

Mandibular Incisor Re-Crowding: Is It Different in Extraction and Non-extraction cases?

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Abstract

Introduction: Relapse of anterior crowding after retention phase is a major complication in orthodontic treatment. It is the most unpredictable phenomena. This study is aimed to compare anterior crowding relapse in patients treated with non-extraction and extraction of upper and lower first premolars related to changes of selected variables.

Materials and Methods: "Irregularity Index" of dental arch of 40 patients (Extraction group=21, Non-extraction group=19) were measured on study models before treatment (T1), post-treatment (T2), and at post-retention (T3). The changes within each group were evaluated using the Wilcoxon test and the Mann-Whitney test was used for inter-group evaluation.

Results: The mean initial irregularity index was 7.23 mm in extraction group and 6.13 mm in non-extraction group which decreased to 0 mm with treatment. Finally, crowding relapsed to 2.11 mm in extraction group and 1.65 mm in non-extraction group at the post-retention period. These changes were equally statistically significant within both groups. (P-value =0.001) However, no preference exists between studies groups concerning fewer incisors relapse. (P-value =0.138)

Conclusion: Extraction and non-extraction protocols are two different methods of treatment but they show similar tendency to incisor relapse.

Key words: Post-retention, Incisor irregularity index, Relapse, Incisor re-crowding

Introduction

Recrowding during post-retention is a dilemma for orthodontist and patient, as well. This has been a disputable topic among researchers. Some researchers have proposed reasons like physiologic changes and patient's noncompliance with retainers as causative factors for such disruption. Angle [1] believed that ideal oral function is tied to ideal tooth alignment. He also tends to treat patients with non-extraction treatment protocols to guarantee better alignment during post-retention period. Sampson [2] advocated the effect of rotational growth and late growth pattern of mandible as predisposing factors for incisor relapse.

To resolve such orthodontic complication, in 1930s following many orthodontic relapse cases, Tweed substantiated the "premolar extraction" concept [1]. For a decade; this was the most preferred treatment protocol among practitioners. However, the result of long-term studies of stability of anterior teeth was not encouraging for orthodontists [4]. To prevent such problem, Nance [3] advocated incisor flaring as a basic strategy for non-extraction treatment. In addition, Brodie [5] in his study of non-extraction cases and Cole [6] in extraction cases concluded that substantial changes in "tooth inclination" during treatment can prone the anterior teeth to relapse during post-retention period. Weinburg [7] and Sadowsky [8,9] as many other studies concerning "stability & relapse" of cases also reached to the same conclusion in their observations. They indicated that unconservative proclination of incisors with treatment is the basis of relapse after treatment. On the contrary, Freitas opposed with the role of incisor inclination in relapse [10].

Other researchers found some other causes for relapse. Changes of "inter-canine width" were another topic of research related to incisor re-crowding. Some researchers believed that the increase of inter-canine width was the cause of late recrowding [11-13] others found no correlation between these two parameters [10-14]. Decrease in "arch length" during post-retention period was the other condition that could subject anterior teeth to re-crowding [15-16].

Due to controversies concerning the phenomenon of "incisor relapse", this study was designed to scrutinize the incisor re-crowding event comparing extraction with non-extraction cases. The hypothesis is that extraction and non-extraction patients are probably facing with a similar rate of relapse since recrowding is a multifactorial phenomenon.

Materials and Methods

This was a retrospective study. Forty patients had sought orthodontic treatment in the university orthodontic clinic. Data was gathered from samples at 3 stages of: Pre-treatment (T1), Post-treatment (T2), and Post-retention [at least 4 years after debonding] (T3). They went under fixed orthodontic treatment for an average period of 2 years and 11 months and the average post-retention length was 6 years. Only four first premolars were extracted for the purpose of treatment. Patients were treated with peri adjusted fixed edgewise appliance. The slot size of edgewise brackets were "0.022". All cases were treated using sliding mechanic technique. Both arches in all cases were banded and bonded according to conventional method. At conclusion of treatment, all patients were delivered upper and lower Hawley retainers for retention.

None of the Patients had any dento-skeletal anomaly, like; clefts, open- or deep-bite, or any kind of tooth malformation. None of the patients received any Circumferential Supracrestal Fibrotomy (CSF), reproximation (inter-proximal stripping), or any other adjunctive treatment procedure.

In extraction group, 16 patients were Class I and 5 patients had Class II Div I malocclusion. The non-extraction patients, 14 presented with Class I and 5 had Class II Div I malocclusion. All cases were delivered upper and lower Hawley retainers for retention. Initial panoramic X-Rays of all samples showed presence of third molars.

Cast Analysis

A number of 120 study models (3 casts for each stage per patient) were collected from archive of the orthodontic department for evaluation. Incisor irregularity index of anterior teeth was measured with a digital caliper (Mitutoyo America, Aurora, IL) with the precision of 0.01mm, as was defined by Little [16]. This measurement was performed by calculating the sum of 5 distances between the anatomic contacts of 6 anterior teeth from mesial aspects of the left canine to the mesial aspect of the right canine, in millimeters (Figure 1).

Statistical Analysis

Mean and standard deviation for the stages T1, T2, and T3 was measured for each individual group. As an overall view, Changes from T1 to T3 were evaluated for all samples. The changes within each group were analyzed using the Wilcoxon Signed Ranks test. P-value was another indicator to define the level of significance of these changes at stage T3 in each of two treatment protocols. The Mann-Whitney test was also used to statistically compare inter-group differences. The Friedman test presented the trend of changes during stages of evaluation. The 0.9 level of Intra-Class Correlation Coefficient (ICCC) test indicated "reliability" approval of the study. Finally, statistical analyses of changes were performed to compare in the recrowding rate between extraction and non-extraction samples in all 3 stages of study (T1, T2 & T3).

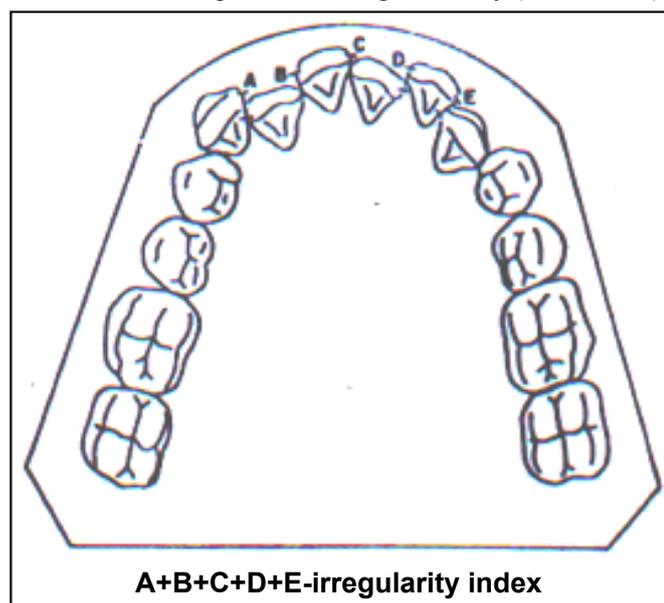


Figure 1. Little's "Irregularity Index" of dental arch. It is the total measurement of five interproximal distances of anterior teeth.

Results

Patients in non-extraction group consisted of: 4 boys and 15 girls with mean age of 16 years and 3 months at stage T1, 18 years and 9 months at stage T2, and 24 years and 7 months at stage T3. For this group, treatment length was 2 years and 7 months and post-retention period was 4 years and 2 months, averagely. The extraction group comprised of: 6 boys and 15 girls with the average age of 14 years and 9 months at stage T1, 17 years and 8 months at stage T2, and 24 years and 6 months at stage T3 (Table 1).

Overall, patients treated with extraction method had more initial crowding than those did with non-extraction method; however, this difference was not statistically significant. (P-value =0.900) The initial value of crowding (T1) for extraction group was 7.23 ± 2.63 mm and for the non-extraction group was 6.13 ± 2.69 mm. This clearly reduced to zero with treatment (T2) for both groups. The irregularity value at the final stage of study (T3) in extraction group returned to 2.11 ± 1.14 mm and in non-extraction group to 1.65 ± 0.73 mm, averagely. This difference was statistically not significant between groups (P-value=0.933) (Table 2) (Figures 2 and 3).

According to Wilcoxon Signed Ranks Test, when each stage of treatment compared to another within each study group (T1&T2, T2&T3, and T1&T3), the results indicated that all changes were statistically significant in 6 paired of analysis, equally (P-value=0.001) (Table 3).

The Friedman test indicates the nominal trend of crowding changes at three stages for both extraction and non-extraction groups. The post-treatment was "1", the post-retention was "2", and the initial crowding was "3". The changes in both groups during treatment statistically satisfied the level of significance (p-value) in all samples (P-value=0.001) (Table 4). The linear trend of crowding changes is depicted in Graph 3.

Independent T-test also statistically did not show any significant difference between two treatment protocols concerning the rate of "initial crowding" (T1) (P-value=0.200) and "post-treatment recrowding" (T3) (P-value=0.162) (Table 5). In addition, another statistical analysis –the Mann-Whitney test also revealed that the difference between initial crowding in both study samples at the stage of "initial crowding" (T1) and "post-treatment recrowding" (T3) was not significant, (P-value=0.143) (P-value=0.138) respectively (Table 5).

Discussion

Long-term stability of incisor alignment after orthodontic treatment is a sincere wish for orthodontist and patient, as well. The present study generally showed some incisor-crowding relapse, in both groups. In comparison, the results of Erdinc [18], Little [19,20], Artun [16] studies showed less recrowding during post-retention period. However, indeed,

Table 1. Age distribution of study cases in two separate non-extraction and extraction groups.

Group (age)	Non-Extraction (year/month)	Extraction (year/month)
T ₁	16/3	14/9
T ₂	18/9	17/8
T ₃	24/7	24/6
No. of Cases	19	21

Table 2. Descriptive statistics for the rate of crowding at different stages of treatment (T1, T2, & T3) of study samples in both groups: a. Non-extraction group b. Extraction group.

Group	TX. Stage	Mean	Std. Deviation	Std. Error Mean	Minimum	Maximum
a. Non-extraction (#19)	Initial Crowding (T1)	6.1295	2.68697	0.61643	3.07	9.70
	Post- Treatment Crowding (T2)	0.0000	0.00000	0.0000	0.00	0.00
	Post- Retention Crowding (T3)	1.6605	0.74844	0.17170	0.80	2.65
b. Extraction (#21)	Initial Crowding (T1)	7.2329	2.66204	0.58091	3.07	10.50
	Post- Treatment Crowding (T2)	0.0000	0.00000	0.0000	0.00	0.00
	Post- Retention Crowding (T3)	2.1033	1.15175	0.25133	0.90	3.50

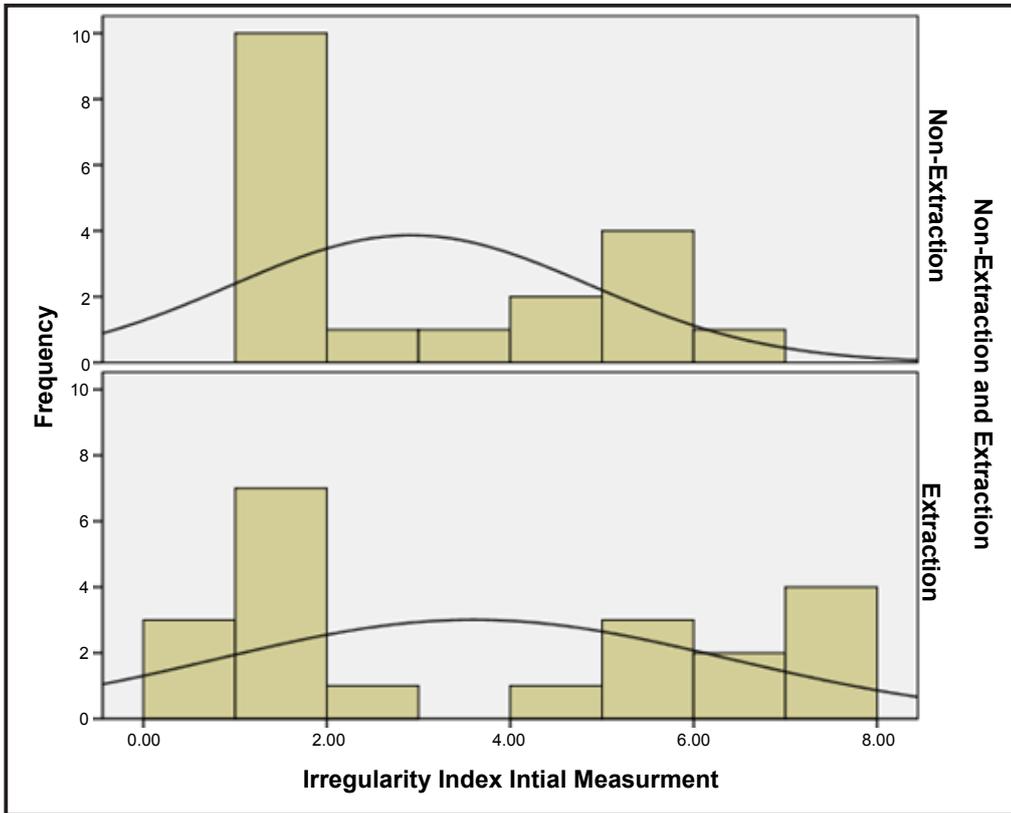


Figure 2. The distribution of irregularity index measurement in non-extraction (top) and extraction (bottom) groups at the initial stage (T1) of treatment.

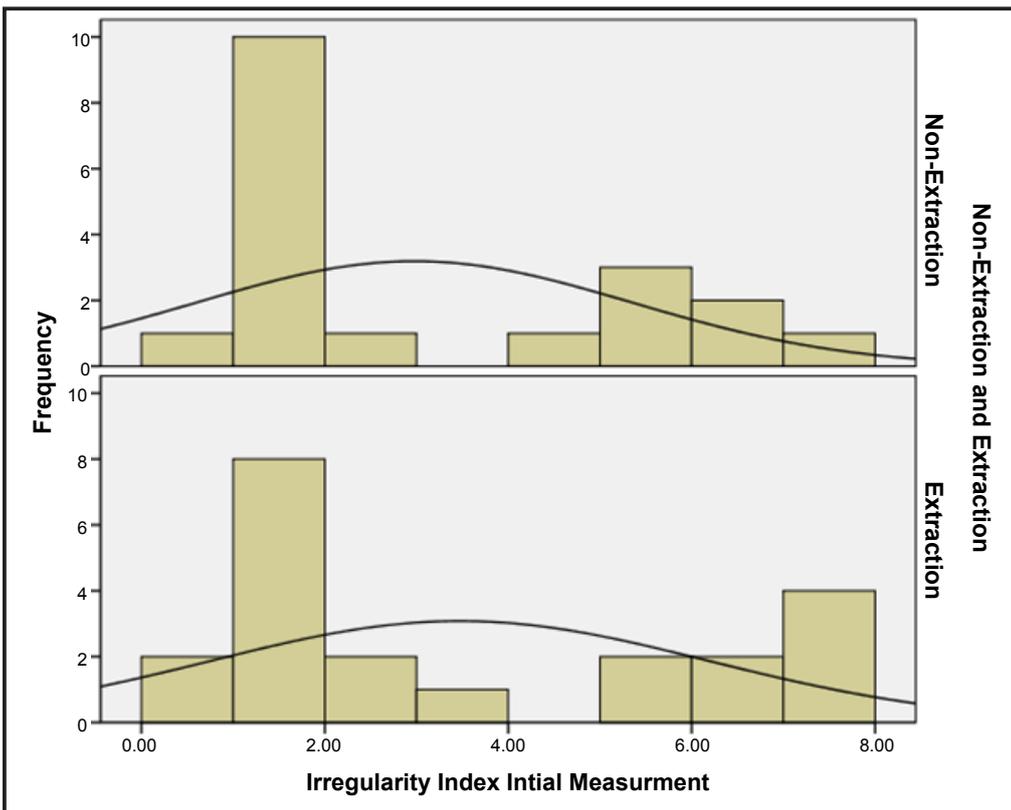


Figure 3. Distribution of irregularity index measurement in non-extraction (top) and extraction (bottom) groups at the final stage (T3) of treatment.

there is this is probably due to little similarity in the study design of different researches.

Reviewing the literature concerning this topic reveals the unique design of this study in its own type when compared to others. Obviously, the diversity in the structure of studies can affect the outcome of studies. These variations are categorized in following conditions [21,22].

1. The wide age range of participants at the initial stage of treatment weakens the results of study due to different growth stage
2. Diversity in the length of retention and/or post-retention period.
3. Prescription of different kinds of retainer appliances for retention (Hawley, Lingual bonded, etc.).

4. Variation in the initial crowding.
 5. Some adjunctive treatments which can discredit the accuracy of the results of study i.e., reproximation or and CSF procedures.
 6. Patients were selected with different type of malocclusion affecting the stability of treatment outcome.
 7. Patients were treated with different kind of mechnotherapy.
 8. Diverse ethnic background of samples. As such, comparison between the results of this study and other studies is not an easy task, if not impossible.
- Conceptually, it is reported by some authors that incisor relapse usually occurs during the first to second year of post-treatment, alerting both patient and orthodontist for the

Table 3. Wilcoxon Signed Ranks Test of study samples: a. Non-extraction group b. Extraction group. Note the changes for all 3 paired stage groups were statistically significant, for both study groups

A. Wilcoxon signed ranks test (non-extraction group, N=19)

	Post- Treatment Crowding (T2) - Initial Crowding (T1)	Post- Retention Crowding (T3) - Initial Crowding (T1)	Post- Retention Crowding (T3) - Post-Treatment Crowding (T2)
Z	-3.825 ^b	-3.823 ^b	-3.829 ^a
P value	.001	.001	.001

B. Wilcoxon Signed Ranks Test (Extraction group, N=21)

	Post-Treatment Crowding (T2) - Initial Crowding (T1)	Post-Retention Crowding (T3) - Initial Crowding (T1)	Post- Retention Crowding (T3) - Post-Treatment Crowding (T2)
Z	-4.015 ^a	-4.015 ^a	-4.023 ^b
P value	.001	.001	.001

Table 4. The Friedman test reports the trend of crowding changes at three stages of treatment. This is reported in two separate parts: a. Non-extraction group, b. Extraction group. The changes in both groups during treatment statistically satisfied the level of significance (P-value=.001) in all samples.

A. Friedman Test (Non-Extraction group)

Ranks		Mean Rank
Initial Crowding (T1)		3.00
Post- Treatment Crowding (T2)		1.00
Post- Retention Crowding (T3)		2.00
Test Statistics		
N		19
Chi-square		38.000
df		2
P value		0.001

B. Friedman test (extraction group)

Ranks		Mean Rank
Initial Crowding (T1)		3.00
Post- Treatment Crowding (T2)		1.00
Post- Retention Crowding (T3)		2.00
Test Statistics		
N		21
Chi-square		42.000
df		2
P value		0.001

Table 5. According to the Mann-Whitney test, no statistically significant difference was also found in the crowding level between the "extraction" and "non-extraction" methods, at none the stages of treatment (T1, T2, or T3).

Statistical test	Initial Crowding (T1)	Post- Treatment Crowding (T2)	Post- Retention Crowding (T3)
Mann-Whitney U	145.500	199.50	145.000
P.value	.143	1.000	0.138

a. Not corrected for ties.

b. Grouping Variable: Non-Extraction and Extraction

importance of and emphasis on retainer wear [23]. Gardner believed that the first year is the time that patient would be prone to re-crowding [24]. Little added that this complication occurs more in first decade than second decade of post-treatment [19].

Based upon the results of this study, both extraction and non-extraction cases are equally susceptible to relapse. This result was similar with the observation of Little [4] Artun [16] and Rossouw [12,13]. In fact, Uhde [25] and Paquette [14] studies showed that non-extraction patient faced with more incisor relapse. Nahl-Neike et al. reported more relapse in extraction cases [15]. Although the mean initial Irregularity Index of lower incisors was more in extraction group than non-extraction group, the relapse in post-retention period had no relation with initial crowding of the case, statistically.

At the end, there are few points to be considered concerning the ideal criteria for case selection. If "growth pattern" had any role in relapse, 10 cases of Class II malocclusion (25%) may distort the result of this study. However, this has been a controversial issue; since Freitas et al. [10] study proved that vertical grower faces with more relapse, while Erdinc et al. [18] oppose with such a cause & effect relationship. The other point is that 12 patients had third molars extracted. This may have some effect on occurrence of relapse. Nonetheless, there is also a blurred opinion whether "the presence of wisdom tooth" can play any role in the incisor re-crowding after retention [26,27]. The other probable confounding factor in some patients can be the role of "occlusal attrition" on relapse. It is clear that in the present study this can be negligible due to the fact that much longer retention term require for this pathological change to happen, if any role can be assumed for that at all.

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The advantage of this unique research was "similarity of initial crowding" in both experimental groups. This design would lead the study to results that are more dependable. The other positive point of this research was that all patients were at the "post-pubertal growth" period. The pretreatment the mean age was 14 years and 9 months in extraction group and 16 years and 3 months in non-extraction group. Then, the post-treatment stage ended at the mean age of 18 years and 2 months and 19 years and 9 months in each group, respectively. The final point is that there is an inevitable phenomenon of "dimensional changes in the facial skeleton" as the age of an individual increases. As such, there is much benefit in wearing retainers for a longer period of time to combat with or minimize the effect of these physiologic changes on the alignment of dentition in older ages. Obviously, this is the matter of an extra compliance of patients with such advices! It should be noted that data gathering for this retrospective study concerning its criteria is troublesome. Unique post-growth age range, specific extraction cases, and selection of cases treated with similar biomechanics were three limitations among some others in the present study.

Conclusion

This study concluded with the following points:

1. Stability of orthodontic treatment was generally acceptable for both study groups.
2. There was no statistically significant relation between late incisor crowding with studied Irregularity Index in this research, in any phase of evaluation. (T1, T2, and T3)
3. Late incisor crowding was similar in both extraction and non-extraction groups.

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