Evaluation of Mandibular Incisor Extraction Treatment Outcome in Patients with Bolton Discrepancy Using Peer Assessment Rating Index

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Abstract
Objective: Mandibular incisor extraction in carefully selected cases as an alternative option to four bicuspid extraction or non extraction treatment has been advocated. The purpose of this study was to determine the degree of improvement in occlusion in patients with Bolton discrepancy treated by one lower incisor extraction using Peer Assessment Rating Index (PAR indexes).

Materials and Methods: Pre and post treatment dental casts of 14 patients treated with one lower incisor extraction were included in the study. Pre and post treatment dental casts were scored with PAR index. 70% reduction in PAR index was considered as high standard improvement. To test the hypothesis that the mean improvement in dental occlusion after one mandibular incisor extraction is at least 70%, one-tail one-sample student t-test was used.

Results: The mean improvement in dental occlusion in this group of patients was 78%. Fifty percent of the cases finished with a post treatment PAR score of 2. Spearman correlation coefficient was 0.763 (p<0.01), showing that more severe cases had greater post treatment PAR scores.

Conclusion: Mandibular incisor extraction treatment may provide a high standard treatment outcome.

Key Words: Mandibular Incisor Extraction; PAR Index; Treatment Outcome

INTRODUCTION
Mandibular incisor extraction as an alternative option to first/second premolar extractions in carefully selected cases has been advocated by many investigators [1-3]. Canut indicated mandibular incisor extraction in four types of clinical situations; namely, anomalies in the number of anterior teeth, tooth size anomalies, ectopic eruption of incisors and moderate class III malocclusions [4]. Advantages and limitations of lower incisor extraction have been described by expert authors [5-10]. The most important advantage of this option is reducing treatment time and costs, maintenance of harmonious profile and more stable results in the anterior region. Possible disadvantages or side effects of this option include the development of a black triangle at the extraction site, space
reopening and creation of a midline discrepancy and increased overjet. Traditionally, an ideal occlusion is considered as the gold standard for assessment of orthodontic treatment outcomes. If the ideal occlusion is the ultimate goal, lower incisor extraction treatment provides less than ideal results and may be considered as a compromised treatment option. However, in contemporary orthodontics, patient expectations and preferences as well as cost effectiveness of various options should be included in the treatment planning process. It has been suggested that extraction of one mandibular incisor in carefully selected cases not only effectively treats the problem of crowding but also may significantly reduce the risks and costs of treatment.

To evaluate the effectiveness of an orthodontic treatment outcome, several reliable indices have been introduced in the literature. The PAR index has been used in several studies and has been shown to have good reliability and validity [11-14]. The purpose of this study was to evaluate the effectiveness of mandibular incisor extraction in a group of patients with Bolton discrepancy and mandibular incisor crowding using the Peer Assessment Rating Index.

**MATERIAL AND METHODS**

Pre and post treatment dental casts of fourteen patients treated with one lower incisor extraction were used in this study. The subjects were selected according to the following criteria: i)
Presence of all permanent teeth (excluding third molars) in pretreatment casts, ii) Completion of a full course of orthodontic treatment with one mandibular incisor extraction and iii) Presence of Bolton discrepancy. Patients with missing mandibular incisors and those who had extractions of other teeth were excluded. Peer Assessment Rating Index (PAR index) described by Richmond et al. [14] was used to evaluate pre/post treatment occlusal variables. Treatment effectiveness was considered as 70% reduction in the PAR index [15]. For intra-examiner reliability, one examiner (AHN) assessed 5 randomly selected cases at two separate time intervals (3 weeks). The assessment was calibrated with a specialist (SMS) experienced in the use of the index who recorded the same randomly selected models. To test the hypothesis that the mean improvement in dental occlusion after one mandibular incisor extraction was at least 70%, one-sample student t-test was used.

RESULTS
The intra-class correlation coefficient between the examiner’s duplicate PAR assessments was 0.91 (0.87-0.93) and that between the examiner and the calibrating specialist was 0.90 (95% CI 0.85-0.92).

The results of the study are presented in Table 1 and indicate that the mean pretreatment PAR index was reduced from 9.43 to 2.14. In other words, the mean improvement in dental occlusion in this group of patients was 78%. The results of statistical analysis (one sample T-test) with test statistic of 5.894 and Df=13 and p<0.001 revealed that the null hypothesis (Ho: $\mu \leq 70\%$) was rejected and the study hypothesis was accepted; H1: $\mu > 70\%$ [“lower incisor extraction option can improve the dental occlusion by more than 70%”].

Table 2 shows joint/marginal distribution of pre and post PAR scores of the samples. The sample is sorted according to the pretreatment PAR score; it shows that 50% of the cases finished with a post treatment PAR score of 2, and 21.4% of the cases finished with a post treatment PAR score of 1 and 3. Spearman correlation coefficient was 0.763 with p<0.01, which is considered a high positive correlation.
showing that more severe cases had greater post treatment PAR scores.

**DISCUSSION**

The results of the present study indicate that in selected cases, lower incisor extraction is an effective treatment option for moderate to severe crowding in the lower anterior region. However, quality assessment of such an option needs a larger sample size, a randomized sampling method and control groups with alternative options. The mean improvement in dental occlusion of this group of patients was 78% which is similar to the findings of Ileri et al. [16] and is considered as high standard finishing [15]. Mandibular incisor extraction (MIE) is indicated in certain types of Cl I malocclusions [1, 5].

Class I (Cl I) malocclusions with acceptable soft tissue balance, very mild or no crowding in the upper arch; Bolton discrepancy (narrow upper incisors or wide lower incisors), acceptable posterior occlusion and about 5-6mm of crowding in the lower incisor area are best candidates for MIE. In clinical practice, a patient with all of the above indications has a PAR score of about 5. In well treated cases, the lowest post treatment PAR score of this patient will be 1 (because the midlines are not coincident). This is equivalent to 80% improvement in treatment outcome (80% reduction in PAR score). This was the case for three of the patients in our sample. (Fig 1)

Post treatment PAR scores increase significantly in Cl I malocclusions with a normal Bolton ratio, if a single mandibular incisor is extracted, due to an increase of over jet or movement of lower canines into a Cl III relationship in one/both sides which severely compromise the treatment outcome. Narrow upper lateral incisors do not guaranty perfect finishing (Fig 2). Reduction of the mesiodistal widths of upper incisors improve the finishing specially in cases with very mild or no crowding in the upper arch [10, 16]. Mandibular incisor extraction is also indicated in mild Cl III patients with an open bite tendency who do not require sagittal alterations in the posterior occlusion [7]. The Cl III cases in our sample had higher pretreatment PAR scores. This was due to the presence of an anterior/posterior cross bite, decreased over bite and half cusp Cl III relation in the buccal segments. Mean post treatment PAR scores of Cl III cases were greater than the Cl I cases mainly due to the presence of a Cl III canine relationship.
Mandibular incisor extraction is usually recommended in minimum overbite cases [8, 10]. However, in our sample, there were two Cl II subdivision cases with moderate to severe deep bites that were effectively treated. In the above cases, extraction of a mandibular lateral incisor at the Cl II side contributed to the correction of the canine Cl II relationship and relief of crowding in the incisor/premolar areas (Fig 3).

In contemporary orthodontics, the achievement of ideal occlusion at the expense of soft tissue balance, periodontal health, occlusal stability and prolonged duration of treatment is questioned. A compromised treatment option with less than ideal treatment outcome may be preferred over an ideal plan with considerable treatment duration, costs and risks. For example, class II malocclusion treatment with 2 maxillary premolar extractions in

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**Table 2.** Joint distribution of pre and post PAR scores. Fifty percent of cases finished with PAR score of 2 and more severe cases finished with greater PAR scores.

| Pre-Treatment PAR score | 1 | 2 | 3 | 4 | Total No. (percent) |
|-------------------------|---|---|---|---|-------------------|
| 5                       |   |   | 3 |   | 3 (21.4)         |
| 8                       |   | 2 |   |   | 2 (14.3)         |
| 9                       |   | 2 |   |   | 2 (14.3)         |
| 10                      | 1 |   | 3 |   | 4 (28.6)         |
| 11                      | 1 |   |   |   | 1 (7.1)          |
| 15                      |   |   |   |   | 1 (7.1)          |
| 17                      |   |   | 1 |   | 1 (7.1)          |
| **Total (percent)**     | 3 | 7 | 3 | 1 | 14 (100)        |

21.4  50.0  21.4  7.1  100
selected cases (upper incisor crowding or protrusion) is preferred both by patients and orthodontists. It is considered as an efficient treatment option compared to the 4-premolar-extraction protocol, as it achieves the same functional, stability and esthetic results with less patient costs and risks [17].

Mandibular incisor extraction is indicated when both the orthodontist and the patient consider it as an efficient approach. One possible alternative to mandibular incisor extraction in these patients is upper arch expansion and creating space to build up narrow upper incisors. Although other alternatives may produce better occlusal results, they lead to significantly higher costs and risks. Patients have the right to contribute to the treatment planning process. If mandibular incisor extraction is preferred to other alternative options, he or she has made an informed decision regarding its possible disadvantages. All the treated cases were satisfied with the results; this was because they contributed to the selection of the option, which well aligned their crowded inci-
sors and was remained unchanged thereafter with fixed retainers. The most important limitation in this study was the restricted number of cases available. Indications of mandibular incisor extraction are limited to situations in which costs and risks of classic treatment options (non-extraction or four bicuspid extractions) surpass its benefits. In this study PAR index was used to evaluate treatment outcomes.

The PAR index only measures the occlusal aspect of treatment outcomes. Recent grading systems focus on other aspects of treatment outcomes including treatment efficiency, facial/arch form, dental esthetics, preservation of the periodontium and root resorption [14]. Another limitation was the retrospective design of this study. A prospective study design with sufficient sample size and an advanced index or grading system will provide more valuable evidence.

CONCLUSION
Mandibular incisor extraction may effectively improve dental occlusion when assessed with PAR index. There is a positive correlation between pre and post PAR scores. More severe cases tend to finish with a greater PAR scores.

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