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Original Article

Treatment Time of Class II Malocclusion, with and without Mandibular Crowding, Treated with Four Premolar Extractions: A Retrospective Study

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Main Points

- We compared the treatment times of complete Class II malocclusion, with and without crowding, treated with the 4 premolar extraction protocol.
- Treatment times were similar.
- No significant correlation between crowding and treatment time was found.

ABSTRACT

Objective: This study aimed to compare the treatment times in patients with complete bilateral Class II malocclusion, with and without mandibular crowding, treated with 4 premolar extractions.

Methods: The sample comprised 57 retrospectively and consecutively selected patients (30 male, 27 female) treated for initial Class II malocclusion, divided as follows: Group 1 consisted of 23 patients (11 males, 12 females; mean age 13.13 years) presenting no crowding or 3 mm at most. Group 2 consisted of 34 patients (19 males, 15 females; mean age13.06 years) presenting more than 4 mm of crowding. Crowding was manually measured in the initial dental casts. The Objective Grading System (OGS) index was manually measured in the final dental casts and radiographic images. The groups were comparable regarding initial age, gender distribution, and final occlusal statuses. The treatment times between the groups were compared using the *t*-test. Correlation between crowding and treatment time was evaluated with Pearson correlation coefficient.

Results: Treatment times between the 2 groups were similar ($P = .890$) and there was no significant correlation between the amount of crowding and treatment time ($r = 0.04$, $P = .760$).

Conclusion: Treatment times for complete Class II malocclusion with and without mandibular crowding, treated with 4 premolar extractions, are similar.

Keywords: Angle Class II; tooth extractions; orthodontics; time-to-treatment.

INTRODUCTION

Treatment time is one of the main complaints of orthodontic patients.[1] There are many factors that can affect this variable, such as age, sex, anteroposterior severity of the malocclusion, operator, bracket prescription, appliance breakage, and missing appointments, and 1- or 2-phase protocols.[1,2]

The need for molar anteroposterior discrepancy correction seems to be the strongest influencer of treatment efficiency and time, specifically in Class II malocclusion.[3-7] It has been demonstrated that in bilateral complete Class II malocclusion, the 2 maxillary premolar extraction protocol involves a shorter treatment time than the 4 premolar extraction and non-extraction approaches. This would be due to the high patient compliance required when

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using external devices— such as extraoral headgear or sagittal elastics—to aid in molar relationship correction when none or 4 premolars are extracted.[5,6] Nonetheless, 4 premolar extractions are still indicated if a significant amount of mandibular crowding and/or dental/labial protrusion are initially present.[8]

It has been speculated that the initial amount of anterior crowding or protrusion and its severity would significantly increase treatment time.[9,10] Andrews stated that treatment time for an anteriorly crowded case would be similar to that of a non-crowded case, with a corresponding dental protrusion.[11,12] From this second statement, one can assume that different groups, matched according to anteroposterior discrepancies and treatment protocol, would present similar treatment times as long as one had an amount of anterior crowding that was equivalent to the amount of protrusion in the other non-crowded group. On the other hand, it has also been suggested that more crowded cases would have a shorter treatment time because most of the extraction spaces would be utilized for crowding correction.[13] There would be only small spaces for anterior or en masse retraction, and therefore, treatment duration would be shorter.[13]

Although previous studies have evaluated the influence of crowding in orthodontic treatment,[1,10,14,15] their results cannot be safely extrapolated because these studies did not specifically evaluate Class II malocclusion treatment.

Thus, this study aimed to compare treatment times of Class II malocclusions treated with 4 premolar extractions, with and without mandibular crowding. The tested null hypothesis was that treatment times are similar in Class II malocclusions treated with 4 premolar extractions, with and without mandibular crowding.

METHODS

The Ethics in Research Committee of Bauru Dental School, University of São Paulo approved this study (Protocol Number 127/2011). All patients involved in this investigation provided written informed consent. Sample size calculation showed that 23 cases would be necessary in each group to detect a minimum difference of 7 months, with a standard deviation of 8.3 months, and a test power of 80%, at a significance level of 5%, in treatment time.[10]

The retrospective samples were consecutively selected from the files of the Orthodontic Department, at Bauru Dental School, University of São Paulo. The 23 patients of Group 1 (11 male, 12 female; initial mean age of 13.13 years) presented, initially, complete bilateral Class II malocclusions,[12,16] and a maximum of 3 mm of mandibular crowding. The 34 patients of Group 2 (19 male, 15 female; initial mean age of 13.06 years) presented, initially, complete bilateral Class II malocclusions, and mandibular crowding greater than 4 mm. Both groups were treated with 4 first premolar extractions. Presence of all other permanent teeth up to the first molars, absence of dental anomalies (shape, size, or number), complete orthodontic records, and treatment with Edgewise fixed appliances comprised the additional inclusion criteria. Initial anteroposterior molar discrepancy determined the groups' selection, regardless of other characteristics. Molar anteroposterior discrepancy severity of all patients was checked in the dental casts by the same calibrated operator (L.N.B.C.S.). Orthodontic treatments were performed by graduate students at the Orthodontic Program under the supervision of the clinical instructors.

Edgewise appliances with 0.022 × 0.028 inch conventional brackets were used. A usual wire sequence of an initial 0.015 inch twist-flex or a 0.016 inch nitinol, followed by 0.016, 0.018, 0.020 and 0.021 × 0.025 or 0.018 × 0.025 inch stainless steel archwires (Unitek, Monrovia, California, USA) was applied. Accentuated and reversed curves of Spee, in the maxillary and mandibular arches, respectively, were used for deep-bite correction. In both groups, anterior teeth were retracted "en masse", with elastic chains combined with rectangular wires. Extraoral headgears were used in both groups to distalize the posterior segment to obtain Class I molar relationship, and to reinforce anchorage. No absolute skeletal anchorage was used. Whenever necessary, intermaxillary Class II elastics were used to aid in obtaining Class I molar relationship. After debonding, the retention protocol consisted of a Hawley plate in the maxillary arch for a mean period of 1 year, and a mandibular fixed retainer bonded on mandibular canines, with a 3-year use recommendation.

Details on sex, initial age, bonding and debonding dates, and full comprehensive data on treatment time were obtained from the orthodontic files.

Mandibular crowding measurement was manually performed in the initial dental casts. It was calculated as the difference, in millimeters, between the arch length (circumference, from left to right first molars), measured with the aid of a brass wire segment, and the sum of crown widths from first molar to its homologous, measured with a dry-point compass.[17] The sum of the tooth widths should be equal to arch length, in well-aligned cases.[18] Crowding was considered when negative values were obtained.

The occlusal statuses of the final dental casts were evaluated by the Objective Grading System (OGS).[19]

Statistical Analyses

Kolmogorov–Smirnov tests were used to assess data normality, and showed that all variables had normal distribution. Therefore, the chi-square test was used for intergroup comparison regarding sex distribution, and the *t*-tests for intergroup comparability regarding initial age, crowding, and final occlusal statuses.

Intergroup treatment time was compared using *t*-tests. To evaluate the correlation between initial mandibular anterior crowding and treatment time, Pearson correlation test was performed. Results were considered significant at $P < .05$. All statistical analyses were performed with Statistica software (Statistica for Windows 7.0; Statsoft, Tulsa, Okla.).

Table 1. Intergroup comparability regarding sex distribution, initial age, crowding and OGS (Chi-square and t tests)

Sample	Group 1 (n=23)	Group 2 (n=34)	*P*
Sex	n (%)	n (%)	
Males	11 (47.83%)	19 (55.88%)	.55¥
Females	12 (52.17%)	15 (44.12%)	
	Mean ± SD	Mean ± SD	
Initial Age (years)	13.13 ± 1.64	13.07 ± 1.70	.90†
Crowding (mm)	1.13 ± 1.45	6.17 ± 2.77	.000†*
OGS scores	19.43 ± 14.67	18.29 ± 10.74	.33†

Group 1: without mandibular crowding, Group 2: with mandibular crowding
¥ - Chi-square test
† - t tests
* - Statistically significant at $P < .05$

Table 2. Intergroup treatment time comparison (t tests)

Variable	Group 1 (n=23) (Without mandibular crowding)	Group 2 (n=34) (With mandibular crowding)	*P*
	Mean ± SD	Mean ± SD	
Treatment Time (years)	2.51 ± 0.62	2.49 ± 0.83	.89
Treatment Time (months)	30.12 ± 7.45	29.88 ± 9.96	.89

RESULTS

Initial age, final occlusal statuses, and sex distribution were similar between the groups. Evidently, Group 1 had significantly smaller mandibular crowding than Group 2 (Table 1).

Treatment time was similar in the groups. No significant correlation was found between mandibular crowding and treatment time (Tables 2 and 3).

DISCUSSION

Because there were 34 patients who fit the selection criteria in Group 2 composition, they were all included to increase the test power even more. Thus, the final test power was 86%.[20]

Patients were selected based only on the initial anteroposterior molar relationship, because it has been shown that the cephalometric characteristics do not influence the occlusal success rate and consequently the treatment time.[21,22] Therefore, the cephalometric variables would not influence the aspects under consideration.

Table 3. Pearson correlation between initial anterior crowding and treatment time

n=57	R	*P*
Treatment Time X Initial Anterior Crowding	0.04	.76

Matching patients regarding the initial and final occlusal status is necessary because the intergroup comparison should be performed between patients who were treated from a similar initial condition to a similar final result.

Additionally, all patients in both groups should present complete bilateral Class II malocclusion because the 4 premolar extraction protocol for the correction of this malocclusion increases treatment difficulty, since it requires more patient compliance to correct the molar anteroposterior discrepancy.[23,24] If one intends to investigate treatment issues in a specific malocclusion, it has to be well defined. Milder severities could blur slight differences that could exist.[25]

There were similarities in initial age, sex distribution and post-treatment occlusal statuses between the groups. Therefore, these variables did not interfere with the comparison.[26-28] It can be argued that craniofacial residual growth may have aided in Class II malocclusion correction of the young patients included in the groups. However, since there was similarity in initial age, the residual growth amount would also be similar in the groups. The amount of initial mandibular crowding was significantly greater in Group 2 than in Group 1. This is evident because the amount of initial anterior crowding was used to divide the groups. It is important to emphasize that the intergroup difference in mandibular crowding was large and very significant, which exactly fit the purpose of the investigation.

Evidently, the use of anchorage reinforcement with extraoral headgear or Class II elastics is influenced by patient compliance, and it is not possible to access the mean compliance performance of each patient.[1] However, since no effort was taken to select patients with higher or lower compliance tendencies for a specific group, it can be assumed that patients with different compliance tendencies were homogeneously distributed in the groups.[29] Thus, this factor probably played no role in the intergroup comparisons.

The groups presented similar treatment times, contrary to other studies which stated that increased crowding would increase treatment time.[1,10] However, these studies were not conducted with a specific malocclusion, but included several types of malocclusions. As stated before, if a study sample is not restricted to a specific malocclusion, the results can be influenced by the heterogeneity of its elements.[25]

This result is in accordance with a previous study,[15] which performed a similar comparison on Class I malocclusion treatment in cases with mild and severe initial anterior crowding. No intergroup difference would be expected because equivalent amounts of anterior crowding or dental/labial protrusion will require similar anchorage reinforcement needs to be corrected, and therefore, would involve similar treatment time.[11,12]

It is speculated that more crowded dental arches would need less time for extraction-space closure because the teeth would quickly occupy the extraction spaces with minor movement, either with or without little need for anterior/en masse retraction,

which may take longer.[13] However, the results of this study reinforce the idea that, in a complete bilateral Class II malocclusion treatment with the 4 premolar extraction protocol, whether the intra-arch extraction space closures will take a little longer or not, is not the main issue. This is not the aspect that will prolong treatment time.[6] The issue that will prolong treatment time is the Class II anteroposterior discrepancy correction which is patient-compliance dependent.[6,23] For this, it is necessary for the patient to use extraoral appliances, such as headgears, or Class II intermaxillary elastics. This is what really prolongs treatment time when 4 premolar extractions are performed in complete bilateral Class II malocclusion treatment, as has been previously demonstrated.[5,7,30] The initial molar anteroposterior discrepancy and treatment times of both groups were also similar. Besides, there was no significant correlation between the amount of mandibular crowding and treatment time (Table 3).

Therefore, the current results also support the fact that correction of complete Class II anteroposterior discrepancy is the major problem to be addressed, when this malocclusion is treated with 4 premolar extractions. The orthodontist should not be influenced by secondary features of malocclusion at the moment of planning or deciding treatment, when estimating treatment time. Further comparisons between groups with similar amounts of initial anterior crowding and different molar anteroposterior relationships should also be performed to confirm the conclusions of this study.

CONCLUSION

The null hypothesis was accepted because:

- Treatment times of Class II malocclusions, with and without crowding, treated with a 4 premolar extraction protocol, were similar.
- Additionally, the amount of initial mandibular crowding was not correlated to treatment time in complete bilateral Class II malocclusion treatment with 4 first premolar extractions.

Ethics Committee Approval: The Ethics in Research Committee of the Bauru Dental School, University of São Paulo, approved this study (Protocol Number 127/2011).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

Peer Review: Externally peer-reviewed.

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Conflict Of Interest: The authors have no conflict of interest to declare.

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