005*	7.37[b] (4.47-10.28)	0.000*
FMIA (°)	T0-T1	5.95[a] (1.73-10.17)	0.009*	-4.26[b] (-8.84-0.31)	0.065	-5.95[b] (-8.43--3.47)	0.000*
	T1-T2	-1.72[a] (-3.81-0.37)	0.099	0.21[a] (-3.29-3.71)	0.899	0.14[a] (-1.89-2.17)	0.887
	T0-T2	4.23[a] (0.51-7.59)	0.028*	-4.05[b] (-7.05--1.06)	0.012*	-5.81[b] (-8.30--3.33)	0.000*
L1-NB (°)	T0-T1	-4.59[a] (-8.45--0.73)	0.023*	4.39[b] (0.29-8.50)	0.038*	6.34[b] (3.89-8.79)	0.000*
	T1-T2	1.45[a] (-0.96-3.87)	0.218	0.23[a] (-2.77-3.23)	0.870	-0.47[a] (-2.23-1.29)	0.579
	T0-T2	-3.14[a] (-6.62-0.34)	0.074*	4.62[b] (2.26-6.99)	0.001*	5.87[b] (3.49-8.25)	0.000*
L1-NB (mm)	T0-T1	-1.87[a] (-3.02--0.73)	0.003*	1.17[b] (-0.09-2.43)	0.066	2.63[b] (1.72-3.53)	0.000*
	T1-T2	1.38[a] (0.62-2.14)	0.002*	0.10[b] (-0.99-1.19)	0.845	-0.47[b] (-1.06-0.13)	0.114
	T0-T2	-0.49[a] (-1.67-0.68)	0.384	1.27[b] (-0.31-2.85)	0.106	2.16[b] (1.19-3.12)	0.000*

(T0: pretreatment, T1: end of active orthodontic treatment, T2: minimum 3 years post-treatment)

[x] Lower and upper bounds were calculated at %95 confidence interval.

* p<0.05 was considered as statistically significant

[a,b] *For the intergroup comparisons, within each row, different superscript letters indicate statistically significant difference (p<0.05).*

With treatment, the interpremolar widths were significantly increased across all groups and remained significantly the same at the retention period except in non-extraction group (Table II). All of the changes occurred with treatment, and retention was similar between the groups (p>0.05) (Table II).

The intermolar width changes were significant from T0 to T1, with a decrease of 2.03 mm in extraction group and an increase of 1.86 and 1.50 mm in ARS and non-extraction groups, respectively (p<0.05). From T1 to T2, the only significant difference was in ARS group, with a decrease of 1.12 mm (p<0.05) (Table II). The changes in intermolar distance were only significant from T0 to T1, and the difference resulted from extraction group (p<0.05) (Table II).

The arch length and depth decreased significantly in extraction group (p<0.05) from T0 to T1 and remained the same at T2. The arch length for ARS and non-extraction groups and arch depth for non-extraction group increased significantly with treatment and decreased significantly during the post-retention period (p<0.05). There was no statistically significant difference in arch depth for ARS group (p>0.05) (Table II).

According to the analysis of cephalometric measurements, in extraction group, IMPA, L1-NB(°) and L1-NB(mm) decreased significantly, and FMIA increased significantly from T0 to T1 (p<0.05). From T1 to T2, while the increase in IMPA and L1-NB(mm) was significant (p<0.05), in FMIA and L1-NB(°), no significant differences were observed (p>0.05) (Table III). In ARS group, the significant differences were the increase in IMPA and L1-NB(°) from T0 to T1, and the changes in IMPA, FMIA and L1-NB(°) from T0 to T2, with an increase in IMPA and L1-NB(°), and a decrease in FMIA (p<0.05) (Table III). In non-extraction group, the changes in all cephalometric measurements showed statistically significant differences from T0 to T1 and from T0 to T2, with an increase in IMPA, L1-NB(°) and L1-NB(mm), and a decrease in FMIA (p<0.05) (Table III).

When intragroup comparisons were evaluated, the statistically significant differences for IMPA, FMIA, and L1-NB(°) were at T0-T1 and T0-T2 intervals, and for L1-NB(mm) at T0-T1, T0-T2 and T1-T2 intervals (p<0.05). All of the significant differences resulted from extraction group (Table III).

DISCUSSION

When deciding on a treatment plan for borderline patients, several factors such as profile, smile esthetics, oral hygiene and the Bolton discrepancy of the arches must be taken into account in order to obtain a successful result. Besides these, the effects of the treatment types on the stability should not be overlooked. The aim of this study was to assess the effects of three different treatment modalities on dental arch dimensions, incisor positions and stability of the treatment outcomes.

In the present study, several parameters that could influence the stability of the treatment results showed no statistically significant differences between the groups, initially. All of the patients had a similar growth period awaiting them, Class I skeletal relationship with no use of any Class II or Class III intermaxillary mechanics that could influence the incisor inclinations, and correspondingly, the stability of the treatment. No statistically significant differences were found in pretreatment ages of the patients, pretreatment irregularity values, or treatment and retention durations between any of the groups. Similar retention protocols were followed at all groups. As Shah[13] claimed, it is difficult to draw a conclusion about the stability of the treatment results when the sample includes patients with various characteristics. As it was a retrospective study, the sample size was determined according to the inclusion criteria with similar irregularity scores and above-mentioned similar characteristics; therefore the sample size was not large. It was a limitation of the present study.

Although the pretreatment values were not significantly different between the groups, the most pronounced relapse was seen in the non-extraction group, and the least relapse was seen in the extraction group, with a significant difference from the other treatment modalities. Erdinc *et al* [11] found similar amount of relapse at mean four years post-retention in extraction and non-extraction groups. This finding differs from the findings of the present study, and this difference probably results from the amount of initial crowding. Despite the excessive initial crowding at the extraction group, the post-retention irregularity index scores were not significantly different between the groups. This is a fact that supports our findings with more tendencies for relapse with non-extraction treatment. In a study that evaluated the post-treatment 15-year outcomes of extraction treatment, it was concluded that satisfactory alignment of mandibular incisors with the irregularity <3.5 mm[14] could be obtained in most patients.[10] Freitas *et al* [9] pointed out that the patients treated with air-rotor stripping tended to have a smaller percentage of relapse, which is in accordance with the present study.

The intercanine width increase was statistically significant in non-extraction group however no difference was found between the groups. This difference was considered as a clinically significant difference. This finding is in accordance with the results of Germec-Cakan *et al* [15], who found no increase in intercanine widths as a result of air-rotor stripping and extraction treatments. At the post-retention period, intercanine widths decreased significantly across all groups. Although there are some controversies,[9,16] the literature mostly supports the maintenance of intercanine widths for stable treatment outcomes.[17,18] In the present study, the most post-retention intercanine width decrease was seen in the non-extraction group with nearly two times the relapse of the other groups, but the changes were not statistically significant. In a longitudinal study that evaluated the intercanine and intermolar width changes in an untreated population over 45 years, a slight decrease of the intercanine width was shown after 13 years of age.[19] Also, Uhde *et al* [20] revealed that the highest single factor for late lower incisor crowding was the mandibular intercanine width reduction at post-retention. In the present study, the decrease of the intercanine widths at post-retention was dedicated to the increase of the widths with treatment as after the post-retention period, the intercanine widths relapsed to nearly pretreatment values.

In all groups, there was a significant increase at the interpremolar widths with treatment, and the results were maintained during the post-retention period, except in the non-extraction group. Despite this difference, the changes in the interpremolar widths were not significantly different between the groups, in accordance with the literature.[11]

The intermolar widths were significantly increased with non-extraction and air-rotor stripping treatments and decreased with extraction treatment, but the only significant relapse was seen in

 doi 10.17796/1053-4628-41.6.13

non-extraction treatment in accordance with other studies.[9, 17, 21] The significant increase seen in the non-extraction and ARS groups could be due to an expansion obtained by arch wires, as arch expansion was not performed in any of the cases. Kahl-Nieke *et al* [22] reported that 4 mm or more intermolar arch expansion was correlated with arch width relapse, but in the present study, only 1.5 mm mean increase resulted in significant relapse in the non-extraction group. With extraction treatment, the spaces were moderately closed so the mesial movement of the molars resulted in a decrease of intermolar width as expected,[4] and the change was preserved at the post-retention period.

The arch length and depth significantly decreased with extraction treatment and preserved post-treatment dimensions in the post-retention period. The arch lengths increased significantly with air-rotor stripping treatment and relapsed to some extent in the post-retention period. The decrease of the arch lengths in the post-retention period was common at all groups and could also be due to the concept of the decrease in arch length consequent to the anterior component of force that tends to cause a mesial drift of the posterior teeth with time.[23]

With non-extraction treatment, both the arch length and depth increased significantly with treatment, and relapsed to almost initial levels during the post-retention period. The changes were stable in the post-retention period with extraction treatment for the mentioned variables, but relapse was significant with non-extraction treatment. As the most irregularity relapse was also seen with non-extraction, these post-retention decreases could also be related to the instability of the results.

When the cephalometric measurements were evaluated; it was seen that the lower incisors were retroclined with extraction treatment and proclined with non-extraction and air-rotor stripping treatments, as expected. There was mild relapse of the lower incisors in the extraction group, while the results were stable in the other groups. The slight proclination of the lower incisors at post-retention seen in extraction treatment is in accordance with the other studies[10, 11] and could be due to the rebound effect.[21] Besides these, surprisingly, the relapse in incisor inclinations was not evident in the other groups. The reason could be the limited post-retention period. It is generally accepted that nearly all incisor relapse occurs within a year or two after retention ends.[24] Although the most significant irregularity increase was seen in the non-extraction and ARS groups, the incisor inclination changes in the post-treatment period were not significant. This finding could mean that the relapse mostly resulted from the intercanine width decrease in these subjects.

When the overall results were assessed, the null hypothesis was rejected and it was revealed that for borderline patients, the most stable treatment outcomes were obtained with extraction treatment, and the most relapse was seen with the non-extraction treatment modality. Although an increase in intercanine width was observed in all groups, an increase higher than 1-1.5 mm that was reported as unstable[25] was only observed with non-extraction treatment and resulted in the most pronounced relapse. Many factors should be taken into account when deciding between extraction or non-extraction treatment, but when the profile and incisor proclinations are suitable; the first choice should be extraction, for the sake of stability. As Bowman stated,[26] "the avoidance of extraction, simply for the sake of its avoidance, could have unintended consequences in terms of compromised stability, periodontal health, and esthetics". This does not mean that all borderline patients must be treated with extraction. When the conditions are not in favor of extraction treatment, air-rotor stripping can be a strong option, as the stability of the treatment results is better than for the non-extraction group.[9] Finally, when a non-extraction treatment decision is made, the use of fixed lingual retainers or other alternatives for increasing stability such as fiberotomy should be taken into consideration.

CONCLUSIONS

1. The greater mandibular anterior relapse was seen with non-extraction treatment, followed by air-rotor stripping and extraction treatments.
2. With non-extraction treatment, the intercanine, interpremolar and intermolar widths and the arch length and depth increased, and a significant relapse was seen at all of the mentioned variables in the post-retention period.
3. The changes in intercanine and interpremolar width at the treatment and post-retention periods were not significantly different for the extraction and air-rotor stripping treatments.
4. The intermolar width, arch length and arch depth decreased with extraction treatment, and the results were stable in the post-retention period.
5. The lower incisors were retroclined with extraction treatment and proclined with air-rotor stripping and non-extraction treatments. A minimal relapse was seen in the extraction group, but the results were stable in the other groups.

REFERENCES

1. Johnston CD, Littlewood SJ. Retention in orthodontics. Br Dent J 218(3):119-122, 2015.
2. Shapiro PA. Mandibular dental arch form and dimension. Treatment and postretention changes. Am J Orthod 66(1):58-70, 1974.
3. Little RM, Wallen TR, Riedel RA. Stability and relapse of mandibular anterior alignment-first premolar extraction cases treated by traditional edgewise orthodontics. Am J Orthod 80(4):349-365, 1981.
4. Motamedi AK, Dadgar S, Teimouri F, Aslani F. Stability of changes in mandibular intermolar and intercuspid distances following orthodontic treatment. Dent Res J 12(1):71-75, 2015.
5. Sheridan JJ. Air-rotor stripping. J Clin Orthod 19(1):43-59, 1985.
6. Aksu M, Kocadereli I. Arch width changes in extraction and nonextraction treatment in class I patients. Angle Orthod 75(6):948-952, 2005.
7. Gianelly AA. Arch width after extraction and nonextraction treatment. Am J Orthod Dentofacial Orthop 123(1):25-28, 2003.
8. Dong ZY, Liu DX, Wang TJ, Liu L. [Changes in arch width after extraction and nonextraction treatment]. Shanghai Kou Qiang Yi Xue 16(4):355-357, 2007.
9. Freitas KMS, de Freitas MR, Henriques JFC, Pinzan A, Janson G. Post-retention relapse of mandibular anterior crowding in patients treated without mandibular premolar extraction. Am J Orthod Dentofacial Orthop 125(4):480-487, 2004.
10. Boley JC, Mark JA, Sachdeva RC, Buschang PH. Long-term stability of Class I premolar extraction treatment. Am J Orthod Dentofacial Orthop 124(3):277-287, 2003.
11. Erdinc AE, Nanda RS, Isiksal E. Relapse of anterior crowding in patients treated with extraction and nonextraction of premolars. Am J Orthod Dentofacial Orthop 129(6): 775-784, 2006.
12. Little RM. The irregularity index: a quantitative score of mandibular anterior alignment. Am J Orthod 68(5):554-563, 1975.
13. Shah AA. Postretention changes in mandibular crowding: a review of the literature. Am J Orthod Dentofacial Orthop 124(3):298-308, 2003.
14. Little RM, Riedel RA, Artun J. An evaluation of changes in mandibular anterior alignment from 10 to 20 years postretention. Am J Orthod Dentofacial Orthop 93(5):423-428, 1988.
15. Germec-Cakan D, Taner TU, Akan S. Arch-width and perimeter changes in patients with borderline Class I malocclusion treated with extractions or without extractions with air-rotor stripping. Am J Orthod Dentofac Orthop 137(6):734e1-734e7, 2010.
16. Paquette DE, Beattie JR, Johnston LE, Jr. A long-term comparison of nonextraction and premolar extraction edgewise therapy in "borderline" Class II patients. Am J Orthod Dentofacial Orthop 102(1):1-14, 1992.
17. Glenn G, Sinclair PM, Alexander RG. Nonextraction orthodontic therapy: posttreatment dental and skeletal stability. Am J Orthod Dentofacial Orthop 92(4):321-328, 1987.
18. Artun J, Garol JD, Little RM. Long-term stability of mandibular incisors following successful treatment of Class II, Division 1, malocclusions. Angle Orthod 66(3):229-238, 1996.
19. Bishara SE, Jakobsen JR, Treder J, Nowak A. Arch width changes from 6 weeks to 45 years of age. Am J Orthod Dentofacial Orthop 111(4):401-409, 1997.
20. Uhde MD, Sadowsky C, BeGole EA. Long-term stability of dental relationships after orthodontic treatment. Angle Orthod 53(3):240-252, 1983.
21. Blake M, Bibby K. Retention and stability: a review of the literature. Am J Orthod Dentofacial Orthop 114(3):299-306, 1998.
22. Kahl-Nieke B, Fischbach H, Schwarze CW. Treatment and postretention changes in dental arch width dimensions—a long-term evaluation of influencing cofactors. Am J Orthod Dentofacial Orthop 109(4):368-378, 1996.
23. Thilander B. Biological Basis for Orthodontic Relapse. Semin Orthod 6:195-205, 2000.
24. Edman Tynelius G, Bondemark L, Lilja-Karlander E. A randomized controlled trial of three orthodontic retention methods in Class I four premolar extraction cases- stability after 2 years in retention. Orthod Craniofac Res 16(2):105-115, 2013.
25. Burke SP, Silveira AM, Goldsmith LJ, Yancey JM, Van Stewart A, Scarfe WC. A meta-analysis of mandibular intercanine width in treatment and postretention. Angle Orthod 68(1):53-60, 1998.
26. Bowman SJ. Pulsus a mortuus equus. Semin Orthod 20(1):36-45, 2014.

 doi 10.17796/1053-4628-41.6.13