COMMENTARY

Managing the developing Class III malocclusion with palatal expansion and facemask therapy

Patrick K. Turley, DDS, MSD, MEd
Santa Monica, Calif

One of the most significant changes in the area of early treatment in recent decades concerns managing the developing Class III malocclusion. Twenty-five years ago, early intervention for Class III malocclusion was not common in the United States. Management usually involved chincup appliances to restrain mandibular growth, camouflage techniques to advance maxillary incisors and retract mandibular incisors, or waiting until growth ceased to pursue orthognathic surgery. The development and refinement of maxillary protraction with facemask and palatal expansion have provided a predictable and effective approach to managing treatment that was once considered difficult.

Most patients with developing Class III malocclusions display anteroposterior and vertical maxillary deficiency with a normal to slightly protruded mandible and average to deep overbite.[1-3] These patients are managed well with maxillary expansion and facemask therapy. Although this approach has been described as maxillary protraction, the correction occurs by a combination of skeletal and dental movements in both the anteroposterior and vertical planes of space.[4] A large range of responses is reported in the literature, with some articles noting significant maxillary advancement and others reporting minimal or no change with treatment.[5-17] This disparity in response might be due to variations in treatment protocol including the design of appliances, the number of hours worn per day, and the overall treatment time. Although the average maxillary advancement in our study was 3.3 mm, 6 of 21 patients showed maxillary advancement from 5 to 8 mm.[4] Similarly, when the average SNA change was 2.35°, 5 of 21 patients showed SNA changes of 4° to 5°. Mandibular clockwise rotation accounted for 25% of the total correction, as did anterior maxillary tooth movement (20%-25%).

Private practice.
Reprint requests to: Patrick K. Turley, 1260 15th St, Suite 812, Santa Monica, CA 90404; e-mail, ppcr@ucla.edu.
Submitted, May 2002; revised and accepted, May 2002.
Am J Orthod Dentofacial Orthop 2002;122:349-52

0889-5406/2002/$35.00 + 0 **8/1/127295**
doi:10.1067/mod.2002.127295

Facemask treatment timing

Only recently has the question of optimal timing for facemask therapy been addressed. Controlled studies on Class II treatment suggest that results can be obtained over a wide range of ages in a child's development and that little is to be gained from timing growth modification treatment to a particular stage of maturation.[18-21] Without referencing any studies, however, some of these authors suggested that there is a small window of opportunity for treating the young Class III patient.[22] Baik[6] examined this question using the records of 47 Korean children divided into 3 groups: less than 10 years of age, 10 to 12 years, and 12 years and older. No statistically significant difference was found among the 3 groups with the Kruskal-Wallis test. The authors stated, however, that "the number in each group was not enough to evaluate the accurate effects according to age." Sung and Baik[15] subsequently evaluated the effect of maxillary protraction in 129 subjects with Class III malocclusion. The patients were divided into 6 age groups from ages 7 to 12, and comparisons were made for treatment effects. The results showed that the amount of skeletal change among the groups was not statistically significant.

Merwin et al[23] examined 30 patients divided into 2 groups, 5 to 8 years of age and 9 to 12 years, treated with maxillary expansion and protraction. Cephalometric changes were similar between the 2 age groups, suggesting that a similar skeletal response can be expected in patients in either the early or the late mixed dentition. Several studies, however, have shown a trend for greater orthopedic change in younger children. Baccetti et al[5] examined the differences in early vs late treatment in 2 groups of children treated with bonded maxillary expanders and facemasks. The younger group showed significantly greater advancement of maxillary structures and significantly more upward and forward direction of condylar growth after treatment. A

subsequent examination of this sample using Bookstein's shape–coordinate and tensor analysis confirmed that treatment produced more favorable size and shape changes in the maxilla and the mandible in the early mixed dentition group.[24]

Suda et al[25] hypothesized that evaluating bone age with hand-wrist radiographs would help to determine the optimal timing for maxillary protraction. Thirty Japanese patients treated with maxillary lingual arch, reverse pull headgear, and active chincup were compared with 30 patients treated with lingual arch, chincup, or both. Each group was divided into younger and older subgroups to examine the effect of early treatment. Younger boys showed greater maxillary advancement than older boys. The SNA angle increased more in boys who were less skeletally mature than the girls. Although these appliances and treatment effects are different from facemask and palatal expansion treatment, the results suggest that earlier treatment, as determined by bone age, might produce more favorable results.

To further address the question of optimum treatment timing, we examined 63 patients treated with banded/jackscrew palatal expanders and facemasks.[9] Three groups were studied: 4 to 7 years (n = 15), 7 to 10 years (n = 32), and 10 to 14 years (n = 16). The younger children (4 to 7 years) showed statistically greater increases in the SNA angle than did the 7-to-10-year olds. The youngest group also showed almost twice the change in SNA as the older group (10-14 years), although the difference was not statistically significant. All other changes were similar among the groups.

Analysis of the changes in anatomic landmarks using the X-Y coordinate system demonstrated greater movement at Point A in the youngest children than in the middle group. There also was less clockwise rotation of the mandible in the younger children. Measurements along the functional occlusal plane demonstrated greater apical base change, and greater molar and overjet correction in the younger (4-7 years) versus the older (10-14 years) children. The middle children (7-10 years) also showed greater apical base change and molar correction than did the older children. The results of this study suggest that earlier treatment produces a more favorable result; however, the older children did demonstrate significant treatment effects, indicating that orthopedic changes can be obtained in the 10-to-14-year age group. Similar results have been reported by Saadia and Torres,[26] who examined 112 patients divided similarly into 3 age groups. Their results were obtained faster and with fewer hours of appliance wear per day in the younger children.

Stability of facemask therapy

Little is known about the stability of facemask therapy, and the few published studies are of short duration and present varying results. Wisth et al[27] investigated the posttreatment growth of 22 children treated with facemask and quad-helix, and compared them with 40 Class I controls. During the posttreatment period, changes in the maxilla, the mandible, and the overbite were not statistically different from the controls. These results suggest that growth is normalized after facemask therapy. Other studies, however, suggest that patients treated with facemasks resume a Class III pattern of growth after treatment. McGill[28] evaluated posttreatment changes in 29 patients treated with facemasks and bonded expanders. The patients were retained with 3-way sagittal appliances or passive acrylic plates. During the 13.7-month observation period, they showed a decrease in overjet because of less-than-average maxillary growth and slightly increased mandibular growth. Chong et al[7] examined 16 patients treated with facemasks and labiolingual appliances or bonded palatal expanders. Posttreatment growth, averaging 3.6 years, was compared with 13 untreated matched Class III controls. No differences were found between the treated patients and the Class III controls during the posttreatment observation period, although some reduction in overjet occurred in the treated group. Shanker et al[29] compared 25 Chinese children treated with maxillary protraction/hyrax expansion with untreated Class III patients matched for age, sex, and race. No significant differences were found in the horizontal or the vertical movement of Point A during the 12-month observation period. These latter studies suggest that patients treated with facemasks continue to grow similarly to Class III patients after treatment.

To further investigate posttreatment growth, we examined the records of 24 Class III patients treated with custom facemasks and banded palatal expanders.[30] Posttreatment growth of 2.3 years was compared with 2 untreated control samples, Class I (n = 24) and Class III (n = 27). When the Class I and Class III untreated patients were compared, the Class III patients showed less maxillary growth measured at Point A (0.4 vs mm) and greater forward movement of the mandible (1.6 mm vs 0.6 mm). After facemask therapy, the maxilla grew the same as in the untreated Class III patients, but less than in the Class I patients (0.4 vs 1.0 mm). Mandibular growth was similar in all groups. Although growth reverted to a Class III pattern, all patients showed positive overjet when examined 2.3 years after treatment.

Gallagher et al[8] showed similar posttreatment responses in a sample of 22 children treated with palatal

expansion and facemask. During the 17-month posttreatment observation period, maxillary growth was less than in the Class I controls, whereas mandibular growth was similar to the controls. Ngan et al[12] examined patients at 4 years posttreatment and observed greater relapse tendencies. Fifteen of 20 patients maintained a positive overjet or end-to-end relationship; 5 reverted to anterior crossbite.

These studies suggest that facemask therapy does not normalize growth but, rather, that treated patients resume a Class III growth pattern, characterized primarily by deficient maxillary growth. Although a longer follow-up period is needed, the data support the practice of overcorrection to compensate for deficient posttreatment maxillary growth.

Benefits of palatal expansion

Palatal expansion has been advocated as a routine part of Class III correction with facemask therapy.[31-33] The benefits of palatal expansion might include expansion of a narrow maxilla and correction of posterior crossbite, increase in arch length, bite opening, loosening or activation of circummaxillary sutures, and initiating downward and forward movement of the maxillary complex. Haas[34] showed that maxillary expansion always moves the maxilla down and often moves it forward. These findings have been supported by others.[35-37] Clinicians have advocated maxillary expansion a week before starting facemask use, even without maxillary constriction or crowding. Critical evaluation of the benefits of expansion, however, have been limited. We initiated a randomized clinical trial to examine the effects of palatal expansion on maxillary protraction.[38] One group was treated with facemasks and active palatal expansion, the other with facemasks and passive expansion appliances. The results of this study showed no differences between the expansion and the nonexpansion groups in any cephalometric variable, in overall treatment time, or in the time for initial crossbite correction. The results suggest that without other reasons for expansion, such as maxillary width or space deficiency, expansion does not significantly aid in Class III correction.

Timing of phase 2 orthodontics

Although optimal timing for phase I therapy is important, another important question is when to begin definitive phase II orthodontic treatment. Starting treatment after the permanent second molars have erupted allows the practitioner to evaluate posttreatment growth and to minimize the duration of fixed appliance therapy. Later development in boys, especially, cautions against treating too early. It is not unusual to see an 11-year-old boy with all his permanent teeth erupted; with 2 more years of orthodontics, his treatment will then finish at age 13 to 13.5 years, just when he will enter his pubertal growth spurt. Most orthodontists have seen such a patient grow into a Class III relationship after treatment, even when he initially was not obviously Class III. For these reasons, I prefer to postpone definitive orthodontics in boys as long as possible.

In addition to the difference in maturation time between boys and girls, there might be other reasons why boys show a greater relapse tendency. Latent mandibular growth seems to be the main cause of posttreatment relapse. Björk and Helm[39] showed that condylar growth continues for approximately 2 years after sutural growth of the maxilla has ceased, and even after growth in height has ceased. Behrents[40] examined changes in the craniofacial complex in adults and showed that growth in the maxilla and the mandible actually continues throughout life in varying amounts and directions. Men show greater condylar growth than women, and both show more mandibular than maxillary growth. Not only do men show more condylar growth, but the direction of growth is different from women, who show primarily a vertical descent of the mandible. Men show a much greater anterior movement of the mandible, which might lead to a greater relapse tendency.[40]

CONCLUSIONS

Although our knowledge about Class III treatment with facemask and maxillary expansion has increased substantially in recent years, much remains to be learned. Studies show that facemask and palatal expansion therapy is an effective method for treatment, and, although earlier intervention might provide a better orthopedic response, treatment in the late mixed or early permanent dentition can produce positive results. Both early and late orthodontic treatment are associated with compromises that should be anticipated by the practitioner. Although the benefits of starting early appear compelling, earlier intervention increases the overall time the patient will be in treatment, especially if a middle phase for crowding or relapse tendencies is needed before full banded orthodontics. Patient compliance is much better in younger children, however, with most of them achieving overcorrection in less than a year. Overcorrection is recommended, because, after treatment, these patients grow similarly to untreated Class III patients. With overcorrection, treatment in the short term (2-3 years) shows good stability, with few patients requiring later facemask therapy. On the other hand, some patients might need continued facemask therapy even during phase II treatment. Currently, we

lack long-term data to answer the many questions that continue to plague orthodontists in regard to the long-term stability of facemask therapy.

REFERENCES

1. Hopkin GB. Craniofacial pattern in mesio-occlusion. Nederlandse Verein Orthod Stud; 1965. p. 81-105.
2. Hopkin GB, Houston WJB, James GA. The cranial base as an aetiological factor in malocclusion. Angle Orthod 1968;38:250-5.
3. Mouakeh M. Cephalometric evaluation of craniofacial pattern of Syrian children with Class III malocclusion. Am J Orthod Dentofacial Orthop 2001;119:640-9.
4. Nartallo-Turley PE, Turley PK. Cephalometric effects of combined palatal expansion and facemask therapy on Class III malocclusion. Angle Orthod 1998;68:217-24.
5. Baccetti T, McGill JS, Franchi L, McNamara JA Jr, Tollaro I. Skeletal effects of early treatment of Class III malocclusion with maxillary expansion and face-mask therapy. Am J Orthod Dentofacial Orthop 1998;113:333-43.
6. Baik HS. Clinical results of the maxillary protraction in Korean children. Am J Orthod Dentofacial Orthop 1995;108:583-92.
7. Chong YH, Ive C, Artun J. Changes following the use of protraction headgear for early correction of Class III malocclusion. Angle Orthod 1996;66:351-62.
8. Gallagher W, Miranda F, Buschang PH. Maxillary protraction: treatment and posttreatment effects. Am J Orthod Dentofacial Orthop 1998;113:612-9.
9. Kapust AJ, Sinclair PM, Turley PK. Cephalometric effects of face mask/expansion therapy in Class III children: a comparison of three age groups. Am J Orthod Dentofacial Orthop 1998;113:204-12.
10. Kiliçolu H, Kirliç Y. Profile changes in patients with Class III malocclusions after Delaire mask therapy. Am J Orthod Dentofacial Orthop 1998;113:453-62.
11. Mermigos J, Full CA, Andreasen G. Protraction of the maxillofacial complex. Am J Orthod Dentofacial Orthop 1990;98:47-55.
12. Ngan PW, Hägg U, Yiu C, Wei SHY. Treatment response and long-term dentofacial adaptations to maxillary expansion and protraction. Semin Orthod 1997;3:255-64.
13. Pangrazio-Kulbersh V. Effects of protraction mechanics on the midface. Am J Orthod Dentofacial Orthop 1998;114:484-91.
14. da Silva OG, Magro AC, Capelozza L. Early treatment of the Class III malocclusion with rapid maxillary expansion and maxillary protraction. Am J Orthod Dentofacial Orthop 1998; 113:196-203.
15. Sung SJ, Baik HS. Assessment of skeletal and dental changes by maxillary protraction. Am J Orthod Dentofacial Orthop 1998; 114:492-502.
16. Williams MD, Sarver DM, Sadowsky PL, Bradley E. Combined rapid maxillary expansion and protraction facemask in the treatment of Class III malocclusions in growing children: a prospective long term study. Sem Orthod 1997;3:265-74.
17. Wisth J. Mandibular function and dysfunction in patients with mandibular prognathism. Am J Orthod 1984;85:193-8.
18. Tulloch JFC, Philips C, Proffit WR. Benefit of early Class II treatment: progress report of a 2-phase randomized clinical trial. Am J Orthod Dentofacial Orthop 1998;113:62-72.
19. Keeling SD, Wheeler TT, King GJ, Garvan CW, Cohen DA, Cabassa S, et al. Anteroposterior skeletal and dental changes after early Class II treatment with bionators and headgear. Am J Orthod Dentofacial Orthop 1998;113:40-50.
20. Ghafari J, Shofer FS, Jacobsson-Hunt U, Markowitz DL, Laster LL. Headgear versus function regulator in the early treatment of Class II, Division I malocclusion: a randomized clinical trial. Am J Orthod Dentofacial Orthop 1998;113:51-61.
21. Bishara SE. Facial and dental changes in adolescents and their clinical implications. Angle Orthod 2000;70:471-83.
22. Proffit WR. Contemporary orthodontics. 2nd ed. St. Louis: Mosby; 1993.
23. Merwin D, Ngan P, Hägg U, Yiu C, Wei SH. Timing for effective application of anteriorly directed orthopedic force to maxilla. Am J Orthod Dentofacial Orthop 1997;112:292-9.
24. Franchi L, Baccetti T, McNamara JA Jr. Shape-coordinate analysis of skeletal changes induced by rapid maxillary expansion and facial mask therapy. Am J Orthod Dentofacial Orthop 1998;114:418-26.
25. Suda N, Suzukl MI, Hirose K, Hiyama S, Suzuki S, Kuroda T. Effective treatment plan for maxillary protration: is the bone age useful to determine the treatment plan? Am J Orthod Dentofacial Orthop 2000;118:56-62.
26. Saadia M, Torres E. Sagittal changes after maxillary protraction with expansion in Class III patients in the primary, mixed, and late mixed dentitions: a longitudinal retrospective study. Am J Orthod Dentofacial Orthop 2000;117:669-80.
27. Wisth PJ, Tritapunt A, Rygh P, Boe OE, Norderval K. The effect of maxillary protraction on front occlusion and facial morphology. Acta Odontol Scand 1987;45:227-37.
28. McGill J. Orthopedic alteration induced by rapid maxillary expansion and facemask therapy [thesis]. Ann Arbor: University of Michigan; 1995.
29. Shanker S, Ngan P, Wade D, Beck M, Yui C, Ilägg IJ, et al. Cephalometric A point changes during and after maxillary protraction and expansion. Am J Orthod Dentofacial Orthop 1996;110:423-30.
30. MacDonald KE, Kapust AJ, Turley PK. Cephalometric changes after the correction of Class III malocclusion with maxillary expansion/facemask therapy. Am J Orthod Dentofacial Orthop 1999;116:13-24.
31. McNamara JA. An orthopedic approach to the treatment of Class III malocclusion in young patients. J Clin Orthod 1987;21:598-608.
32. Turley PK. Orthopedic correction of Class III malocclusion with palatal expansion and custom protraction headgear. J Clin Orthod 1988;22:314-25.
33. Turley PK. Orthopedic correction of Class III malocclusion: retention and phase II therapy. J Clin Orthod 1996;30:313-24.
34. Haas AJ. Rapid expansion of the maxillary dental arch and nasal cavity by opening the mid–palatal suture. Angle Orthod 1961; 31:73-90.
35. Wertz RA. Skeletal and dental changes accompanying rapid midpalatal suture opening. Am J Orthod 1970;58:41-66.
36. Wertz RA. Midpalatal suture opening: a normative study. Am J Orthod 1977;71:367-81.
37. da Silva OG, Boas MCV, Capelozza L. Rapid maxillary expansion in the primary and mixed dentition: a cephalometric evaluation. Am J Orthod Dentofacial Orthop 1991;100:171-81.
38. Vaughn G, Mason B, Moon H-B, Turley PK. The effects of maxillary protraction therapy with or without rapid palatal expansion: a prospective, randomized clinical trail [abstract]. J Dent Res 2001; 80 SI:541(0117).
39. Björk A, Helm S. Prediction of the age of maximum pubertal growth in body height. Angle Orthod 1967;37:134-43.
40. Behrents RG. Growth in the aging craniofacial skeleton, Monograph 17. Craniofacial Growth Series. Ann Arbor: Center for Human Growth and Development; The University of Michigan; 1985.