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Comparison of anterior crowding relapse tendency in patients treated with incisor extraction, premolar extraction, and nonextraction treatment

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ABSTRACT

Background and aim: Relapse of incisor crowding is usually a serious challenge for orthodontists, and achieving long-term stable occlusion after treatment is one of the primary goals of orthodontic treatment. Stability of aligned incisors is unpredictable, and the difference is attributed to the type of malocclusion, treatment procedures, patient co-operation, or soft tissue growth and adaptability. Considering controversies in this issue, this study is aimed to compare various treatment plans used for incisor alignment in order to find the most useful one, which achieves long-term stability.
Methods: The study included 120 study casts from 40 patients with the mean age of 23.1 years and range of 15 to 38 years. The patients were treated with either nonextraction, single extraction, or premolar extraction and were evaluated at three time points, including T1 (before treatment), T2 (after treatment), and T3 (after retention).
Results: Relapse were observed in all three groups. The mean of mandibular incisor irregularity index was 0.37 ± 0.31, 0.37 ± 0.41, and 0.51 ± 0.47 in the nonextraction, premolar extraction, and incisor extraction groups, respectively. One-way analysis of variance suggested that there was no significant difference among the three groups in this regard ($P = 0.2$).
Conclusions: Given the results of this study, it appears that treatment modality in terms of extraction or nonextraction is not a major determinant in posttreatment relapse.
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1. Introduction

One of the main goals of orthodontic treatment is to achieve and preserve stable occlusion. Long-term studies have estimated that relapse occurs in 70% of cases [1–3]. Tooth movement after orthodontic treatment is suggested to be associated with several factors, such as normal changes and jaw growth over time [4,5], and also the pretreatment tooth alignment. However, the most vulnerable cases and the severity of the relapse may not be predicted precisely. The literature has not suggested any relation between the relapse and molar relationship [6], initial incisor alignment, rate of tooth movement, and presence of the third molars [7]. Several studies have assessed outcome and stability of various orthodontic treatments. Accordingly, stability of aligned incisors is unpredictable and variable [8]; however, this variability may be due to different malocclusions and treatments, soft tissue adaptability, and patient compliance [9].

Some authors have suggested that mandibular incisor position influences treatment stability, and pretreatment position may be a reliable predictor for the future stable condition [10–12]. Uhde et al. [13] revealed that protruding mandibular incisor is not a reliable technique for aligning teeth. Brodie et al. [14] and Cole et al. [15], who assessed extraction and nonextraction treatments, respectively, demonstrated that change in axial inclination of the incisors makes them more prone to relapse. Some studies have shown that stable incisor alignment may be achieved once mandibular intercanine width (ICW) is maintained [16–18],

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whereas others suggested that decrease in arch length (AL) is the main cause of posttreatment crowding [19]. Another factor influencing orthodontic treatment is jaw growth and rotation, which is more pronounced in the mandible than maxilla [20,21]. In past decades, extraction of incisors or premolars was considered as the acceptable treatment to resolve dental crowding; however, nonextraction treatments are put in the spotlight due to the pivotal role of aging and soft tissue profile in esthetics [22]. Arch width and length, and specifically ICW, decrease over time, which is suggested to be associated with the mesial drift of the posterior teeth.

The basal bone covers the tooth root so the interaction between the tongue and lips leads to crowding in the anterior teeth, especially the mandibular incisors; hence, it is prudent to maintain the ICW. Tooth alignment is always accompanied with increase in ICW or protrusion, unless interproximal reduction or incisor extraction is performed [23]. It is assumed that even premolar extraction does not prevent increase in ICW because the canines are pushed toward a wider segment of the dental arch. Comparison of patients undergoing mandibular incisor extraction with other tooth extraction or nonextraction treatments demonstrated more favorable stability of incisor teeth over time. Extraction of the incisor teeth is among several methods of decreasing ICW, and hypothetically this will enhance stability. Incisor extraction is associated with several advantages, such as decreasing the treatment time [24–26]. Compared with premolar extraction, this approach requires less retraction, so anterior-posterior position of the incisors and profile are less altered. In addition, this technique may further enhance long-term stability because ICW is not increased. The greatest disadvantage of incisor extraction, especially when there is no Bolton discrepancy, is increase in overjet or Class III canine relation. Furthermore, interdental papilla may be lost, dark space may develop, and midline deviation will always be present [27]. The present study aimed to compare extraction of incisor teeth with other treatments regarding effect of the stability of the outcomes, especially incisor crowding.

2. Materials and methods

In this cross-sectional study, 120 consecutive patients, 99 women and 21 men (40 subjects per group) referred to a private clinic receiving comprehensive orthodontic treatment, were included. The subjects completed a mean of 3.5 years after completion of their fixed appliance treatment. The patients were using a retainer for a mean of 8 months; 61.7% were using Hawley retainers and 38.3% were using clear retainers based on clinician preference.

Sample size was calculated to be 40 individuals in each group according to the previous study using R software. The present study was approved by the ethics committee at Research Deputy of Hamedan University of Medical Sciences (identifier IR.UMSHA.REC.1395.114).

Exclusion criteria were as follows: patients suffering from craniofacial defects, open bite, and patients who had previously undergone orthognathic surgery and Rapid Palatal Expansion. All patients were having either Class I or Class II Division 1 malocclusion, and they were all treated by MBT prescription straight wire appliance (0.022 × 0.028-inch slot size).

The patients were allocated to three groups according to the treatment received as: nonextraction group (33 females, 7 males, mean age 24 ± 6 years), premolar extraction group (35 females, 5 males, age mean 22.9 ± 5), and incisor extraction group (31 females, 9 males, age mean 21.6±4 years) (Table 1). Postretention impressions were obtained from the patients and the casts were compared in three time points: before the treatment (T1), after the active treatment (T2), and at least 2 years following retention with mean of 3.5 years (T3) (Fig. 1). Generally, 82.5% of the selected participants were female and 17.5% were male, and in all three groups the number of the female patients was higher than male patients. The casts were assessed by one of the authors by digital caliper (Mitouyo, Kawasaki, Japan) in 0.1 mm. The measurements were randomly performed in duplicate on 20 casts, and the intraobserver agreement was measured by paired t test and there was no significant difference between measurements ($P > 0.05$).

Table 1
Demographic characteristics of study

	Single ext.	Nonext.	Premolar ext.	
Gender Male	9	7	5	21
Female	31	33	35	99
Age (SD)	21.62 (4.7)	24.87 (6.3)	22.9 (5.8)	23.13 (5.8)
Duration of retention (SD)	8.6 (4.9)	7.2 (4.1)	8.4 (5.1)8 (4.7).	
Time (SD)	3.35 (0.9)	3.5 (2.13)	3.2 (1.11)	3.35 (1.48)

Ext, extraction; Nonext, nonextraction.

Because the number of interproximal contacts was less in the incisor extraction group, we used the mean of incisor irregularity index, which is the sum of anatomical contacts from the mesial surface of left canine to the mesial surface of the right canine divided by the number of the contacts (four contacts in the incisor extraction group vs. five in the others).

The following describes the measured indices:

Overjet: the distance between the most labial maxillary and mandibular central incisors parallel to the occlusal plane

Overbite: vertical overlap of the lower and upper incisors

AL: sum of the distance of the right and left first molars to the central contact point

Intermolar width (IMW): distance between the central fossa of the right and left first molar

ICW: distance between the right and left canine tips

Incisal irregularity index (Ir): sum of the contacts from the mesial of left canine to the mesial of right canine (Fig. 2)

2.1. Statistical analysis

Mean and SD of all the variables were calculated and the pre- and postretention groups were compared using a paired t test. All analyses were carried out by SPSS software version 22 (IBM Corp., Chicago, IL). The changes between T1, T2, and T3 (postretention incisal crowding) in groups were compared by ANOVA and Tukey post hoc test. Significance level was determined at $P < 0.05$. The correlation between pretreatment incisal irregularity index, and duration with posttreatment incisal crowding was calculated with Pearson correlation coefficient. The correlation between types of the retainer with posttreatment incisal crowding was calculated with Spearman correlation coefficient.

3. Results

In the present cross-sectional study, 120 dental casts of three time points (T1: before the treatment; T2: exactly after the treatment; and T3: after the retention) were analyzed. Seventy-four patients were using Hawley retainers and 46 subjects were using clear retainers. There was no significant correlation between the incisor irregularity index and duration of retention (Pearson correlation = 0.06) and its type (correlation coefficient = 0.07). This finding may suggest that our study was not influenced or biased by the type of retainer. In addition, there was no significant correlation between the mandibular incisor irregularity index with gender or age.

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