A prospective study of 28 growing children (mean age of 8 years 3 months) with Class III malocclusions was consecutively treated using rapid maxillary expansion and maxillary protraction. All patients were treated from a negative overjet to a positive overjet and from a Class III dental malocclusion to a Class I dental relationship. For each patient, a lateral cephalogram was taken before treatment (T1), immediately posttreatment (T2), and after an observation period (T3) averaging 2 years 5 months. Using analysis of variance, the cephalograms were analyzed to determine skeletal and dental changes resulting from treatment. Long-term changes (2 years 5 month observation period) were also evaluated. Results showed that immediately posttreatment, the maxilla moved anteriorly a mean of 1.54 mm and Sella-Nasion-A point increased 0.87°. The maxillary teeth moved anteriorly 2.73 mm and proclined 5.23°, while the mandible rotated in a downward and backward direction. Long-term, the anterior position of the maxilla was maintained, but some of the Class III correction was lost because of mandibular growth. Comparison of this study's results to Riolo's longitudinal Class I data showed that, overall, rapid palatal expansion and maxillary protraction produced a small orthopedic effect with a moderate dentoalveolar effect which together contributed to the correction of the Class III malocclusion. (Semin Orthod 1997;3:265-274.) Copyright © 1997 by W.B. Saunders Company

Class III malocclusions are considered to be among the most challenging orthodontic problems to treat. Class III malocclusions also have a strong genetic basis with an incidence of approximately 1% to 5% in Caucasian populations and as high as a 13% incidence in Asian populations.1-7

Studies of the multifactorial etiology of Class III malocclusions have shown that true maxillary skeletal retrusion is as common in a Class III malocclusion as mandibular prognathism. Studies on Class III individuals have reported that from 32% to as high as 63% of the patients with skeletal Class III malocclusions have a retruded maxilla or a combination of a retruded maxilla and excessive growth of the mandible.8-12

Enlow13 describes the typical Class III individual as showing a middle cranial fossa which is aligned in a backward and upward manner, resulting in the nasomaxillary complex being in a more retrusive position. The ramus in a Class III malocclusion is retruded.
Williams et al.

III skeletal pattern is often rotated forward with the upward and backward middle cranial fossa and a vertically short nasal region. The gonial angle in the Class III patient is more open, increasing the overall mandibular length, steepening the mandibular plane angle, and increasing the lower anterior facial height. The combination of these anatomic features together with dentoalveolar compensations (maxillary incisor proclination and mandibular incisor retroclination) contributes to the overall appearance of the Class III individual.

Treatment to correct or improve a developing Class III malocclusion has historically been directed at treating the mandible by controlling or retarding its growth. In some animal studies, the use of a posteriorly directed force on the mandible has resulted in an alteration in the growth of the mandible. However, the use of chincup therapy in human studies has shown variable and inconsistent mandibular growth changes. Several studies report no difference in mandibular growth between Class III patients treated with chincup therapy and untreated controls. The unpredictable nature of chincup therapy is even greater when the Class III malocclusion is due to maxillary retrusion. Protraction of the maxilla may be a more desirable treatment for the latter type of malocclusion.

Studies have documented that, with rapid palatal expansion (RPE) with a tooth-borne, banded appliance, the maxilla is affected in both the transverse dimension as well as in the anteroposterior dimension. These studies indicated that, as a result of RPE, point A moved anteriorly in most instances and in several cases moved inferiorly as well. Other rapid maxillary expansion studies, however, have failed to show any significant anterior movement of point A as a result of the maxillary expansion. The downward and forward displacement of the maxilla resulting from RPE has been shown to be minimized by the use of a bonded type palatal expansion appliance. Although reported displacements of the maxilla differ in the various palatal expansion studies, most agree that a disruption of the maxillary sutures may occur which might render the maxilla more responsive to anteriorly directed forces, an advantageous effect when treating a Class III malocclusion.

Following the promising outcomes of rapid maxillary expansion studies on Class III patients, interest moved to the effects of maxillary protraction, via extraoral anchorage, for the correction of developing Class III malocclusions. Maxillary protraction in animal studies has shown that the maxilla can be consistently moved anteriorly by means of heavy forces. Clinical studies, although few in number, have shown similar favorable results with most showing the maxilla to be moved anteriorly 2 to 3 mm or less.

Summarizing maxillary protraction studies, the maxilla moves anteriorly and often rotates in a counterclockwise direction, with the posterior nasal spine (PNS) moving inferiorly more than the anterior nasal spine (ANS). This vertical movement of the maxilla is accompanied by a clockwise rotation of the mandible, causing the chin to move downwards and backwards. The lower anterior facial height increases while the overbite decreases. The soft tissue profile may improve, with the nose and upper lip moving forward and the soft tissue chin either remaining relatively unchanged or moving downward and backward. Clinical studies have employed maxillary protraction in the late-mixed to early-permanent dentition stages of development in order to take maximum advantage of growth. Some studies have indicated that the orthopedic response may be greater if treatment is initiated at an even earlier age.

Purpose of the Study

A number of clinical studies have been performed documenting the initial and short-term response to maxillary expansion and protraction. Data on the long-term effects of maxillary protraction (longer than 6 months), are however, limited. The purpose of the present study was to evaluate not only the short-term treatment effects but also the long-term changes (more than 2 years after treatment) of rapid maxillary expansion with protraction facemask therapy commenced in mixed dentition patients with developing Class III malocclusions. This prospective study followed patients from pretreatment to as long as 3 years after maxillary protraction therapy.

Materials and Methods

Twenty-eight Class III Caucasian patients with ages ranging from 5 years 5 months to 13 years 0
months (mean age 8 years 3 months) treated in the office of a single orthodontist were used in this study. All patients had a negative dental overjet and were actively growing. There were 11 male and 17 female patients.

The maxillary expansion appliance was either a banded Hyrax-type palatal expansion device or a bonded palatal expansion device. The banded appliance consisted of bands fitted to the two permanent maxillary first molars and two deciduous maxillary first molars. The contralateral bands were connected together using a 0.04 in stainless steel wire with an expansion jack screw located at the midline. The bonded appliance differed from the banded appliance in that approximately 2 to 3 mm of acrylic was constructed on the occlusal and buccal surfaces of the teeth. The acrylic occlusal pads served to control the vertical dimension during expansion. The selection criteria on the choice of palatal expansion appliance type was based on the following:

1. The first criterion used in choosing a palatal expansion appliance was the pretreatment cephalometric lower anterior facial height. If no increase in the lower anterior facial height was desired, the bonded palatal expansion appliance was chosen. If an increase in the lower anterior facial height was desired, a banded palatal expansion appliance was used.

2. The second criterion used in choosing a palatal expansion appliance was the mandibular plane angle. If patients presented with cephalometric mandibular plane angles greater than 37°, the bonded palatal expansion appliance was used. Those patients with mandibular plane angles less than 37° were treated with a banded palatal expansion appliance.

During the expansion phase, patients were instructed to activate the expansion appliance twice daily (0.25 mm per activation) resulting in 0.50 mm of expansion per day. Patients were monitored weekly until the transverse discrepancy was corrected. However in most patients, the maxilla was overcorrected with the palatal cusps of the maxillary teeth over the buccal cusps of the mandibular teeth.

On the same day that the palatal expansion device was placed, a protraction headgear was fitted with elastics from the facemask attached to hooks located at the permanent maxillary first molars. A force of 28 oz per side was applied via elastics in a vector parallel to the occlusal plane. The patients were instructed to wear the facemask 14 hours per day. The protraction facemask therapy was continued until at least a positive dental overjet was achieved. The average duration of the protraction phase of treatment was 140 days (range 120 to 339 days). Over 80% of the patients were treated to a positive dental overjet in 150 days or less. Figure 1 illustrates a typical patient treated with rapid maxillary expansion and a protraction facemask.

Cephalometric Evaluation

Cephalometric radiographs were taken for each patient before the initiation of treatment (T1). A second radiograph was taken at the completion of the protraction phase of treatment (T2), and, finally, a third radiograph (T3) was taken after an observation period (range of 1 year 1 month to 4 years 2 months with a mean of 2 years 5 months). The overall net treatment effect was calculated by comparing the long-term radiographs (T3) with the initial radiographs (T1). In an attempt at assessing the effects of the therapy without the contributions of growth, comparisons were made with data provided by Riolo et al in Class I patients. The calculated mean growth of the Class I data was subtracted from the total change in the present study sample. Any change remaining was attributed to treatment. The shortcomings of using a Class I control in this way are recognized and these comparisons should be evaluated with caution.

The cephalometric analysis employed was previously described by Pancherz (1982), and the landmarks and measurements used are illustrated in Figures 2 and 3. All radiographs were hand traced on acetate paper and measured by a single examiner. A coordinate system or reference grid from which linear measurements were made was constructed for each patient’s pretreatment radiograph (T1) using the occlusal plane and occlusal plane perpendicular through Sella. This reference grid was then transposed to radiographs T2 and T3 by superimposing on line Sella-Nasion registering at Sella. Ten cephalometric radiographs were randomly selected and retraced in order to calculate the error of method.
The arithmetic mean and standard deviations (SD) were calculated for each cephalometric variable. Mean parameter changes were compared using repeated measures analysis of variance (ANOVA) to determine any statistical differences. Measurement comparisons were made between pretreatment (T1) and posttreatment (T2) to determine the effects of treatment. Comparisons between posttreatment (T2) and the long-term radiograph (T3) were made to determine changes that took place during the posttreatment observation period, and comparisons of the pretreatment radiograph (T1) to the long-term radiograph (T3) were made to evaluate the net change occurring after treatment and a period of observation. The sample was further analyzed for possible age-related and gender-related differences. The level of significance used was $P < .05$. Tracing error calculated by $t$-test and Pearson Correlation showed that the tracing method was not biased and that landmark identification was very consistent. Compari-
Results

Results were analyzed for skeletal and dental changes in both anteroposterior and vertical dimensions (Tables 1 and 2). Results are reported as immediate treatment responses (T1-T2) and long-term responses (T2-T3) and are separated into skeletal and dental changes.

The Immediate (T1-T2) Effects of Combined Rapid Palatal Expansion and Protraction Forces

Maxillary Skeletal Changes

Anteroposterior. The A point moved anteriorly an average of 1.54 mm (−2 to +3.5) and the angle Sella-Nasion-A point (SNA) increased by 0.87° (−3° to +3°), both measurements being statistically significant.

Vertical. The palatal plane measured to SN did not change as a result of treatment nor were there any changes in the linear measurements SN-PNS and SN-ANS. The occlusal plane to SN flattened from a mean of 19.15° to mean of 17.70°, a change of 1.45° (−6° to +7°).

Changes in the Maxillary Dentition

The maxillary incisor moved anteriorly an average of 2.73 mm (−2 to +8) and inferiorly an average of 1.15 mm (−1 to +7) as measured to the incisal edge. Both were statistically significant. Maxillary incisor angulation as measured to the line SN showed that the maxillary incisors tipped labially an average of 5.23° (−5° to +13°). All patients changed from a negative overjet to a positive overjet, an average change of 2.89 mm (−3 to +11), as measured from maxillary incisal edge to the mandibular incisal edge. The molars were corrected from a Class III relationship to a Class I relationship.

Mandibular Response to Maxillary Protraction

Anteroposterior. No significant change occurred in the SNB angle or the length of the mandible as measured from point Condylion (Co) to point Pogonion (Pg).

Vertical. Significant changes were observed in the mandibular plane angle which increased an average of 1.0° (−3° to +6°) from pretreatment (T1) to posttreatment (T2). The y-axis also increased an average of 1.18° (−4° to +11°). Both of these measurements reflect an opening or clockwise rotation of the mandible.
Table 1. Cephalometric Measurements, Means, and Standard Deviations for Pretreatment (T1) and Posttreatment

<table>
<thead>
<tr>
<th>Variable</th>
<th>T1</th>
<th>SD</th>
<th>T2</th>
<th>SD</th>
<th>PValue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sagittal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA (dg)</td>
<td>79.32</td>
<td>4.86</td>
<td>80.19</td>
<td>4.46</td>
<td>0.0046</td>
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<td>SNB (dg)</td>
<td>79.27</td>
<td>4.06</td>
<td>79.27</td>
<td>4.06</td>
<td>NS</td>
</tr>
<tr>
<td>ANB (dg)</td>
<td>-0.48</td>
<td>2.14</td>
<td>0.91</td>
<td>2.12</td>
<td>0.0043</td>
</tr>
<tr>
<td>WITS</td>
<td>-5.78</td>
<td>3.33</td>
<td>-3.84</td>
<td>2.36</td>
<td>0.0024</td>
</tr>
<tr>
<td>pg (ram)</td>
<td>83.31</td>
<td>5.06</td>
<td>83.81</td>
<td>5.79</td>
<td>NS</td>
</tr>
<tr>
<td>pg-co (ram)</td>
<td>84.63</td>
<td>11.5</td>
<td>84.63</td>
<td>11.31</td>
<td>NS</td>
</tr>
<tr>
<td>A point (mm)</td>
<td>74.62</td>
<td>2.87</td>
<td>76.17</td>
<td>3.24</td>
<td>0.0001</td>
</tr>
<tr>
<td>Max Incisor (mm)</td>
<td>79.94</td>
<td>4.48</td>
<td>82.67</td>
<td>4.68</td>
<td>0.0001</td>
</tr>
<tr>
<td>Mand Incisor (mm)</td>
<td>99.07</td>
<td>13.81</td>
<td>104.3</td>
<td>8.99</td>
<td>0.0084</td>
</tr>
<tr>
<td>Overjet (mm)</td>
<td>-1.09</td>
<td>1.97</td>
<td>1.8</td>
<td>2.49</td>
<td>0.0001</td>
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<tr>
<td>Max Molar (mm)</td>
<td>52.57</td>
<td>4.56</td>
<td>55.06</td>
<td>4.90</td>
<td>0.0003</td>
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<tr>
<td>Molar Molar (mm)</td>
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<td>4.32</td>
<td>56.87</td>
<td>4.47</td>
<td></td>
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<tr>
<td>Molar Relation (mm)</td>
<td>-3.74</td>
<td>2.65</td>
<td>-1.78</td>
<td>2.44</td>
<td>0.003</td>
</tr>
<tr>
<td>Vertical</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SN-PP (dg)</td>
<td>7.74</td>
<td>4.05</td>
<td>7.07</td>
<td>3.2</td>
<td>NS</td>
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<td>Occ P1-SN (dg)</td>
<td>19.15</td>
<td>3.58</td>
<td>17.7</td>
<td>2.96</td>
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<td>MP-SN (dg)</td>
<td>33.37</td>
<td>3.98</td>
<td>34.37</td>
<td>3.91</td>
<td>0.0227</td>
</tr>
<tr>
<td>y-axis (dg)</td>
<td>64.26</td>
<td>2.98</td>
<td>65.44</td>
<td>4.05</td>
<td>0.0105</td>
</tr>
<tr>
<td>ANS-Me (mm)</td>
<td>60.96</td>
<td>4.02</td>
<td>63.11</td>
<td>3.84</td>
<td>0.0001</td>
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<tr>
<td>SN-ANS (mm)</td>
<td>48.41</td>
<td>3.3</td>
<td>49.33</td>
<td>3.13</td>
<td>NS</td>
</tr>
<tr>
<td>SN-PNS (mm)</td>
<td>41.85</td>
<td>3.82</td>
<td>42.63</td>
<td>2.62</td>
<td>NS</td>
</tr>
<tr>
<td>Max Incisor-PP (mm)</td>
<td>24.15</td>
<td>2.16</td>
<td>25.3</td>
<td>2.49</td>
<td>0.0025</td>
</tr>
<tr>
<td>Mand Incisor-MP (mm)</td>
<td>36.56</td>
<td>2.12</td>
<td>37.44</td>
<td>2.1</td>
<td>0.0049</td>
</tr>
<tr>
<td>Max Molar-PP (mm)</td>
<td>18.93</td>
<td>2.09</td>
<td>20.56</td>
<td>2.49</td>
<td>0.0006</td>
</tr>
<tr>
<td>Mand Molar-MP (mm)</td>
<td>28.48</td>
<td>1.72</td>
<td>28.96</td>
<td>1.7</td>
<td>NS</td>
</tr>
<tr>
<td>Mand Incisor-OL (mm)</td>
<td>0.93</td>
<td>2.92</td>
<td>-0.5</td>
<td>2.67</td>
<td>0.0091</td>
</tr>
</tbody>
</table>

NOTE. Statistical differences present at P < .05.
Abbreviation: NS, not significant.

Mandibular Dental Changes Seen in Maxillary Protraction

No statistically significant changes were observed in the mandibular dentition in either the sagittal or vertical dimensions.

Maxillomandibular Relationships

*Anteroposterior.* The maxillomandibular relationships changed significantly. The ANB angle changed from a pretreatment (T1) mean of -0.48° to a posttreatment (T2) mean of 0.91°, a 1.39° (-3° to +4°) increase. Similarly, the WITS showed a trend toward a Class III correction with a change from -5.78 to -3.84, a difference of 1.94 (-2.9 to +13.3).

*Vertical.* Vertical changes in the lower anterior facial height observed by the measurement ANS-Menton (Me) showed an average increase of 2.15 mm (-5 to +5).

Long-Term Observation (T2-T3) Changes

In the time period from posttreatment (T2) to the end of the observation period (T3) no further orthodontic treatment was carried out. This observation period ranged from 1 year 1 month to 4 years 2 months with a mean of 2 years 5 months.

Long-Term Maxillary Skeletal Changes

*Anteroposterior.* The maxilla from posttreatment (T2) to the end of observation (T3) moved anteriorly at point A an average of 1.64 mm (-1.5 to +5.5). No significant change was observed in the angle SNA which increased only 0.14°. In the Class I sample of Riolo, the A point was observed to move anteriorly 2.55 mm over a 3-year period in similar age children.

*Vertical.* Point A moved inferiorly an average of 1.57 mm (-1 to +5). In addition, the anterior
maxilla (measured at ANS) and the posterior maxilla (measured at PNS) moved inferiorly 2.31 mm (−1 to +6) and 2.07 mm (−3 to +6), respectively. The angular measurements of line SN to palatal plane and line SN to occlusal plane showed no significant change.

### Long-Term Maxillary Dental Changes

**Anteroposterior.** The maxillary incisor, measured linearly from the occlusal line perpendicular to the incisal edge, showed anterior movement of 3.69 mm (−1 to +8). During the long-term observation period (T2-T3), the maxillary incisor angulation did not change. The overjet remained positive throughout the long-term observation period. The maxillary molar was observed to move anteriorly an average of 2.87 mm (−3 to +8), measured linearly from the occlusal line perpendicular to the mesial surface of the maxillary first molar. In Riolo’s Class I data over a 5-year time period, the upper incisor moved anteriorly 4.9 mm and proclined 1.35°.

**Vertical.** No significant vertical change occurred in the maxillary dentition during the observation period.

### Long-Term Changes in the Mandible

During the observation period (T2-T3), changes in the anteroposterior dimension of the mandible were observed. The angle SNB increased an average of 1.02° (−2° to +4°). Mandibular length as measured from point Co to point Pg increased 4.96 mm (+2 to +11). The mandibular plane angle decreased 1.48° from an average 34.37° at the end of protraction treatment to 32.89° at the end of the observation period. The y-axis also decreased, but only by 0.94° (−12 to +11) which was not statistically significant.

### Long-Term Changes in the Mandibular Dentition

**Anteroposterior.** The mandibular incisor was observed to move anteriorly an average of 4.29
mm (0 to +9) as measured from the occlusal line perpendicular to the incisal edge. Similarly, the mandibular first molar moved anteriorly an average of 4.45 mm (+1 to +9).

Vertical. The mandibular incisor and mandibular first molar moved superiorly 1.44 mm (-2 to +5) and 1.83 mm (0 to +7), respectively.

Maxillomandibular Relationships
The angle ANB decreased an average of 0.91° (-4° to +1°), reverting back towards a Class III skeletal relationship. This change was small but statistically significant. The WITS showed no significant change. The lower anterior facial height as measured from point ANS to point Me increased an average of 1.68 mm (-2 to +6).

Age and Sex Differences
The protraction facemask sample was analyzed for treatment effect differences between those patients younger than 8 years of age and those older than 8 years of age at the commencement of treatment. Analyses were also performed to determine any treatment effect differences between male and female subjects. Statistical results showed a trend toward slightly greater treatment effects in the older age group and in the male subjects. This finding was probably due to the small size of the age and sex subsamples, therefore definite conclusions should not be drawn.

Discussion
The ANOVA used for comparison of means in this study is an analysis of descriptive statistics. Because of the sample size and small standard deviations calculated for some of the variables analyzed, small differences between the means are reported to be statistically significant. Therefore, some of the changes in this study, even though shown to be statistically significant, may not be large enough to be noticeable in a clinical setting.

The results from the present study indicate statistically significant skeletal and dental changes after treatment with rapid maxillary expansion and protraction facemask when employing the descriptive statistical method previously described. All of the patients treated in this study were considered to be clinically successful in the short-term, with a Class I molar relationship at the end of treatment.

Analysis of the Class III correction from pretreatment (T1) to posttreatment (T2) showed both orthopedic and dental contributions. In the maxilla, the skeletal contributions to the Class III correction were observed through anterior movement of point A. When mean changes were calculated for the entire sample, A point was observed to move anteriorly 1.54 mm and SNA increased by 0.87°.

The remaining Class III correction was achieved by moderate dental movement. Measurements of the maxillary incisors showed a mean anterior movement of 2.73 mm and anterior proclination of 5.23°. Few statistically significant changes occurred in the mandible and mandibular dentition, but the changes which occurred further contributed to the Class III correction. The mandibular plane and the y-axis opened by 1.00° and 1.18°, respectively. Minor retroinclination of the mandibular incisors occurred but was not statistically significant. Superimposition and statistical analysis showed no significant rotation of the maxilla. This was evaluated by measuring the palatal plane (ANS-PNS) to line Sella-Nasion, which remained unchanged from pretreatment (T1) to posttreatment (T2).

The treatment effects from this study are consistent with those of previous studies, most showing statistically significant anterior movement of the maxilla, less than 2 mm, as well as an increase in the length of the maxilla from PNS to ANS.33,35-37,45-49 Dental changes, reported in previous studies, resulting from maxillary protraction were also similar to those found in the present study, indicating anterior movement and proclination of the maxillary incisors, and retroclination of the mandibular incisors.

The changes during the long-term observation period (T2-T3) indicated a trend toward a returning Class III pattern. While a small anterior displacement of the maxilla was observed (T2-T3), the mandible from posttreatment (T2) to the end of the observation period (T3) showed significant anterior movement as indicated by the increase in the SNB angle of 1.02° and pogonion 4.67 mm. The maxillo-mandibular growth discrepancy from posttreatment (T2) to the end of observation (T3) resulted in a decrease of the ANB angle by 0.91°. The change
RPE and Protraction Facemask in Class III Children

in WITS from -3.84 to -5.04, although not statistically significant, also indicated a tendency toward a returning Class III pattern. Of interest is that the anterior movement of the maxilla resulting from treatment was stable during the period of observation, and, in fact, the maxilla continued to move anteriorly after treatment (T2-T3), which can be attributed to normal growth after treatment. In addition, the mandibular plane angle and the y-axis closed from time T2 to time T3 by 1.48° and 0.94°, respectively, which also increased the projection of the mandible. The maxillary incisors showed further proclination but the positive overjet and overbite were maintained. The growth discrepancy was not of sufficient magnitude to result in a relapse to a negative overjet.

Comparison of the authors' results with the longitudinal cephalometric growth study by Riolo et al143 gives some possible indication of what changes can be attributed to growth and what can be attributed to treatment in a similar age group observed over a similar period of time. This type of comparison helps to differentiate growth from treatment, however, conclusions reached must be cautiously interpreted because the present study is one of a Class III sample whereas the averages of Riolo et al are for a Class I sample. Our study showed approximately 0.75 mm greater anterior movement of point A and a 0.68° greater increase in the angle SNA than the patients of Riolo et al of similar age and time period. Anterior movement of the upper incisor when compared with that of normal growth in the sample of Riolo et al showed that, with maxillary protraction, the maxillary incisor was advanced anteriorly 1.52 mm and proclined 7.1° more than would be expected with growth alone. Changes in the mandibular position as measured by the angle SNB showed no difference between the treated Class III group and the untreated Class I group. Overall vertical changes in the maxillary dentition were also similar to those of the untreated Class I control.

Conclusions

1. It is reasonable to assume from the results of this study, that correction of a Class III malocclusion with a negative overjet of 4 to 5 mm or more may be outside the range of successful treatment outcome with rapid maxillary expansion and protraction facemask. This conclusion is arrived at through the mean dental and skeletal changes. This does not necessarily mean that treatment in children with a negative overjet greater than 5 mm is contraindicated.

2. No conclusions could be arrived at as to whether the effects of RPE with protraction facemask are age related or gender related.

3. The effects of maxillary protraction appear to be stable. The return to a Class III pattern was primarily because of mandibular growth rather than relapse of treatment directed at the maxilla.

References

16. Janzen EK, Bluher JA. The cephalometric, anatomic, and histologic changes in Macaca mulatta after continuous-