**Retrospective comparison of long-term stability of first premolar extraction orthodontic treatment in skeletal Cl I and Skeletal Cl II patients**

**Pooya Olyaee1 , Mohamad Hossein Ahangar Atashi2**

**1 Assistant Professor, Department of Orthodontics, Faculty of dentistry, Urmia university of medical sciences.**

**2 Associate Professor, Department of Orthodontics, Faculty of dentistry, Tabriz university of medical sciences.**

**Abstract**

**Introduction**: The purpose of this retrospective study was to compare long-term stability of first premolar extraction orthodontic treatment in skeletal Cl I and Skeletal Cl II patients.

**Materials and Methods**: 28 skeletal Class I samples and 28 skeletal Class II samples were randomly selected. Irregularity index, mandibular arch length, mandibular intercanine width, and mandibular intermolar width were measured on pretreatment, post-treatment and post-retention study models. Independent t-test was applied to compare Irregularity index, mandibular arch length, and mandibular inter-canine and inter-molar width, between the two groups.

**Results**: Class I cases showed more irregularity index at post-retention (2.81±1.08mm), more decrease in inter-canine width (2.66±0.081) and arch length decrease (3.01±1.13) from post-treatment to post-retention period. There were positive and direct correlations found between the amount of pre-treatment irregularity index and irregularity index post-retention (i.e., cases with more initial irregularity showed greater crowding post-retention).

**Conclusion**: Patients with class I skeletal pattern and higher pretreatment irregularity index are at increased risk of increased post-treatment relapse of mandibular anterior crowding.

**Keywords**: Irregularity index, mandibular arch length, mandibular inter-canine width, and mandibular inter-molar width.

**Introduction**

Stability of the attained treatment results is one of the three major goals of orthodontic treatment including esthetics, function, and stability. Maintaining anterior alignment following termination of active orthodontic treatment has been a challenge for the orthodontist1.

The etiologic factors of the relapse of anterior crowding have not yet been verified clearly2. There is controversy about the amount of crowding occurring during the post retention period in follow up studies, and it has been reported to recur up to 90%3-5.

Kujipers-Jagtman6 have reported that the lower anterior contact point displacement, showed a fast and continuous relapse even exceeding the initial score in the 10 year follow up of patients post retention period. Little7 showed that the long-term response to mandibular anterior alignment was unpredictable; no variables, such as degree of initial crowding, age, sex, Angle classification, etc., were useful in establishing a prognosis. Salvatore8 has concluded that the quality of orthodontic treatment outcomes is not related to the long-term occlusal stability.

In the study of Ormiston9, the initial severity of malocclusion, as graded by the PAR index and the irregularity index, was negatively correlated with post retention stability—i.e., patients with more severe index scores before treatment tended to be less stable. Kahl- Nieke10 found that residual Class II or III molar relationships were associated factors in the process of post-retention increase of crowding and incisor irregularity. Rossouw11 reported that there are no significant differences between extraction and nonextraction treatments regarding anterior alignment stability.

O’ Neill12 in 2007 has systematically reviewed 1004 abstracts or full-text articles from PubMed and Cochrane Library electronic databases and suggests that there is a great need for well-designed studies with sufficient sample sizes; and sample selection according to type of malocclusion, age and growth pattern. Most studies do not support a greater relapse in Class II Division 1 cases when compared with other malocclusion groups,however, a slight change in overjet toward pretreatment values was demonstrated in all malocclusion groups13.

Labially inclined incisors pretreatment tend to be associated with less long-term crowding14. It is postulated that the weaker labial muscular forces do not induce lingual movement of the dentition and subsequent arch length shortening. When teeth are aligned by orthodontic treatment, there is a documented tendency for a return toward the original pattern of malocclusion. For this reason, rotational overcorrection has been advocated14.

In a recent study in 2010, to evaluate differences in long-term post retention changes between adolescents and adults, Park et al15 studied 96 subjects, 51 adolescents and 45 adults retained for 3 years and followed approximately 16 years post treatment, which were randomly selected from two private practices. Prior to treatment, 38 and 58 had Class I and Class II malocclusions, respectively. Over the 16-year posttreatment period, adolescents showed significantly greater increases in mandibular incisor irregularity, and the PAR index than adults. Treated Class I patients demonstrated less increase in overjet and greater decreases in mandibular intermolar width than Class II patients.

One of the limitations of previous studies is disregarding skeletal pattern. Regarding the basic differences between patients with Skeletal Class I and Skeletal Class II facial patterns including soft tissue pressure, mandibular size and position, and growth pattern it can be questioned whether the skeletal pattern influences the amount of relapse or not16-18?
 The aim of this study is to make a retrospective comparison of long-term stability of first premolar extraction orthodontic treatment in skeletal Cl I and Skeletal Cl II patients.

**Materials & methods**

The sample of this retrospective analytical study consisted of records of 28 randomly skeletal class I and 28 skeletal Cl II patients(α was set at 0.05 and the power 80%, and the mean difference of 1mm between the groups in irregularity index.). ANB angle and Wits appraisal were used to divide them into class I and class II. Inclusion criteriawere; presence of full records (pretreatment,post-treatment, and post-retention**),** four first premolar extractions, absence of tooth anomalies, normal transverse dimensions, and normal vertical pattern (FMA between 22-28).Exclusion criteria were; history of functional therapy, indication of orthognathic surgery, supracrestal fiberotomy, interproximal reduction, noncompliance with the retainer appliance, and absence in follow up visits.

All samples underwent routine orthodontic therapy by one of the authors with 18 slot standard edgewise appliance and were at least 10 years post-retention period. The retention period for all samples included 4 months full-time Hawley Retainer in maxilla and mandible, and 8 months of night-time wear of the appliance. The patients in the mentioned practice are followed monthly for one year after debonding, and on a yearly basis for 5 years afterwards. Samples were matched two-by-two according to the amount of crowding and irregularity index. Treatment quality, results and the amount of change post-treatment had no influence in inclusion or exclusion of the cases.

To calculate the amount relapse, irregularity index, mandibular arch perimeter, mandibular intercanine width and intermolar width were measured by a single blind examiner for each set of casts with a digital caliper calibrated to 0.01 mm. After a two-week interval from the first measurement, the dental casts of ten patients were randomly selected and re-measured by the same examiner. The t test for differences between the replications showed statistically no signiﬁcant differences and indicated the reliability of the measurements.

**Statistical analysis**

Data were processed with SPSS 13 software. Smirnov-Kolmogrov test was applied to test normality of data distribution. Descriptive analysis includes mean, standard deviation, standard error, minimum and maximum for each variable. Independent sample t-test was used to compare Class I and Class II. Paired t-test was used to compare differences of each variable at the intervals.

**Results**

The sample consisted of 56 patients with a mean pretreatment age of 16.5±1.54 years. The mean pretreatment age of class I was 17.2±1.47 and class II 15.8±1.61 years. The mean treatment time was 20.5±4.4 months. Smirnov-Komlmogrof test showed normal distribution therefore parametric tests could be used.

Comparison of skeletal class I and class II

Independent sample t-test showed that at the pretreatment stage the mean intercanine width had no significant difference between groups. There was also no significant difference between intercanine width of class I and Class II groups at post-treatment and post-retention. At the pretreatment stage the mean intermolar width had no significant difference between groups. There was a significant difference between intermolar width of class I and Class II groups at post-treatment stage (t=2.74, p= 0.008), class I cases having a larger intermolar distance. The difference at post-retention was not significant.

At the pretreatment stage the mean irregularity index had no significant difference between groups. There was also no significant difference between irregularity index of class I and Class II groups at post-treatment period. But there was significantly more irregularity observed at post-retention in Class I group (Table 1).

At the pretreatment stage the mean arch length had no significant difference between groups. There was also no significant difference between arch length of class I and Class II groups at post-treatment and post-retention.

**Relapse tendency comparison**

To compare relapse tendency post-retention intercanine width value was subtracted from post-treatment value. Independent t-test showed significantly more relapse in intercanine width of Class I group. (Table2,3)

Post-retention intermolar width value was subtracted from post-treatment value. Independent t-test showed no significant difference between groups.

To compare relapse tendency post-retention irregularity index value was subtracted from post-treatment value. Independent t-test showed significantly more relapse in irregularity index of Class I group. (Table4)

Post-retention arch length value was subtracted from post-treatment value. Independent t-test showed significantly more relapse in arch length of Class I group (t=3.61, p= 0.001).

There were positive and direct correlations found between the degree of pre-treatment irregularity and irregularity index post-retention using Pearson's Correlation test, cases with more pretreatment irregularity showed greater crowding post-retention, (r=0.78, p<0.001).

**Table1.**Comparison of mean postretention irregularity index between groups.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Group** | N | Mean±SD | Total mean | F | P-Value | t | Df | P-Value |
| **Class I** | 28 | ± 1.082.81 | 2.13 | 12.52 | 0.001 | 6.11 | 54 | 0.000 |
| **Class II** | 28 | ± 0.481.44 |

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| --- |
| **Table 2.** Mean change from post-treatment to post-retention in the total sample . |
| **VARIABLE** | N | Mean | Std.Error of Mean | Std Deviation | Minimum | Maximum |
| **Intercanine width chande** | 56 | 2.18 | 0.11 | 0.85 | 0.50 | 4.66 |
| **Intermolar width chande** | 56 | 2.51 | 0.37 | 2.82 | 0.29 | 21.92 |
| **Irregularityindex change** | 56 | 2.04 | 0.144 | 1.08 | 5.37 | 0.44 |
| **Arch length change** | 56 | 2.52 | 0.15 | 1.13 | 0.60 | 5.93 |

**Table3.**Comparison of mean intercanine width change from posttreatment to postretention between groups.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Group3** | N | Mean±SD | Total mean | F | P-Value | t | Df | P-Value |
| **Class I** | 28 | ± 0.812.66 | 2.18 | 1.48 | 0.22 | 4.97 | 54 | 0.000 |
| **Class II** | 28 | ± 0.591.71 |

**Table4.**Comparison of mean irregularity index change from posttreatment to postretention between groups.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Group** | N | Mean±SD | Total mean | F | P-Value | t | Df | P-Value |
| **Class I** | 28 | ± 1.082.73 | 2.04 | 12.36 | 0.001 | 6.17 | 36.99 | 0.000 |
| **Class II** | 28 | ± 0.471.35 |

**Discussion**In the present study , there is greater relapse tendency in the class I group, showing greater amounts of irregularity post-retention (2.81±1.08mm). In the post-retention period a lingual displacement of the anterior mandibular segment relative to the body of the mandible is seen. This has also been described during normal growth. It is postulated that the weaker labial muscular forces do not induce lingual movement of the dentition and subsequent arch length shortening in class II subjects19.

 The class I group showed slightly greater decreases in mandibular intermolar width than Class II patients but this was not statistically significant. The Class I patients in the study of Park showed significantly greater decreases in mandibular intermolar width than Class II patients. Although they did not provide statistical comparisons, De La Cruz et al and Glenn et al also showed greater posttreatment decreases in mandibular intermolar widths among Class I patients than among Class II patients15.

Although the method of studying muscle balance has been developed, it is not yet a part of routine record-gathering procedures. Assuming that these forces can be accurately measured, we would need records on a large sample at the three time intervals of this study. The debate regarding the role of occlusion and function relative to stability is knotty and unresolved. Long-term records are again unavailable, while data collection, standardization, measuring techniques, and countless other problems hinder investigation7.

The Class I patients in the study of Park showed significantly greater decreases in mandibular intermolar width than Class II patients. Although they did not provide statistical comparisons, De La Cruz et al and Glenn et al also showed greater posttreatment decreases in mandibular intermolar widths among Class I patients than among Class II patients15.

There is evidence to show that intercanine and intermolar widths decrease during the postretention period, especially if expanded during treatment. For this reason, the maintenance of arch form rather than arch development is generally recommended. Expansion is thought to be better tolerated in Class II Division2 cases that show a signiﬁcantly greater ability to maintain intercanine expansion than Class I and Class II Division1 cases. This statement, however, was based on a sample of six patients and was not accepted by Little et al. who maintained that intercanine and intermolar width will relapse if expanded in Class II Division2 cases as much as in other Angle classiﬁcations20.

Arch length decreased from pre-treatment to post-treatment which is quite predictable due to extraction treatment and a combination of molar protraction and incisor retraction, however arch length decrease in the post-retention period was significantly greater post-retention in class I group, consistent with more crowding seen in the class I group.

There were positive and direct correlations found between the degree of pre-treatment irregularity and irregularity index post-retention (i.e., cases with more initial irregularity showed greater crowding post-retention). There were also were positive and direct correlations found between the degree of intercanine width relapse and irregularity index post-retention.

In view of the present knowledge, it was impossible to identify if difference between class I and class II relapse posttreatment was the result of orthodontic treatment alone or of physiologic changes in the dentition and surrounding tissues during the follow-up period. It has been shown that craniofacial alterations occur in adults and are accompanied by compensatory changes in the dentition. To evaluate the relapse, where several factors may act at different time intervals together with natural craniofacial alterations and compensatory changes in the dentition, the researchers have to focus on and use prospective well-designed follow-up studies with untreated controls. Efforts should be made to avoid bias by using well-defined and sufficiently large samples.

**Conclusion**

Patients with class I skeletal pattern and higher pretreatment irregularity index are at increased risk of increased post-treatment relapse of mandibular anterior crowding.

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