Quantitative assessment of the effectiveness of phase 1 orthodontic treatment using the American Board of Orthodontics Discrepancy Index

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Introduction: This retrospective study included a sample of 300 randomly selected patients from the archived records of Saint Louis University's graduate orthodontic clinic, St. Louis, Mo, from 1990 to 2012. The objective of this study was to quantify the changes obtained in phase 1 of orthodontic treatment and determine how much improvement, if any, has occurred before the initiation of the second phase. **Methods:** For the purpose of this study, prephase 1 and prephase 2 records of 300 subjects were gathered. All were measured using the American Board of Ortodontics Discrepancy Index (DI), and a score was given for each phase. The difference of the 2 scores indicated the quantitative change of the complexity of the treatment. Paired *t* tests were used to compare the scores. Additionally, the sample was categorized into 3 groups according to the Angle classifications, and the same statistics were used to identify significant changes between the 2 scores. Analysis of variance was applied to compare the 3 groups and determine which had the most change. Percentages of change were calculated for the significant scores. **Results:** The total DI score overall and the scores of all 3 groups were significantly reduced from before to after phase 1. Overall, 42% improvement was observed. The Class I group showed 49.3% improvement, the Class II group 34.5% and the Class III group 58.5%. Most components of the DI improved significantly, but a few showed negative changes. **Conclusions:** Significant reductions of DI scores were observed in the total sample and in all Angle classification groups. This indicates that early treatment reduces the complexity of the malocclusions. Only 2 components of the DI showed statistically significant negative changes. (Am J Orthod Dentofacial Orthop 2016;150:997-1004)

The questions on the importance of early treatment, also referred to as phase 1, have not been fully answered. Many clinicians and researchers are still skeptical, and 1 reason is probably the inadequate evidence about the benefits and effectiveness of this early phase.

Early treatment can be generally defined as the treatment initiated during the deciduous or mixed dentition to prevent, intercept, or correct a specific orthodontic problem. A preventive early treatment refers to the intervention on a developing malocclusion through the cessation of a harmful habit or the maintenance of favorable development. On the other hand, interceptive early treatment is an attempt to correct or minimize an orthodontic problem that has already occurred by restoring better conditions for normal growth and development.

Early intervention should include well-designed treatment goals and accurate application of the appropriate mechanics. The objectives should be the establishment of a good occlusion, the prevention of problems that could potentially damage the dentition and supporting structures, the reduction of trauma risk to the anterior teeth, the management of the leeway space, the correction of any transverse asymmetry, and the correct use of the evidenced-based theories of growth and development.[1-13]

Emphasis must also be given to psychologic factors affecting patients and families; in certain cases, these

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are strong reasons to seek orthodontic help. Enhancing the self-confidence of a young child may be a key factor for the psychosocial growth and the development of a balanced personality, which tends to be the new paradigm in all health care.[14,15]

A study done in Germany in 2004 evaluated 1975 children aged between 6 and 8 years to estimate the prevalence of malocclusions using the Index of Orthodontic Treatment Need during the early mixed dentition period. Open bites with a range from 1 to 12 mm were recorded in 17.7% of the children. Deepbites with and without gingival contact were registered in 46.2% of those examined, and bilateral crossbites occurred in 7.7%. Class III malocclusion (skeletal) with reverse overjet was found in 3.2%. Overjets ranged from 0.5 to 14.0 mm. Overjets greater than 3.5 mm (Class II Division 1) were registered in 31.4% of patients. Anterior crowding greater amounts than 3 mm were recorded in the mandible in 14.3% of the subjects and in the maxilla in 12%.[16] The conclusion of this study was that an orthodontist can detect a problem when the child is still young and then make a decision about the timing of the treatment.

The mixed dentition period is the time that most arch and dental changes are happening, and it may provide the opportunity for orthodontic intervention and modification of development. About 6 years of age, the transition from the deciduous to the permanent dentition begins with the eruption of the permanent first molars followed by the permanent incisors. The maxillary permanent incisors are larger than the deciduous ones; during this transition, growth adaptations occur.[17] In the maxillary arch, the permanent incisors erupt more labially; as a result, there is a slight increase in the dental arch of 1 to 2 mm in the average child.[18]

In the mandibular arch, there is not much gain because the incisors erupt basically following the same inclination of their predecessors. In both arches, the presence of interdental and primate spaces, when present, may allow for the early adjustment of the occlusion.[19]

The mandible in reality has the potential for more loss of space because of the late adjustment of leeway space. The early mesial shift and the late mesial shift contribute to the reduction of mandibular arch length.[20,21]

Apparently, there is a continuous mesial drift of the permanent teeth that tends to reduce arch length. In addition, the mandibular incisors tend to upright because of the differential growth of the maxilla and the mandible. Mandibular growth occurs distal to the first molars, and it does not contribute to any gain of space.[22,23]

In the anteroposterior dimension, there are many changes during the transition from the mixed to the permanent dentition. The terminal plane of the deciduous second molars can be used as an indicator of the permanent molars' final relationship. Differential forward drift of the permanent molars and the differential forward growth of the maxilla and the mandible contribute to the final position. If there is a mesial step, there is a 97% chance that a Class I molar relationship will be established and a 3% possibility of a Class III relationship. A flush terminal plane results in a Class I (70%) or a Class II (30%) molar relationship, whereas a distal step almost invariably results in a Class II permanent molar relationship.[24]

The evaluation of treatment need and outcome can be difficult. Much attention has been given to the assessment of the severity of a malocclusion before orthodontic treatment is rendered. However, the assessment of an early intervention in orthodontics has been mostly subjective. According to the latest guidelines of the American Association of Orthodontists, a child should receive an orthodontic checkup no later than age 7. The reason for this visit is the early diagnosis of dental and facial irregularities that may be prevented from developing.

Numerous orthodontic indexes have been used for many years for attempting to determine the need for treatment. The Peer Assessment Rating index estimates a patient's deviation from normal alignment and occlusion; it has good reliability and validity, but it excludes several aspects of a malocclusion.[25] The Index of Orthodontic Treatment Need and the Dental Health Component are designed to evaluate treatment need. The Standard Component of Aesthetic Need is also used to determine treatment need but includes a subjective judgment of esthetics, which might compromise its reliability.[26]

The American Board of Orthodontics thought that the evaluation of case complexity would be more quantifiable. It is defined as "a combination of factors, symptoms, or signs of a disease or disorder which forms a syndrome."[15] Within the framework of this evaluation, the American Board of Orthodontics Discrepancy Index (DI) was developed to evaluate complexity based on the analysis of pretreatment records.

The DI takes into account both dental and skeletal irregularities measured on dental casts and panoramic and cephalometric x-rays. It includes the evaluation of 12 features that are the most common characteristics of malocclusion and were chosen because they are considered to be "clinical entities that are measurable and have generally accepted norms."[27] Those are overjet, overbite, anterior open bite, lateral open bite, crowding, occlusal relationship, lingual posterior crossbite, buccal posterior crossbite, ANB angle, IMPA, SN-GoGn, and a category called "other" that evaluates other complexities such as ankylosed, supernumerary, or malformed teeth. Each feature receives a score, and the sum of all individual scores constitutes the DI score, which indicates the level of complexity of the case.[27]

The purpose of this study was to use the DI as an objective method to quantify the changes obtained from phase 1 of orthodontic treatment and determine whether there is a reduction in complexity before phase 2.

MATERIAL AND METHODS

This retrospective study included a sample of 300 subjects randomly selected from the archived records of Saint Louis University's graduate orthodontic clinic in St. Louis, Mo, from 1990 to 2012. All patients had phase 1 treatment. The sample included 164 girls and 136 boys, who started phase 1 treatment at a mean age of 9 years 3 months. At the initiation of treatment (T1), all patients were in the mixed dentition with at least the first molars and central incisors present. The most common treatment methods used in our clinic are 2×4 appliances, cervical or high-pull headgears, functional appliances, reverse pull facemasks, lip bumpers, lingual holding arches, and serial extractions. The mean treatment duration was 14.5 months. The second set of records was taken within 10 months after the completion of phase 1 treatment (T2). During this period, minimal changes may be expected. The inclusion criteria consisted of T1 and T2 casts as well as cephalometric and panoramic x-rays. Patients with syndromes or craniofacial deformities were excluded. The degree and type of malocclusion, the treatment method, and the operator were not considered for the selection of the subjects. Once all inclusion and exclusion were met, 300 records were gathered to be measured according to the DI.

The DI was used to evaluate each of the 300 subjects. All measurements were done by the principal investigator (N.V.). Since all T1 and many of the T2 models were in the mixed dentition, the Tanaka-Johnston analysis[28] for predicting the mesiodistal size of unerupted canines and premolars was used to calculate the amount of dental crowding.

The study of the x-rays and tracings of cephalometric x-rays were done in 2 ways because of the availability of the records. Subjects who were treated before 2003 had x-ray films, and those treated after 2003 had digital forms of x-rays. Cephalometric x-ray films were traced using a light box, tracing paper, and a protractor, whereas digital x-rays were uploaded and traced with orthodontic software (version 11.5; Dolphin Imaging and Management Solutions, Chatsworth, Calif). The difference in the method of tracing did not influence the values because all cephalometric measurements for this study (ANB, SN-MP, IMPA) were angular, and they were not affected by magnification. In addition, it has been established that there is no difference in acquiring accurate cephalometric measurements when manual tracing was compared with digital measurements.[29]

The DI sums of points that were assigned to each subject at T1 and T2 were calculated, along with the differences in these scores between the 2 phases. The subtraction of the T2 values from the T1 values provided the quantitative change of each variable of the DI as well as the change of the total score after phase 1 of treatment.

Statistical analysis

Descriptive statistics, means and standard deviations, of the score differences at the 2 time points were used to identify the changes. Positive mean values would indicate reduction of the severity of the malocclusion after treatment, whereas negative mean values would indicate a posttreatment increase in severity. Paired t tests were used to compare the overall DI scores at T1 and T2, as well as the individual scores for each variable, to identify statistically significant changes before and after phase 1 treatment. Because of the large number of t tests that were performed (13), α was set as 0.004 according to the Bonferroni correction for multiple comparisons to prevent type 1 statistical errors.

The data were then categorized into 3 groups according to the Angle classification: Class I (81 subjects), Class II (165 subjects), and Class III (54 subjects). A 1-way analysis of variance (ANOVA) test between the differences of the scores at T1 and T2 was applied to determine which of the 3 groups had the most change with phase 1 treatment. All statistical analyses were made with SPSS software (version 22.0; IBM, Armonk, NY).

Furthermore, percentages of change for each feature of the DI and for the total score were calculated to demonstrate the difference in complexity before and after phase 1 of treatment. The same percentage measurements were calculated for each of the 3 Angle classification groups. The percentage method was used in this study to give the reader a more understandable measure of changes when compared with the DI component scores.

For intraexaminer reliability, 30 subjects were remeasured a month after the initial measurements, and an intraclass correlation coefficient test was performed as a replication error procedure.

RESULTS

The mean total DI scores were 17.26 points at T1 and 9.98 points at T2, indicating a mean reduction of 7.28 points in the DI score, which according to the t test was a statistically significant change. Each variable of the DI was assessed individually in the same way, and those that showed a statistically significant reduction of their scores were overjet, anterior open bite, crowding, occlusal relationship, posterior lingual crossbite, ANB

Table I. Overall DI score differences

	Mean, T1	Mean, T2	Mean difference	SD	P value
Overjet	3.06	0.87	2.19	2.64	<0.001*
Overbite	0.94	0.77	0.17	1.13	0.008
Anterior open bite	1.32	0.41	0.9	3.00	<0.001*
Lateral open bite	0.21	0.21	0	1.59	0.971
Crowding	1.92	1.25	0.67	1.76	<0.001*
Occlusal relation	3.49	1.96	1.54	2.73	<0.001*
Posterior lingual crossbite	0.91	0.083	0.83	1.37	<0.001*
Posterior buccal crossbite	0.02	0.11	−0.09	0.62	0.016
ANB angle	1.32	0.75	0.57	2.04	<0.001*
SN-MP	2.15	2.27	−0.12	2.59	0.410
IMPA	0.66	0.85	−0.19	2.26	0.146
Other	1.26	0.46	0.80	1.29	<0.001*
Total	17.26	9.98	7.28	7.06	<0.001*

n = 300.
*Statistically significant difference at $P < 0.004$.

Table II. DI score differences for the Class I group

	Mean, T1	Mean, T2	Mean difference	SD	P value
Overjet	2.27	0.57	1.7	1.6	<0.001*
Overbite	0.53	0.39	0.14	0.89	0.174
Anterior open bite	2.04	0.42	1.62	3.49	<0.001*
Lateral open bite	0.32	0.07	0.25	1.53	0.150
Crowding	1.49	0.87	0.62	1.76	0.001*
Occlusal relation	0	0.35	−0.35	1.58	0.002*
Posterior lingual crossbite	0.89	0.10	0.79	1.31	<0.001*
Posterior buccal crossbite	0	0.02	−0.02	0.22	0.320
ANB angle	0.57	0.58	−0.01	1.57	0.944
SN-MP	1.96	2.08	−0.12	2.44	0.650
IMPA	0.55	0.33	0.22	1.73	0.252
Other	1.11	0.15	0.96	1.52	<0.001*
Total	11.74	5.95	5.79	5.30	<0.001*

n = 81.
*Statistically significant difference at $P < 0.004$.

angle, and "other." The rest of the variables had nonsignificant changes (Table I).

In the Class I group, the mean total DI scores were 11.74 points at T1 and 5.94 points at T2, showing a mean reduction of 5.79 points, which also proved to be a statistically significant change. All variables were analyzed with the same methodology, and those that showed a statistically significant change were overjet, anterior open bite, crowding, occlusal relationship, posterior lingual crossbite, and "other." All significant changes pointed toward a reduction of the DI score at T2 (Table II).

In the Class II group, the mean total DI scores were 19.13 points at T1 and 12.53 points at T2, showing a mean reduction of 6.60 points, which also was a statistically significant change. The features that showed significant reductions in DI scores were overjet, anterior open bite, crowding, occlusal relationship, posterior lingual crossbite, ANB angle, and "other." In this group, IMPA demonstrated a statistically significant increase in score; this indicated that after treatment the position of the mandibular incisors was less favorable (Table III).

In the Class III group, the mean total score was 19.85 points at T1, which was reduced to 8.24 points at T2. The mean difference was 11.6 points, a statistically significant change. The variables that underwent significant changes were overjet, crowding, occlusal relationship, posterior lingual crossbite, and "other." The *t* test for posterior buccal crossbite was not possible because there was no change (Table IV).

Percentages were also calculated to describe the amounts of change comparing T1 with T2. The initial score was marked as 100, and the final score was

Table III. DI score differences for the Class II group

	Mean, T1	Mean, T2	Mean difference	SD	P value
Overjet	2.62	1.08	1.54	1.76	<0.001*
Overbite	1.41	1.15	0.26	1.32	0.01
Anterior open bite	0.91	0.24	0.67	2.43	<0.001*
Lateral open bite	0.17	0.27	−0.10	1.63	0.418
Crowding	2.33	1.68	0.65	1.88	<0.001*
Occlusal relation	5.13	2.80	2.33	2.87	<0.001*
Posterior lingual crossbite	0.62	0.07	0.55	1.12	<0.001*
Posterior buccal crossbite	0.04	0.18	−0.14	0.81	0.023
ANB angle	1.57	0.82	0.75	2.03	<0.001*
SN-MP	2.31	2.42	−0.11	2.31	0.523
IMPA	0.78	1.37	−0.59	2.58	0.004*
Other	1.25	0.44	0.81	1.25	<0.001*
Total	19.13	12.53	6.60	6.60	<0.001*

n = 165.
*Statistically significant difference at $P < 0.004$.

calculated as a percentage of the initial score with the formula: 100 times the mean DI at T2 minus the mean DI at T1. The difference between the initial (100) and final percentages showed the change of the score as a percentage. Positive values suggested that the subjects obtained a lower DI score at T2; thus the complexity was reduced, whereas a negative value would show the opposite. The change for all 300 patients was 42.19%. The Class I group showed an overall improvement of 49.32%, and the Class II and Class III groups showed improvements of 34.5% and 58.89%, respectively (Table V).

Table IV. DI score differences for the Class III group

	Mean, T1	Mean, T2	Mean difference	SD	P value
Overjet	5.61	0.68	4.93	4.05	<0.001*
Overbite	0.13	0.18	−0.05	0.73	0.582
Anterior open bite	1.48	0.92	0.56	3.64	0.267
Lateral open bite	0.148	0.18	−0.03	1.58	0.864
Crowding	1.33	0.48	0.85	1.64	<0.001*
Occlusal relation	3.74	1.78	1.96	2.73	<0.001*
Posterior lingual crossbite	1.83	0.11	1.72	1.76	<0.001*
Posterior buccal crossbite	0	0	0	0	-
ANB angle	1.67	0.74	0.92	2.5	0.009
SN-MP	1.94	2.09	−0.15	3.50	0.757
IMPA	0.46	0.05	0.41	1.61	0.068
Other	1.5	1	0.50	0.95	<0.001*
Total	19.85	8.24	11.6	8.96	<0.001*

n = 54.
*Statistically significant difference at $P < 0.004$.

Lastly, 1-way ANOVA showed significant differences between the 3 malocclusion groups for total score, overjet, occlusal relationship, posterior lingual crossbite, ANB angle, and IMPA.

According to the Bonferroni post hoc test, the difference in overjet was significantly greater for the Class III group. The change in occlusal relationship was significantly greater in the Class II and Class III groups compared with the Class I group, but no statistical difference was detected between the Class II and Class III groups. The changes observed in posterior lingual crossbite were significantly greater for the Class III group. For the cephalometric measurements, there were no significant differences in the changes among the groups.

The changes for the overall score are significantly more for the Class III group, whereas there was no statistically significant difference between the Class I and Class II groups.

As the result of the reliability test, the Cronbach alpha was 0.98 and showed that all measurements were reliable.

DISCUSSION

Very little literature regarding the quantitative assessment of phase 1 treatment outcome exists. The purpose of this study was to quantify changes before and after phase 1 treatment using the DI scoring methodology. The evaluation was done at 2 time points, T1 and T2, before and after the first phase of treatment. Thus, the efficacy of the treatment was assessed with the DI to register positive or negative results.

Among the overall changes, a reduction in the DI score designates an overall decrease in the complexity

Table V. Percentages of change (%)

	Class I	Class II	Class III	Overall
Total	49.3*	34.5*	58.5*	42.2*

*Statistically significant differences as shown by *t* tests at $P < 0.004$.

of the malocclusion, which was confirmed by the percentage of change indicating a 42% improvement. Regarding the different components of malocclusion, the improvements in overjet and occlusal relationship contributed the most to the overall treatment result by 30% and 21%, respectively. Posterior lingual crossbite was 1 feature that underwent the greatest change, represented by 11% of the total improvement. This change was expected since posterior crossbites are a common malocclusion at an early age and need to be corrected as soon as they are detected. This can be supported by the studies of Petren and Bondemark[30] and Petren et al,[31] in which it was shown that expansion at an early age for unilateral crossbite was not only effective but also stable at 3 years posttreatment. Many clinicians target this specific feature to reestablish normal development at an early age. The correction of the anterior open bite also was relevant, accounting for 12% of the total improvement.

The change in ANB angle represented 8% of the total improvement, which combined with occlusal relationship improvement shows that the anteroposterior dimension is routinely addressed in phase 1 with good results. Nevertheless, the correction of occlusal relationship in some instances can occur spontaneously as a result of the physiologic transition to a Class I molar relationship.

The category "other" includes unusual developmental features normally not necessarily included in a phase 1 intervention (eg, congenitally missing teeth or anomalous morphology of teeth) but also important in the assessment of the severity of a malocclusion. Another consideration for this category is a maxillary central diastema of 2 mm or more, which adds 2 points to the DI score. Because the pretreatment records were taken before the maxillary permanent canines erupted, this diastema could spontaneously close later on, without orthodontic intervention. This category also showed a significant improvement: 11% of the total improvement after phase 1. The percentages of the contribution of the improvement of each variable to the total improvement do not add up to 100%, since the results are also affected by the variables that underwent nonsignificant changes (Table VI).

Although all the previous features showed positive changes, there were certain components of the

Table VI. Percentages of contribution to the total improvement (%)

Overjet	Anterior open bite	Crowding	Occlusal relationship	Posterior lingual crossbite	ANB angle	Other
30	12	9	21	11	8	11

Table VII. Percentages of contribution to the total improvement in the Class I group (%)

Overjet	Anterior open bite	Crowding	Occlusal relationship	Posterior lingual crossbite	Other
29	28	11	−6	14	17

DI (SN-MP, IMPA, and buccal posterior crossbite) that underwent negative changes. These changes can be considered side effects of the mechanics used to correct the different occlusal problems and may be transitory. However, none of these measurements proved to be statistically significant.

The Class I group had a 49.3% total improvement. Crowding and posterior lingual crossbite were the main variables affecting the Class I malocclusion, and they both improved significantly. Their contributions to the total result were 11% and 14%, respectively. Overjet showed a significant change, which accounted for 29% of the total improvement in this group. A large contribution to this correction was probably the alignment of the anterior teeth by partial bonding. Anterior open bite showed an improvement of 28% of the total. This change is supported by the study of Torres et al,[32] who compared a group of children, 6 to 10 years of age with an Angle Class I malocclusion and an anterior open bite greater than 1.0 mm, treated with a palatal crib and a high-pull chincup, with a matched untreated group. A greater closure of the anterior open bite was observed in the treated group that was mainly due to dentoalveolar changes. The category "other" also showed an improvement of 17% of the total. On the contrary, the occlusal relationship showed negative changes, which actually attenuated the total improvement by 6% (Table VII). All other variables including the cephalometric measurements underwent changes that were not statistically significant.

In the literature, Class II early intervention is the most controversial. The Class II group was categorized by an end-on or full-step molar relationship. For this group, the total changes from T1 to T2 were also positive, representing a mean improvement of 34.5%. The contributions to the improvement of each component were 10% for anterior open bite, 10% for crowding, 8% for posterior lingual crossbite, and 12% for "other." The main components of the DI that express the severity of the Class II malocclusion are occlusal relationship, overjet, and ANB angle. These features had significant improvements and contributed to the results by 35%, 23%, and 11%, respectively. On the contrary, IMPA showed a negative change—proclination of the mandibular incisors—that could be seen as a side effect of the mechanics used to reduce overjet or "advance" the mandible. The change of this feature reduced the total improvement by 9% (Table VIII). In a study that compared a Class II group treated early with headgear with a control group, the authors found a significant reduction in ANB angle and alleviation of crowding in the maxillary arch, but contrary to our results, there was no significant difference in the reduction of overjet.[33] This discrepancy was probably because in this study there were both headgear and bite-jumping appliances in the group. A different study compared 3 groups of preadolescent patients with Class II discrepancy, 2 that had early treatment and a control group. One group was treated with headgear and the second with functional appliances. The results showed that the untreated group demonstrated no change, whereas the treated groups had a significant change in ANB angle that was confirmed in our study also. In the headgear group, there was a positive effect on the maxilla, and in the functional appliance group the mandibular response was more representative.[34] The total sample including the control group was treated in a second phase, and the initial changes tended to dissipate. This result was confirmed by another study in which 2 Class II groups were compared; the first had 2 phases of treatment, and the second had only comprehensive treatment. Although there was an initial improvement of ANB angle after early treatment in the 2-phase group, in the end of both phases the skeletal measurements of all groups did not show a significant difference.[35]

Class III patients were categorized by a small to full mesial step molar relationship. This group demonstrated a total improvement of 58.5% The features that were mostly affected in the Class III malocclusion were overjet, which is usually negative or edge to edge, posterior crossbite, and occlusal relationship. All these features showed significant improvements: 43%, 15%, and 17% of the total improvement, respectively (Table IX). This change can be attributed to treatment with a reverse-pull facemask combined with expansion of the maxillary arch. A significant change was also expected for ANB angle; however, although there was indeed an improvement represented by a score of 0.92 points, the change was not statistically significant. The reason may be related to the fact that according to the DI

Table VIII. Percentages of contribution to the total improvement in the Class II group (%)

Overjet	*Anterior open bite*	*Crowding*	*Occlusal relationship*	*Posterior lingual crossbite*	*ANB angle*	*IMPA*	*Other*
23	10	10	35	8	11	−9	12

Table IX. Percentages of contribution to the total improvement in the Class III group (%)

Overjet	*Crowding*	*Occlusal relationship*	*Posterior lingual crossbite*	*Other*	*Total*
43	7	17	15	4	100

instructions, only an ANB angle less than −2 points is scored. This skeletal discrepancy is expected in more severe Class III patients, and it was not corroborated by this study. These results are aligned with those that compared early use of a protraction facemask with an untreated group and found increases of ANB angle and overjet in the facemask group.[36] Additionally, crowding and "other" improved significantly, accounting for 7% and 4% to the total result, respectively.

The ANOVA test showed that the Class III group benefited the most from early treatment compared with the Class I and Class II groups, which had less improvement. This could be an indication that the mechanics used for Class III correction are more predictable, and the changes are more pronounced because of the initial severity of the malocclusion. Overjet and posterior lingual crossbite correction were more distinct in the Class III group; the molar occlusal relationship behaved similarly in the Class II and Class III groups. It might be interesting to further investigate if the Class III group that benefited the most from the early intervention would be able to sustain the changes due to growth-related variables.

CONCLUSIONS

1. Phase 1 orthodontic treatment was effective in the reduction of the severity of malocclusions.
2. An overall 42.5% reduction of the DI score was observed. It indicates that early treatment significantly reduced the complexity of the correction.
3. The Class I, Class II, and Class III groups showed total improvements of 49.3%, 34.5%, and 58.5%, respectively.
4. The Class III group had the most changes.

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