ORIGINAL ARTICLE

Comparison of Dento-Alveolar and Skeletal Changes Between Immediate and Delayed Placement of Fixed Appliances After Twin Block Therapy

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ABSTRACT

Introduction: A parallel design randomized clinical trial was conducted to compare dentoalveolar and skeletal changes in two groups of patients who had completed twin block therapy; one group had a three-month night-time retention period whereas the other group had no retention period, after twin block therapy but before fixed appliances. **Methods:** 26 participants of Malay ethnicity aged 10 to 15 years were included in the trial and had an overjet of 5mm or greater, molar relationship greater than half cusp Class II on a skeletal Class II base which had been corrected to a Class I molar relationship following twin block therapy. Following randomization, the 26 were divided into two groups of 13. Group A had fixed appliances bonded immediately whereas group B continued wearing twin block at night for three months, after which fixed appliances were bonded. Lateral cephalograms assessed were those taken before randomization, upon twin block therapy completion (T1) and six months after bond-up of fixed appliances (T2). **Results:** Paired t-test showed several statistically significant dentoalveolar and skeletal changes in group A. In contrast, only condylar head position exhibited a statistically significant change in group B. Despite a statistical significance, changes measured in both groups were minimal at less than 2mm and therefore clinically insignificant. Independent t-test showed no statistically significant difference between the changes recorded in both groups. **Conclusion:** The results suggest that a three-month night-time retention period after twin block therapy does not lead to any changes that may be considered clinically beneficial.

Keywords: Retention, Twin block, Class II malocclusion

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INTRODUCTION

Use of the twin block to correct skeletal Class II malocclusions, followed by a second phase of treatment with fixed appliances to improve dental alignment, is common orthodontic practice. The treatment procedure and its effects have been widely documented in literature (1 – 4).

Once twin block treatment is completed, some clinicians choose to bond fixed appliances immediately. Others advise a transition period before the bond-up, usually of three months duration. During this time all appliances are removed in order to allow assessment of relapse after the functional appliance phase and of anchorage requirements for the fixed appliance phase of treatment. Alternatively, the three months may be used for retention (5 – 6).

Currently, the decision of whether or not to incorporate a transition period into the treatment plan is made based solely on the experience and opinion of the clinician. The objective of this study was to provide evidence of the benefits, or lack thereof, of a three month transition retention period between twin block therapy and fixed appliance bonding by evaluating the dentoalveolar and skeletal changes brought about by a transition retention period and comparing these changes with those seen when a transition retention period is not a part of the treatment plan.

MATERIALS AND METHODS

This was a parallel design, randomized clinical trial with block randomization, conducted at Universiti Sains Malaysia (USM) from 2008 until 2010. After approval of research protocol by the local ethics committee, children from five primary schools around Kota Bharu, Kelantan as well as children visiting USM orthodontic

and outpatient clinics were screened for eligibility. Inclusion criteria specified that the children be of Malay ethnicity, 10 to 15 years of age, have an overjet of 5mm or greater, a molar relationship of greater than half cusp Class II, a Class II division 1 malocclusion on a skeletal Class II base and be undergoing twin block therapy to achieve a Class I molar occlusion.

Selected children and their parents were told about the research and invited to participate, of which 34 consented (Figure 1). They were advised that the research would begin upon successful completion of their child's twin block appliance treatment. A copy was obtained of the lateral cephalometric radiographs taken of the children before twin block appliance treatment was started, for the purpose of examining baseline data.

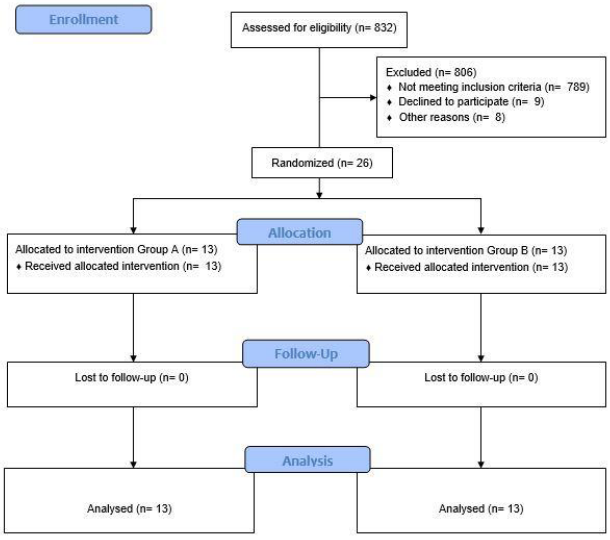

Figure 1: Flow diagram of patient progress through the trial

All children were wearing the twin block for 24 hours a day, which had been fabricated with Adam's clasps on the first premolars and molars, and three ball end clasps on the mandibular appliance for added retention. The bite blocks met at an angle of approximately 70 degrees and no labial bow was used (Figure 2).

The children attended monthly follow up appointments at which time compliance was ascertained and any improvement in molar occlusion and overjet was checked. Eight children asked to discontinue treatment during this stage. From what the researcher was able to determine, these children had begun treatment at the insistence of their parents and were not self-motivated to seek orthodontic care. Some also complained of the twin block being uncomfortable to wear or of being shy to wear the appliance around their friends.

The remaining 26 children met the inclusion criteria by completing twin block therapy and achieving a Class I molar occlusion and were therefore included in the trial. A lateral cephalometric radiograph was taken upon completion of their twin block appliance treatment (T1) and they were then randomized into one of two groups; Group A or Group B. The randomization was carried out by the researcher opening a sealed envelope which contained either the letter A or B. The envelopes were prepared earlier by the co-researcher and the sequence of letters was unknown to the researcher.

Figure 2: TB appliance used in the study

Patients randomized into group A had separators placed immediately and fixed appliances bonded one week later. Group B patients were asked to continue wearing the twin block appliance for three months, but only during night-time as a retentive device. Fixed appliances were bonded after the three-month period was completed.

Patients of both groups had 0.020" slot MBT prescription brackets bonded and began treatment with a 0.014" NiTi arch wire. 6 out of the 26 patients also had extractions carried out during fixed appliance stage of treatment.
A second lateral cephalometric radiograph (T2) was taken six months after the bond up of fixed appliances. The researcher, blinded to the group of the patient, used Pancherz analysis to trace the radiographs. The analysis was used to calculate the overjet and molar relationship, as well as anteroposterior position of maxillary and mandibular incisors, molars, skeletal bases, condylar head and mandibular length. These were calculated using the variables Incisor superius-Occlusal line perpendicular (Is/OLp), Incisor inferius-Occlusal line perpendicular (Ii/OLp), Molar superius-Occlusal line perpendicular (MS/OLp), Molar inferius-Occlusal line perpendicular (Mi/OLp), Condylion-Occlusal line perpendicular (Co/OLp), Point A-Occlusal line perpendicular (A/OLp), and Pogonion-Occlusal line perpendicular (Pg/OLp).

All data generated through radiographic measurements was analysed using Predictive Analytics Software (PASW) 18.0. Paired t-test analysis was used to assess within-group changes and independent t-test analysis to compare differences between the two groups.

To determine reliability of the data, inter-examiner and intra-examiner intra-class correlation coefficient (ICC) tests were done. To determine inter-examiner reliability, nine randomly chosen radiographs were traced by a colleague in the orthodontic department of USM and the findings compared with those of the researcher. For intra-examiner reliability, nine radiographs were chosen

at random and traced by the researcher one month after they had completed tracing the radiographs for the first time.

At the beginning of the research, the sample size had been calculated using the PS: Power and Sample Size Calculation software version 3.0.34. After discussion with 2 consultant orthodontists and the co-researchers of this study, 3mm was chosen as the minimum value that would represent a clinically significant difference between the two groups of this trial. This was decided taking into consideration that some amount of measurement error would be present when tracing cephalometric radiographs (8, 9). Therefore, in order to detect a difference of 3mm between the two groups at a 5% significance level, with 80% power and using a standard deviation of 3mm taken from a previous study (10), the required sample size was 17 patients per group. Since we were able to obtain only 13 patients per group, a posthoc analysis was later carried out using the standard deviations calculated within this trial to assess the true value of power.

RESULTS

Out of the 26 children who met the inclusion criteria for this study, all 26 participated in the research without any dropouts during the trial. Demographic data of the children revealed a mean age of 12.38 years with females [19] outnumbering the males [7] by a ratio of 2:1 in group A and 3:1 in group B. The mean duration of appliance wear was 9.51 months. Independent t-test showed no statistically significant difference ($P < 0.05$) between age of the patients or duration of twin block appliance wear between the two groups. A sample profile of all the children can be found in Table I.

The pre-twin block treatment radiographs of patients in Group A and Group B were compared using independent t-test to determine baseline equivalence and showed no statistically significant difference between the groups for any of the dentoalveolar or skeletal variables.

Table 1. Sample profile of patients included in the trial

	Group A (n =13)	Group B (n =13)	Mean difference	*P* value[a]
Male patients	4	3		
Female patients	9	10		
Mean age in years at start of treatment (SD)	12.31 (1.89)	12.46 (1.56)	-0.15	0.823
Mean duration in months of twin block wear (SD)	9.70 (2.36)	9.33 (2.03)	-0.39	0.673
Extractions during fixed appliance stage	1	5		

[a] independent t test. P value is significant if < 0.05

Both intra and inter-examiner ICC analyses values showed that the majority of the variables were in the range of 0.9 to 1 with two variables showing a value of 0.8 and above and one variable, Pg-OLp, a value of 0.77.

The radiographic measurements recorded for group A children at the end of twin block therapy (T1), six months post-fixed appliance bond-up (T2) and the difference between these (T2 minus T1) are presented in Table II. The same measurements for children of group B are presented in Table III. The T2 minus T1 values reflect the amount of relapse or conversely, the stability of the results achieved during twin block therapy. It is clear that none of the changes in either group were clinically significant, all being less than 3mm. Despite this, some of them were seen to be statistically significant, highlighting the pattern of change taking place.

Six variables measured in group A patients showed statistically significant changes as compared to only one variable in group B. Variable Co-OLp showed a

Table II: Post-twin block treatment (T1) and six months post-fixed appliance bond-up (T2) values for group A patients (n =13)

	T1 Mean (SD)	T2 Mean (SD)	Diff. (T2-T1)	*P* value[a]
Overjet (Is/OLp – Ii/OLp)	4.39 (1.34)	4.21 (1.08)	-0.18	0.553
Molar relation (Ms/OLp – Mi/OLp)	-2.65 (1.86)	-1.35 (0.99)	1.30	0.002*
Skeletal changes				
Maxillary base (A/OLp)	68.89 (3.49)	68.80 (3.17)	-0.10	0.636
Mandibular base (Pg/OLp)	71.97 (3.06)	70.68 (3.55)	-1.29	0.032*
Condylar head (Co/OLp)	8.22 (2.72)	9.32 (2.10)	1.10	0.003*
Mandibular length (Co/OLp + Pg/OLp)	80.18 (3.70)	80.00 (4.32)	-0.19	0.654
Dento-alveolar changes				
Maxillary incisor (Is/OLp – A/OLp)	10.09 (2.04)	10.02 (2.36)	-0.08	0.779
Mandibular incisor (Ii/OLp – Pg/OLp)	2.64 (3.52)	3.93 (3.29)	1.29	0.006*
Maxillary molar (Ms/OLp – A/OLp)	-20.66 (2.04)	-19.48 (2.00)	1.18	0.004*
Mandibular molar (Mi/OLp – Pg/OLp)	-21.07 (2.71)	-20.01 (2.46)	1.07	0.032*

[a] paired t test.
* statistically significant difference between T1 and T2 (P value < 0.05)

Table III: Post-twin block treatment (T1) and six months post-fixed appliance bond-up (T2) values for group B patients

	T1 Mean (SD)	T2 Mean (SD)	Diff. (T2-T1)	*P* value[a]
Overjet (Is/OLp – Ii/OLp)	4.35 (1.55)	4.39 (1.29)	0.04	0.911
Molar relation (Ms/OLp – Mi/OLp)	-2.48 (2.46)	-1.63 (1.28)	0.85	0.237
Skeletal changes				
Maxillary base (A/OLp)	69.04 (3.41)	69.10 (3.52)	0.06	0.746
Mandibular base (Pg/OLp)	70.59 (3.17)	69.64 (3.19)	-0.95	0.189
Condylar head (Co/OLp)	6.89 (3.34)	8.35 (3.20)	1.46	< 0.001*
Mandibular length (Co/OLp + Pg/OLp)	77.49 (4.97)	77.99 (4.63)	0.51	0.425
Dento-alveolar changes				
Maxillary incisor (Is/OLp – A/OLp)	10.91 (2.11)	10.81 (2.14)	-0.10	0.828
Mandibular incisor (Ii/OLp – Pg/OLp)	5.00 (4.02)	5.88 (3.28)	0.88	0.127
Maxillary molar (Ms/OLp – A/OLp)	-19.39 (2.00)	-18.42 (2.85)	0.97	0.088
Mandibular molar (Mi/OLp – Pg/OLp)	-18.47 (4.24)	-17.33 (3.63)	1.13	0.111

[a] paired t test.
* statistically significant difference between T1 and T2 (*P* value < 0.05)

Table 4. Comparison of T2 *minus* T1 changes between group A and B patients

	Group A T2 – T1 Mean (SD)	Group B T2 – T1 Mean (SD)	Diff.	*P* value[a]
Overjet (Is/OLp – Ii/OLp)	-0.18 (1.07)	0.04 (1.23)	-0.22	0.631
Molar relation (Ms/OLp – Mi/OLp)	1.30 (1.19)	0.85 (2.45)	0.45	0.555
Skeletal changes				
Maxillary base (A/OLp)	-0.10 (0.71)	0.06 (0.64)	-0.15	0.566
Mandibular base (Pg/OLp)	-1.29 (1.92)	-0.95 (2.46)	-0.34	0.699
Condylar head (Co/OLp)	1.10 (1.08)	1.46 (1.04)	-0.36	0.400
Mandibular length (Co/OLp + Pg/OLp)	-0.19 (1.46)	0.51 (2.23)	-0.70	0.356
Dento-alveolar changes				
Maxillary incisor (Is/OLp – A/OLp)	-0.08 (1.02)	-0.10 (1.57)	0.02	0.975
Mandibular incisor (Ii/OLp – Pg/OLp)	1.29 (1.41)	0.87 (1.92)	0.42	0.529
Maxillary molar (Ms/OLp – A/OLp)	1.18 (1.19)	0.97 (1.89)	0.21	0.743
Mandibular molar (Mi/OLp – Pg/OLp)	1.07 (1.59)	1.13 (2.37)	-0.06	0.938

[a] independent t test. *P* value is significant if < 0.05

statistically significant change of 1.1mm in group A and 1.46mm in group B, suggesting a tendency for relapse toward its initial posterior location.

A comparison of dentoalveolar and skeletal changes (T2 minus T1) between groups A and B are shown in Table IV. All variables exhibited less than 1mm of difference between the two groups. Independent t-test analysis showed none of these were statistically significant.

A post hoc was performed to analyse the actual power of every variable measured in the trial. This was above 80% for all of the variables, as can be seen in Table V.

DISCUSSION

A number of statistically significant dentoalveolar and skeletal changes were seen to have taken place from the end of twin block therapy until six months post-bond-up of fixed appliances. In group A children, these included the mandibular base and condylar head shifting posteriorly in the sagittal plane, by 1.29mm and 1.10mm respectively, indicating a relapse toward the initial Class II malocclusion. Group B children also exhibited a 1.46mm posterior shift in position of the condylar head.

If we compare these results with those of other studies, Mills and McCulloch, 2000, (10) treated their participants with the twin block appliance, followed by an average of 18 months night-time retention. Lateral cephalometric radiographs were taken four years upon completion of appliance treatment and showed stable skeletal changes. Another study by Keeling et al., 1998, (11) treated their participants with the bionator appliance, randomized them into six month retention and no retention groups and took a lateral cephalometric radiograph one year later. They also reported that the skeletal changes achieved during the functional appliance stage of treatment were stable at that time. This is in contrast to the USM trial which exhibited skeletal relapse as early as six months after the end of twin block therapy.

One possible reason for the difference could be the age of the patients at the start of treatment. Both other trials (10, 11) began functional appliance therapy on children

Table V: Post hoc power analysis

	Group A[a] T2 – T1 Mean (SD)	Power	Group B[a] T2 – T1 Mean (SD)	Power
Overjet (Is/OLp – Ii/OLp)	-0.18 (1.07)	1.000	0.04 (1.23)	1.000
Molar relation (Ms/OLp – Mi/OLp)	1.30 (1.19)	1.000	0.85 (2.45)	0.850
Skeletal changes				
Maxillary base (A/OLp)	-0.10 (0.71)	1.000	0.06 (0.64)	1.000
Mandibular base (Pg/OLp)	-1.29 (1.92)	0.967	-0.95 (2.46)	0.847
Condylar head (Co/OLp)	1.10 (1.08)	1.000	1.46 (1.04)	1.000
Mandibular length (Co/OLp + Pg/OLp)	-0.19 (1.46)	0.998	0.51 (2.23)	0.908
Dento-alveolar changes				
Maxillary incisor (Is/OLp – A/OLp)	-0.08 (1.02)	1.000	-0.10 (1.57)	0.995
Mandibular incisor (Ii/OLp – Pg/OLp)	1.29 (1.41)	0.999	0.87 (1.92)	0.967
Maxillary molar (Ms/OLp – A/OLp)	1.18 (1.19)	1.000	0.97 (1.89)	0.971
Mandibular molar (Mi/OLp – Pg/OLp)	1.07 (1.59)	0.994	1.13 (2.37)	0.872

[a] n =13

of mean age nine years, which means craniofacial growth would have continued even after therapy was completed and this would be reflected in their findings. In comparison, children in the USM trial had a mean pre-treatment age of 12 years, with the range being 10 to 15 years. It is possible that some children in the older age range may have crossed their period of maximum growth and not responded well to twin block therapy. They may have formed a habit of posturing the mandible forward and lost the habit once the appliance was removed. On cephalometric radiographs, this would have been reflected as skeletal relapse.

Alternatively, it is possible that the patients responded well to twin block therapy and the relapse seen was truly skeletal with the mandible shifting posteriorly into its original position once the appliance was removed, leading to compression and therefore resorption of any newly formed bone in the glenoid fossa/condylar head region. In this case, the relapse may be attributed to differences in study and/or appliance design. Both other studies (10, 11) had retention periods considerably longer than the three months employed in the USM trial. Also, Keeling et al., 1998, (11) reported the effects of a Bionator whereas Mills and McCulloch, 2000, (10) that of a twin block modified to allow patients to wear Class II elastics at night. The twin block appliances used in the USM trial had a different design.

Perhaps to compensate for the skeletal relapse, the dentoalveolar structures exhibited positional changes that would help maintain the established Class I occlusion. Group A children showed 1.29mm anterior movement of the mandibular incisors and 1.07mm mesial shifting of the mandibular molars. Children in group B also showed 0.88mm anterior movement of the mandibular incisors and 1.13mm mesial movement of molars, although the changes in group B were not statistically significant. These findings of dentoalveolar compensation are also unlike previous studies which have reported mostly dentoalveolar relapse after functional appliance therapy.

Overall, a comparison of the two groups revealed that only one variable in group B was statistically significant in contrast to six variables in group A. Despite this notable difference, independent t-test analysis confirmed there were no statistically significant differences between the two groups. In addition, all dentoalveolar and skeletal changes within the groups, as well as the difference in change between the groups, was less than 2mm and therefore clinically insignificant. These results suggest that there is no clinically obvious benefit to a three-month retention period between twin block and fixed appliance phases of treatment. Because there is no obvious gain, the disadvantages become more apparent; increased treatment time that may tax patient co-operation and greater chances of appliance breakage.

It is also essential to recognize the strengths and limitations of this trial. It is known that differences exist in craniofacial measurements according to ethnicity (12, 13), therefore it was decided to conduct this trial only on children of Malay ethnicity in Kelantan. Since Malays constitute 94.6% of the Kelantan state population (14), the other ethnicities being Indian and Chinese, these children can be considered good representatives of the population of this state.

Also noteworthy is the fact that participants were recruited for this trial from both primary schools and USM orthodontic and outpatient clinics. This had the advantage of simulating a real-world setting where patients with different motivations and social-economic backgrounds were all included in the trial.

Limitations of this study included the issue of a small sample size. Results of the posthoc analysis, however, indicate that the chances of false-negative results due to a small sample size are minimal.

A second concern was the greater number of female participants as compared to male. It is known that

biological differences exist between genders such as an earlier growth spurt for females (15) and males having a less convex facial growth pattern (16). Despite this, grouping males and females together in this trial would not have significantly influenced the results. This is because differences between gender in facial growth patterns would take years to express themselves whereas this trial measured only the changes that took place within a period of six to nine months. Also, the distribution of males and females in both groups of the trial was almost equal. Any minor differences in dentoalveolar or skeletal changes that might have occurred due to gender would have existed in both groups, allowing a fair comparison.

Another point to note is that the cervical vertebral maturation classification was not used during this trial due to the constraints of time and scope of study. It may be beneficial to utilize this classification in any future similar studies undertaken on a larger scale.

A final limitation that needs to be addressed is the number of patients who required extractions during the fixed appliance phase of treatment. Only one patient in group A had extractions carried out compared to five patients in group B. This is important because some authors have found that extractions lead to dentoalveolar changes such as incisors uprighting and forming a more obtuse interincisal angle (17) as well as an increased mandibular inter-molar arch width (18). It is suggested that these findings are a result of closing the residual space through retracting the incisors, protracting the molars mesially or loss of anchorage during either procedure. The amount of pre-treatment crowding, and residual space left after extractions have been suggested to be important factors in determining how the mandibular incisors are affected (19, 20).

In the USM trial, only one patient had all first four premolars extracted and this was due to severe crowding blocking the canines out of the arch line. The residual spaces were to be used for bringing the canine into the arch line and aligning the incisors rather than for incisor retraction or molar protraction. Two other patients of the USM trial had one mandibular premolar each extracted due to the premolars themselves being crowded out of the arch line. These extractions, therefore, left behind less than 2mm of unilateral residual space, which in six months' time would not have made a significant difference clinically, nor in radiographs. The remaining three patients had two premolars each extracted due to crowding. For all three cases, as with the other patients in the trial who had extractions carried out, the final radiographs were taken before the start of space closure mechanics and thus the extractions are not expected to have influenced the results.

This study saw a total of 6 out of 26 patients have extractions carried out during fixed appliance treatment. The pattern of extraction was not similar for these patients and also none of the 26 patients had finished treatment at the time that the second lateral cephalometric radiograph was taken. This means that the extractions would not have influenced the radiographic results to a significant degree at this point.

CONCLUSION

Based on the results of this trial, it appears that a three month night-time transition retention period between twin block therapy and bonding fixed appliances provides no clinically significant benefit and should not be incorporated into the treatment plan for the sole purpose of retention.

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