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ONE PHASE VERSUS TWO PHASE TREATMENT IN MANAGEMENT OF GROWING CLASS II PATIENTS: A RETROSPECTIVE STUDY

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ABSTRACT

Objective: To compare the effects of two treatment modalities for correction of Class II malocclusion in late growing patients: one-phase fixed orthodontic treatment using Class II intermaxillary elastics versus two-phase treatment with Twin-block appliance (TB) followed by fixed appliance.

Material and Methods: The pretreatment and posttreatment lateral cephalograms of 20 females with skeletal Class II due to mandibular deficiency, treated with either one-phase of fixed appliance using Class II intermaxillary elastics (10 patients, mean age 12.55±0.88), or two-phase of TB appliance followed by second phase of fixed appliance (10 patients, mean age 11.57±1.03) were retrieved from the archive of the Orthodontic Department. Cephalometric analysis was carried, and the results were statistically analyzed and compared.

Results: The two-phase treatment group showed significant mandibular growth represented by significant increase in the SNB angle (1.91±0.72) and the mandibular length (Co-Gn=3.66±2.04). There was significant reduction in the ANB angle (-1.91±0.49) and minor decrease in the SNA angle (-0.44±0.26). No statistically significant skeletal changes were observed in the one-phase treatment group. The mandibular incisors were more proclined and only significantly intruded in the one-phase treatment group. Both the upper and lower lips moved forward which was more statistically significant in the two-phase treatment group. The angle of convexity was only statistically improved in the two-phase treatment group.

Conclusion: Satisfactory treatment outcomes were achieved by the two treatment modalities. However, the two-phase treatment was able to produce significant skeletal changes represented by increased mandibular growth, with less mandibular incisors proclination, together with better soft tissue profile.

KEYWORDS: Class II intermaxillary elastics, Twin-block appliance, Class II division 1.

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INTRODUCTION

Timing of treatment is a very critical decision during treatment planning in orthodontics. It is based to a great extent on the clinician's experience due to the limited studies targeting the question about early treatment.[1]

One rationale of early treatment is that early correction of the visible traits of the malocclusion during the child's maturation stage will prevent the development of poor self-concept.[2] Another goal of early treatment is to correct existing or developing skeletal, dental, and muscular imbalances to create a better environment for the remaining growth and development. [3-5] On the other hand, early treatment increases the total cost and time of treatment. Therefore, a cost-benefit analysis should always be considered before taking a decision for every single case.

Class II division 1 is a common malocclusion associated with an increased overjet that can lead to increased risk of incisor trauma, teasing and bullying in children.[6,7] This can have a negative psychological impact that affects the child's self-confidence. In addition to improving the self-concept, early treatment of Class II malocclusion via two-phase treatment has the advantage of making use of the residual growth needed for growth modification which reduces the overall need for a more complex orthodontic treatment like permanent tooth extraction or orthognathic surgery.[8] Opponents of two-phase Class II treatment argue that many patients have only limited capacity to cooperate and that the total treatment time for dual treatments that require 2 phases of compliance and retention may be more.[9] Moreover, many studies found no change in the mean self-concept score in subjects treated with two- phase treatment with no improvement in their perception about themselves after reduction of the Class II malocclusion after an early phase treatment of growth modification.[10]

The timing the patient presents to the orthodontist with a skeletal Class II malocclusion greatly affects the decision. In case of early show, many orthodontists prefer to make use of the active growth period and go through growth modification with a functional appliance followed by a second phase of fixed appliance treatment for detailing and finishing. A greater problem presents in case of late show in the late stages of growth specially in females. The orthodontist usually becomes in a conflict, whether to try to make use of the residual growth remaining which can be useless in this critical timing increasing the cost and treatment duration, or to start a single phase camouflage fixed appliance treatment forgetting all about growth modification and only targeting dental modification.

The twin block appliance (TB) introduced by William Clark in 1988 is one of the most commonly used functional appliances used for growth modification in growing Class II division 1 patients.[11] It proved to be efficient to reduce the overjet, correct the molar relationship, and reduce the severity of malocclusion. However, it was assumed that the majority of the improvement was due to dentoalveolar changes with small amount of favorable skeletal effects. Skeletal changes were found to account for one-third of the decrease in the overjet while the remainder was found to be predominantly due to dental compensations.[12]

Correction of Class II malocclusion using Class II intermaxillary elastics is a well-known treatment option. Although it was reported to have some skeletal effects in some previous studies[13,14], however, the majority of the effects were dentoalveolar, including lingual tipping of the incisors with extrusion of the maxillary and intrusion of the mandibular; mesial tipping and extrusion of the mandibular molars; together with clockwise rotation of the occlusal plane.[15-21]

Hence the aim of this study was to compare between the treatment effects of two different methodologies for the management of patients with skeletal Class II due to mandibular deficiency, presenting with a little amount of residual growth remaining; one phase treatment with fixed appliance and intermaxillary elastics versus two-phase treatment of growth modification followed by a second phase of fixed appliance treatment for detailing and finishing.

MATERIAL AND METHODS

This retrospective study was conducted using the pretreatment and posttreatment lateral cephalograms of 20 growing females ranging in age from 11 to 14 years with skeletal Class II malocclusion due to mandibular deficiency, who were treated with 2 different Class II non-extraction methodologies. Group I were treated with single phase of fixed appliance treatment using Class II intermaxillary elastics. Group II were treated with 2 phase treatment: growth modification with TB appliance followed by fixed appliance treatment. The records were retrieved from the archive of the Orthodontic Department, Faculty of Dentistry-Ain Shams University.

The inclusion criteria of the selected sample were: Class II division 1 malocclusion with normal maxilla and retrognathic mandible (SNB≤76), growing patients in late active growth period confirmed by pre-operative lateral cephalometry using the cervical vertebral maturation method (stage 3 or 4), horizontal or normal growth pattern with mandibular plane angle≤30^0, Angle Class II molar relationship bilaterally, 5 ≤ Overjet ≥ 10mm, permanent dentition stage with full set of permanent dentition in both arches with minimal or no crowding or spacing in either arch.

Patients with Class II malocclusion due to maxillary protrusion only with a normal mandible, vertical growth pattern, posterior crossbite or tendency for posterior crossbite, systemic disease or syndromes affecting growth or craniofacial development, extracted or congenitally missing permanent teeth (except the third molars) were excluded.

For group I, the mean age for the included sample of 10 females was 12.55+0.88 years. A single-phase non-extraction camouflage treatment was carried for all patients using 0.018 inch preadjusted fixed appliance, following the same steps of comprehensive fixed appliance treatment, starting by leveling and alignment. Correction of Class II canine and molar relationship was initiated using Class II intermaxillary elastics (1/4 inch-6 ounces) after placing heavy maxillary and mandibular archwires; 0.017 x 0.025 inch stainless steel. These elastics were applied from maxillary canines to mandibular first molars bilaterally (Figure 1). Follow up visits were scheduled every 4-6 weeks where the force level was measured each visit with a tension gauge to adjust the appropriate size of the elastics while having the patient biting in maximum intercuspation.

Fig (1). Class II intermaxillary elastics used in one-phase treatment group

For group II, the sample consisted of 10 females with a mean age 11.57±1.03 years. In Phase I treatment, patients were treated with a standard removable TB appliance to allow for growth modification and advance the retrognathic mandible.[22] During wax-bite registration, a single-step mandibular advancement was carried to reach an edge-to- edge incisor relationship with a 2-3 mm bite opening between the central incisors. Acrylic capping of the lower incisors was added to the standard design (Figure 2). Patients were instructed to wear the appliance 24 hours per day except during mealtimes. Follow up visits were scheduled every 4 weeks until the end of treatment where the interocclusal acrylic was trimmed in all of the patients and the labial bow was kept passive throughout the treatment. Phase I treatment was discontinued when the overjet and the overbite were reduced to 1-2mm. Duration of phase I varied greatly according to the degree of patient cooperation. Phase II non-extraction treatment was started immediately using 0.018 inch preadjusted fixed appliance to correct minor displacement, coordinate the arches, and to finalize the occlusion. During the finishing stage, Class II intermaxillary elastics as well as elastics for interdigitation were used when indicated.

Fig 2. Twin-block appliance used in two-phase treatment group

The study was carried using the pretreatment lateral cephalograms acquired immediately before placement of any of the used appliances (T1), and the posttreatment lateral cephalogram acquired at the end of treatment after achieving class I canine and molar relationship (T2). The duration of treatment of either of the two treatment modalities varied among patients depending on the degree of cooperation, as both treatment modalities are compliance dependent.

Dolphin Imaging 11.0 Software (Dolphin Imaging and Management solutions, Chatsworth, Calif) was used to analyze the retrieved lateral cephalometric radiographs. The anatomical landmarks were first digitized, then the predefined lines and angles in the data base of the program were measured and calculated automatically by the software program. The resulting skeletal, dental and soft tissue measurements were compared between the 2 groups.

To ensure the reliability of the measurements, they were carried twice by the same observer within one month interval, and by another observer. Cronbach's alpha reliability coefficient results showed very good intra-observer and inter-observer agreement with Cronbach's alpha value not less than 0.800 for all the variables.

Statistical analysis

Statistical analysis was performed utilizing SPSS software (version 20.0, IBM; Armonk, NY). Descriptive statistics described by the Mean, Standard Deviation (SD) as well as the mean differences between the pre and post measurements were measured for all quantitative variables. To test normality hypothesis for further choice of appropriate parametric and non-parametric tests, Shapiro-Wilk test of normality was used for all quantitative variables. As the majority of the variables were found normally distributed, parametric tests were used. Paired sample t-test was used to compare T1 and T2 measurements within each group. Independent samples t-test was used for comparing the difference (T2-T1) between the two groups. The significance level was set at $P < 0.05$.

RESULTS

Tables 1,2 and 3 show the changes between T1 and T2 in each group, as well as the comparison between the mean differences (T2-T1) of the measurements between the 2 groups.

Skeletal changes

The two-phase treatment group showed significant skeletal changes represented by significant mandibular growth represented by significant increase in the SNB angle (1.91±0.72) together with significant increase in the mandibular length (Co-Gn=3.66±2.04). There was a significant reduction in the ANB angle (-1.91±0.49) and a minor decrease in the SNA angle (-0.44±0.26). The mandibular plane angle (Sn/Go-Gn) also showed a significant increase in this group (0.97±0.57). On the other hand, no statistically significant skeletal changes were observed in the one-phase treatment group with a statistically significant difference between the 2 groups for the SNB angle and the Co-Gn measurements (P>0.05).

Dental changes

The maxillary incisors were significantly retroclined and extruded in both groups with no significant difference between the 2 groups (P>0.05). The mandibular incisors were significantly proclined in both groups but with more statistically significant proclination in the one-phase treatment group. Vertically, the mandibular incisors were only significantly intruded in the one-phase treatment group (-2.38+3.78).

The maxillary molars were significantly distalized in both groups but with more significant distalization in the two-phase treatment group (0.82±0.62). The mandibular molars were extruded in both groups with no significant difference between the 2 groups (P>0.05).

Both groups showed significant clockwise rotation of the occlusal plane, reduction in the overjet and overbite, all of which was not statistically significant between both groups (P>0.05).

Soft tissue changes

Both treatment groups showed an improvement in the soft tissue profile represented by a significant decrease in the distance between Eline to both the upper and lower lips which was more statistically significant in the two-phase treatment group (P>0.05). The nasolabial angle was improved in both groups while the angle of convexity was only statistically improved in the two-phase treatment group (2.52±1.05).

TABLE (1). Mean values of measurements at T1 and T2 and the mean difference (T2-T1) in the one-phase treatment group; Paired t-test.

Measurement	T1		T2		Mean diff.	SD	P value
	Mean	SD	Mean	SD			
Skeletal measurements							
SNA*	80.24	1.93	80.08	2.06	-0.16	1.63	0.30425
SN*	75.11	1.16	75.16	1.65	0.05	1.11	0.92456
ANB*	5.13	0.90	4.62	1.63	-0.51	1.52	0.25191
SN/Go-Gn*	29.46	0.80	30.60	2.07	1.14	1.63	0.19507
Co-Gn mm	103.30	3.11	102	3.32	-1.30	0.67	0.01232
Dental measurements							
U1/SN*	107.98	3.76	104.32	2.76	-3.66	1.92	<0.05*
U1-FH mm	10.86	1.12	12.38	2.54	1.53	0.95	<0.05*
L1/MP*	94.01	7.03	105.76	11.19	11.75	6.78	<0.05*
L1-MP mm	22.76	1.18	20.38	4.07	-2.38	3.78	<0.05*
U6-PTV mm	40.16	0.52	39.30	0.76	-0.86	0.34	<0.01*
U6-FH mm	30.68	1.88	31.71	1.43	1.03	1.52	0.15448
L6-MP mm	18.64	2.13	20.56	2.31	1.92	0.26	<0.001*
Occlusal plane/SN*	16.93	2.33	20.23	3.86	3.31	1.98	<0.05*
Overjet	5.71	1.39	2.34	1.07	-3.36	2.23	<0.05*
Overbite	4.57	0.92	0.75	0.49	-3.82	0.90	<0.001*
Soft tissue measurements							
UL-Eline mm	2.25	0.68	1.41	0.84	-0.83	0.49	<0.05*
LL-Eline mm	-0.52	1.49	0.80	1.38	1.32	0.56	<0.01*
Nasolabial angle	111.72	4.70	115.80	4.95	4.08	2.97	<0.05*
Angle of Convexity	156.46	3.05	157.60	3.98	1.14	1.22	0.10528

, Significant at P ≤ 0.05

TABLE (2). Mean values of measurements at T1 and T2 and the mean difference (T2-T1) in the two-phase treatment group; Paired t-test.

Measurement	T1		T2		Mean diff.	SD	P value
	Mean	SD	Mean	SD			
Skeletal measurements							
SNA*	81.16	2.11	80.73	1.91	-0.44	0.26	<0.05*
SNB*	74.69	1.25	76.61	0.85	1.91	0.72	<0.01*
ANB*	6.07	1.22	4.16	1.49	-1.91	0.49	<0.001*
SN/Go-Gn*	28.54	1.23	29.51	1.53	0.97	0.57	<0.05*
Co-Gn mm	97.72	5.74	101.38	4.14	3.66	2.04	<0.01*
Dental measurements							
U1/SN*	114.16	4.02	107.78	4.40	-6.85	4.85	<0.05*
U1-FH mm	11.06	1.15	12.56	1.75	1.50	1.04	<0.05*
L1/MP*	92.49	6.69	99.24	6.77	6.75	3.77	<0.05*
L1-MP mm	37.24	3.28	36.30	3.97	-0.94	0.87	0.07259
U6-PTV mm	14.62	1.20	15.44	1.36	0.82	0.62	<0.05*
U6-FH mm	17.74	3.29	18.76	3.05	1.02	0.96	0.06315
L6-MP mm	27.06	3.89	29.22	3.82	2.16	1.07	<0.05*
Occlusal plane/SN*	18.30	4.58	19.63	4.26	1.34	0.95	<0.05*
Overjet	8.54	1.85	3.09	0.82	-5.45	1.89	<0.01*
Overbite	2.61	1.10	1.31	0.80	-1.30	0.75	<0.05*
Soft tissue measurements							
UL-Eline mm	2.94	1.27	0.40	1.08	-2.54	1.15	<0.01*
LL-Eline mm	3.56	0.77	1.78	0.45	-1.78	0.68	<0.01*
Nasolabial angle	110.09	6.27	112.20	8.21	2.11	3.79	<0.05*
Angle of Convexity	156.88	3.81	159.40	2.95	2.52	1.05	<0.01*

, Significant at P < 0.05

TABLE (3). Comparison of the mean differences (T2-T1) of the measurements between the 2 groups; Independent sample t-test.

Measurement	One-phase treatment		Two-phase treatment		Mean diff.	SD	P value
	Mean	SD	Mean	SD			
Skeletal measurements							
SNA*	-0.86	1.63	-0.44	0.26	-0.42	0.74	0.58487
SNB*	0.05	1.11	1.91	0.72	-1.86	0.59	<0.05*
ANB*	-0.91	1.52	-1.91	0.49	1.00	0.71	0.19712
SN/Go-Gn*	1.14	1.63	0.97	0.57	0.17	0.77	0.83547
Co-Gn mm	1.30	0.67	3.66	2.04	-2.36	0.96	<0.001*
Dental measurements							
U1/SN*	-3.66	1.92	-6.85	4.85	3.19	2.33	0.20870
U1-FH mm	1.53	0.95	1.50	1.04	0.03	0.99	0.97810
L1/MP*	11.75	6.78	6.75	3.77	5.00	3.47	<0.05*
L1-MP mm	-2.38	3.78	-0.94	0.87	-1.44	1.74	0.43090
U6-PTV mm	-0.86	0.34	0.82	0.62	-1.68	0.32	<0.001*
U6-FH mm	1.03	1.52	1.02	0.96	-0.99	0.49	0.07695
L6-MP mm	1.92	0.26	2.16	1.07	-0.24	0.49	0.64009
Occlusal plane/SN*	3.31	1.98	1.34	0.95	1.97	0.98	0.07956
Overjet	-3.36	2.23	-5.45	1.89	2.08	1.31	0.14996
Overbite	-3.82	0.90	-1.30	0.75	-2.52	0.53	0.06121
Soft tissue measurements							
UL-Eline mm	-0.83	0.49	-2.54	1.15	1.71	0.56	<0.05*
LL-Eline mm	1.32	0.56	-1.78	0.68	3.10	0.39	<0.001*
Nasolabial angle	4.08	2.97	2.11	3.79	1.97	5.20	0.07455
Angle of Convexity	1.14	1.22	2.52	1.05	-1.38	0.72	<0.05*

, Significant at P < 0.05

DISCUSSION

The debate about the timing of Class II treatment will always exist. Some orthodontists believe that the execution of phase I treatment of growth modification simplifies the treatment even if noticeable skeletal effects are not achieved, but it makes the second phase of treatment much easier. On the other hand, other practioners find it a waste of resources to carry a first phase of treatment although the same results can be achieved when we wait to achieve single phase of camouflage treatment decreasing the burden of time and money and avoiding losing the patient's interest and cooperation. Hence, the aim of this study was to try to find an answer for this debate through analysis of the pretreatment & post-treatment records of a sample of growing females with skeletal Class II due to mandibular deficiency in their late growth stages treated with one-phase & two-phase treatment protocols, where the conflict always exists. Only females were selected to exclude the factors of different growth timing and rates a between males and females.

The results of this study showed significant skeletal effects in the two-phase treatment group represented by slight forward position of the mandible (SNB°=1.91±0.72) which was in accordance with previous studies investigating the effects of the TB appliance.[22-24] Moreover, there was significant increase in mandibular length which was in accordance with other studies as well.[22,24-26] Furthermore, there was a slight headgear effect represented by the slight decrease in the SNA angle (-0.44±0.26) which has been reported by many previous studies.[12,22,24,25,27] As the mandible was postured forward by the TB appliance, a reciprocal force acted distally on the maxilla and restricted its forward growth. On the other hand, few studies did not report any maxillary restraint effect by either removable[11,28] or fixed functional appliances.[29,30] Consequently, the two-phase treatment group induced a more favorable correction in the intermaxillary sagittal relationships than did the one-phase treatment (ANB°, -1.91 and -0.91, respectively). As for the vertical skeletal changes, the two-phase treatment induced a significant posterior rotation of the mandibular which has been previously reported.[23] Although few studies reported some skeletal effects for the intermaxillary Class II elastics like anterior mandibular displacement[13] and restriction of anterior maxillary growth[14], however, the majority of the studies denied any skeletal effects for the one-phase treatment using intermaxillary Class II elastics which was in accordance with the results of this study.[21,31,32]

Both groups showed significant retroclination and extrusion of the maxillary incisors but with no significant difference between the 2 groups. In the one-phase treatment group treated with fixed appliance together with Class II intermaxillary elastics, this could be explained by the vector of elastics force on the maxillary incisors being distal and extrusive which is expressed even in the presence of full thickness archwire in the bracket slots of the multibracket appliance as reported by previous studies.[15-21] On the other hand, the distal tipping and extrusion of the maxillary incisors in the two-phase treatment group can be due to the headgear effect of the TB appliance. It could be also due to the labial bow of the appliance that gets in contact with the incisors during sleep causing them to tip palatally and consequently extrude in relation to the reference plane.[33]

Although the overjet was improved in both groups, but the absence of mandibular skeletal effects in the one-phase treatment group led to more dental compensation represented by more significant proclination of the mandibular incisors which has been reported by previous studies.[15-21] This was accompanied by significant intrusion of the mandibular incisors in this group, because as the teeth procline, the vertical distance to the reference plane decrease. On the other hand, the proclination of the mandibular incisors in the two-phase treatment group was due to the mesial force expressed on them by the forward posture of the mandible. However, this amount of proclination was less than that found in the one-phase treatment group that showed more forward position of the mandible causing less dental compensation. Another reason might be the design of the used TB appliance with acrylic capping over the mandibular incisors which provided more control on their position. This explanation was in accordance with some previous studies investigating the effect of mandibular incisors capping [34-36], while opposing the opinion of other studies that did not find any inhibitory effect for the acrylic capping on the proclination of the mandibular incisors.[37]

The more significant maxillary molar distalization seen in the two-phase treatment group can be explained by the headgear-effect of the TB appliance that was consistent with previous studies.[11,22,24] On the other hand, Tumor and Gultan[38] reported that the twin block appliance only restricted the forward movement of the maxillary first molar. The extrusion of the mandibular first molar seen in the one-phase treatment group can be explained by the vector of Class II intermaxillary elastics. On the other hand, this extrusion in the two-phase treatment group can be explained by the design of the TB appliance having the inclined plane on the mandibular premolars, allowing the first molars to slightly over-erupt.

The position of both the upper and the lower lips was improved in both groups, but with more forward movement of both lips in the two-phase treatment group representing better soft tissue response for this treatment modality. Moreover, the angle of convexity was only improved in the two-phase treatment group due to the forward movement of the mandible that was reported in this group.

From the results of this study, we can conclude that both treatment modalities were effective for treating mild to moderate late growing skeletal Class II females. However, whenever we have remaining growth to make the hard tissues more responsive to the applied forces and the soft tissues highly adaptable, the two-phase treatment can provide better results regarding the more improvement of the soft tissue profile and the less dental compensations.

Limitations

The small sample size and the absence of a control group are considered as limitations for this study that should be considered in future studies. Moreover, if this study was prospective rather than retrospective, it would have had higher level of scientific evidence. Furthermore, this study only showed the short-term effects of the two treatment modalities which was in favor of the two-phase treatment modality that showed some favorable skeletal effects. Long-term studies are needed to be carried to investigate whether these skeletal effects are sustainable or not on the long-term.

CONCLUSION

- Both treatment modalities were effective in correcting Class II division 1 malocclusion in late growing females.
- The two-phase treatment was able to produce more significant skeletal changes in terms of mandibular advancement and growth stimulation.
- The one-phase treatment induced more dentoalveolar changes than the two-phase treatment, with greater amount of proclination of the mandibular incisors.
- Acceptable position of the upper and lower lips was achieved by the 2 treatment modalities but with more improvement in the angle of convexity in the two-phase treatment group.

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