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Six Keys to Nonextraction Treatment

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Over the past 20 years, there has been an increase in the percentage of nonextraction cases in the average orthodontic practice, which now stands as high as 80%.[1] There are many reasons for this trend.

Mid-arch extractions can compromise facial esthetics, especially in patients with concave profiles.[2,3] The treatment plan must allow for post-treatment facial growth,[4] including the tendency for the noses and chins of young adults to grow more forward than their lips.[5] Today's patients prefer a broader smile,[6] which means we need to leave the dentition fuller after treatment.[5]

Nonextraction treatment techniques and the skills of the orthodontist are constantly improving. In the past, an overjet may have been treated by removal of the first premolars and retraction of the anterior teeth. Headgear, with its inherent compliance problems, may have been used for distalization. Now, orthodontists can consider a variety of functional appliances or mandibular surgery to bring the lower jaw forward. Expanding the maxillary arch then provides more space for the dentition, and there is no need for overjet reduction.[7,8]

When patients are aware that there is a choice between a nonextraction and extraction treatment, they naturally prefer not to have healthy teeth extracted. This article presents my six keys to successful nonextraction treatment, along with several cases to illustrate them.

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First Key: Leeway Space

Leeway space of as much as 7mm in the lower arch and 5mm in the upper arch becomes available when the second deciduous molars exfoliate and the second premolars erupt.[9] To capture this space, it is best to fit an appliance such as a lip bumper, lingual arch, or palatal bar before the second deciduous molars exfoliate. Dugoni has shown that more stable results can be achieved by using leeway space than by extracting premolars.[10]

Second Key: Mesial Molar Rotations

As many as 70% of all malocclusions have mesial molar rotations,[11] which are responsible for a high percentage of Class II molar relationships. A digital sucking habit can cause the molars to rotate around their palatal roots, while the upper teeth are tipped forward and the arch narrows. A rotated upper first molar may occupy 12mm of mesiodistal width, compared to 10mm for a properly oriented first molar. Correcting the molar rotations not only increases the available space, but also changes the archform from a tapered "V" shape to a "U" shape, providing extra space for overjet reduction.

Third Key: Passive Uprighting

Passive uprighting occurs when the constrictive forces of the lips and cheeks are removed and lingually inclined teeth are allowed to upright spontaneously. Studies have shown that as much as a 4mm increase in arch width can be achieved with lip bumpers or Fränkel appliances.[12-15] Because the teeth will not move spontaneously through cortical bone, many clinicians believe this kind of expansion is more stable. The best time for such treatment is in the late mixed dentition, so that the erupting permanent teeth are encouraged to move into a wider archform before

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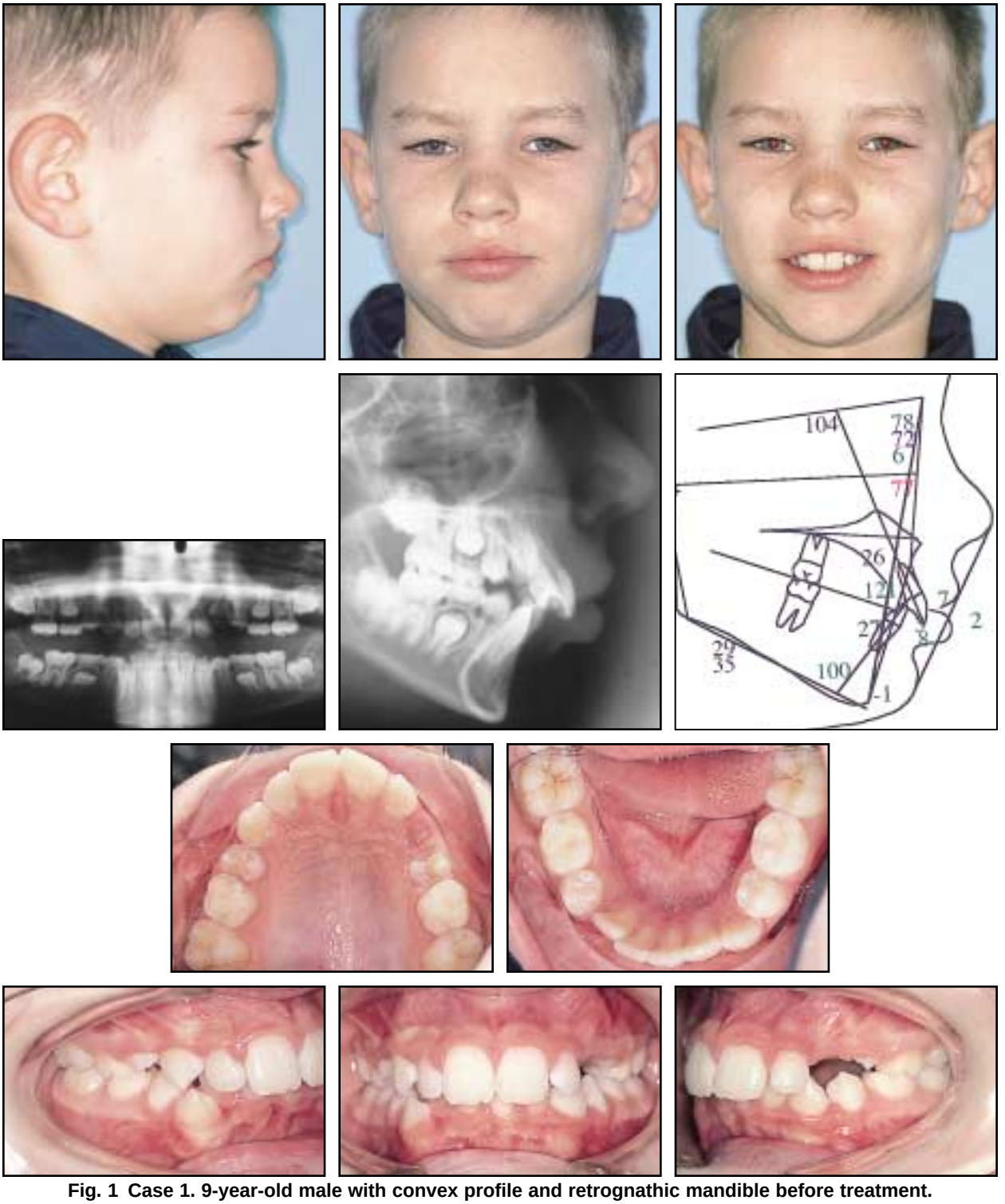

Fig. 1 Case 1. 9-year-old male with convex profile and retrognathic mandible before treatment.

they become locked into occlusion.[4] This also meets today's esthetic demand for a broader smile.[6]

Fourth Key: Active Uprighting

Once the teeth are locked into an established malocclusion, passive uprighting can be

Fig. 2 Case 1. Upper transpalatal bar and lower lip bumper in place.

Fig. 3 Case 1. Removable appliance and headgear used to distalize upper first molars.

problematic. In such a case, an expander may be needed for uprighting. To avoid relapse, it is important that the teeth not be tipped excessively.

Fifth Key: Distal Movement

Although it is relatively easy to move teeth distally into upright positions or to tip them distally, bodily distal movement is difficult to achieve without adverse side effects, and can also be demanding on the patient. It is easier to move first molars distally than to move both first and second molars distally, but if the lower second molars have erupted, their interference may hinder efficient movement of the upper first molars.

Tooth movement is best achieved with constant force. Younger patients are generally more cooperative with headgear wear[16-18]; since it is impractical to expect a headgear to be worn 24 hours a day, however, a removable appliance such as an ACCO should be worn simultaneously to provide continuous pressure.[11,19] In the future, the use of skeletal anchorage for distal movement may become more common.[20]

Sixth Key: Skeletal Modification

There is considerable controversy concerning how functional appliances actually work, but their value in correcting a full-unit Class II malocclusion is well recognized.[21-24] Proper use of functional appliances reduces the need for extractions.[7,8] Alternatively, orthognathic surgery that brings the lower jaw forward to correct the overjet and improve the facial profile is a common nonextraction strategy in most orthodontic practices.

Case 1

A 9-year-old male presented because his mother was concerned about his prominent teeth. Clinical examination revealed a convex profile with a retrognathic mandible (Fig. 1). The patient's lower lip was everted, in association with an overjet of 7mm and a deep overbite, and his lower midline was deviated to the right. The panoramic radiograph revealed the presence of all permanent teeth except the third molars. The patient's second deciduous molars were wide mesiodistally, and the upper first molars showed mild mesial rotations. The lower right canine was crowded out of the arch.

The treatment objectives were to capture leeway space in both arches, move the first molars distally into an overcorrected Class I relationship, align the dentition, and correct the overjet, overbite, and midlines. A transpalatal bar was inserted initially to resolve the mesial upper molar rotations, and a lower lip bumper was placed from first molar to first molar (Fig. 2).

A removable appliance worn 24 hours a day, supported by a headgear worn 10 hours a day, was used to distalize the upper first molars (Fig. 3). An elastic was attached to the Kloehn facebow from cuspid hook to cuspid hook, pass-

Fig. 4 Case 1. Cross-elastics and Class III elastics worn with headgear to correct midlines.

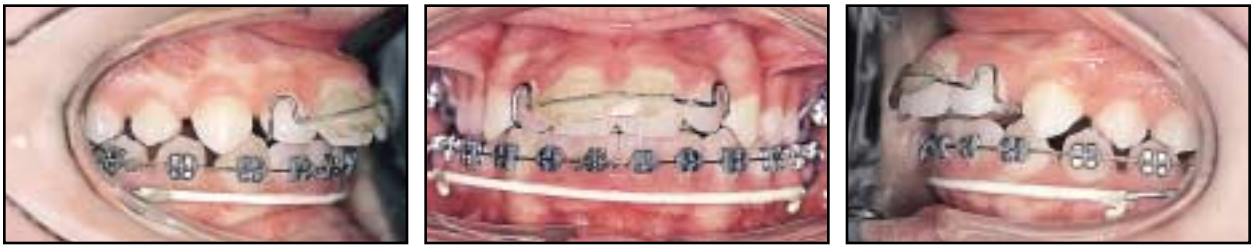

Fig. 5 Case 1. Lower .019" × .025" stainless steel archwire in place after 15 months of treatment.

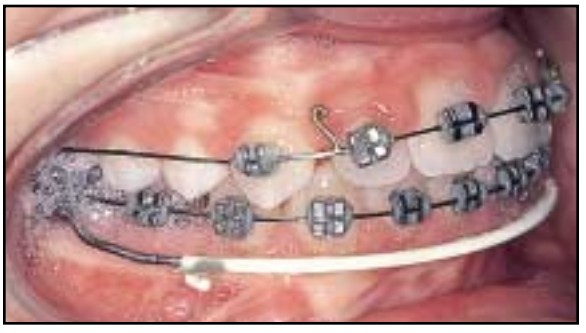

Fig. 6 Case 1. Upper .019" x .025" stainless steel wire with slightly exaggerated curve of Spee worn with Alastiks to correct overjet and close space.

Fig. 7 Case 1. Finishing archwires in place.

ing under the acrylic on the labial bow, to prevent loss of anchorage.

Four months later, when the upper first molars had been distalized sufficiently, the clasps on the removable plate were cut and the teeth were allowed to drift distally. After another five months, the lower arch was bonded with .022" Roth-prescription brackets, and an .014" nickel titanium archwire was inserted. Light cross-elastics and Class III elastics from the cuspid hooks and first molars were worn only with the headgear to correct the midlines (Fig. 4).

Another six months later, the overbite was reduced, the lower arch was leveled, and the midlines were corrected. The lower archwire was changed to .019" × .025" stainless steel, with the lip bumper remaining as an anchor unit (Fig. 5).

The upper anterior teeth were then bonded, and an .018" nickel titanium archwire was placed. This was followed by an .019" × .025" stainless steel wire with a slightly exaggerated curve of Spee, worn with Alastiks* to correct the overjet and close space (Fig. 6). The premolars were not bracketed at this stage to prevent archwire binding as the overjet was reduced.

The entire maxillary arch was bonded for finishing (Fig. 7). The patient wore elastics from the soldered archwire hooks to the first molars, in conjunction with the headgear. After 26 months of treatment, fixed appliances were removed and retainers fitted (Fig. 8). Post-treatment analysis showed that more than 4mm of leeway space had been gained in the upper arch, and more than 6mm in the lower.

Case 2

This 11-year-old patient's mother was con-

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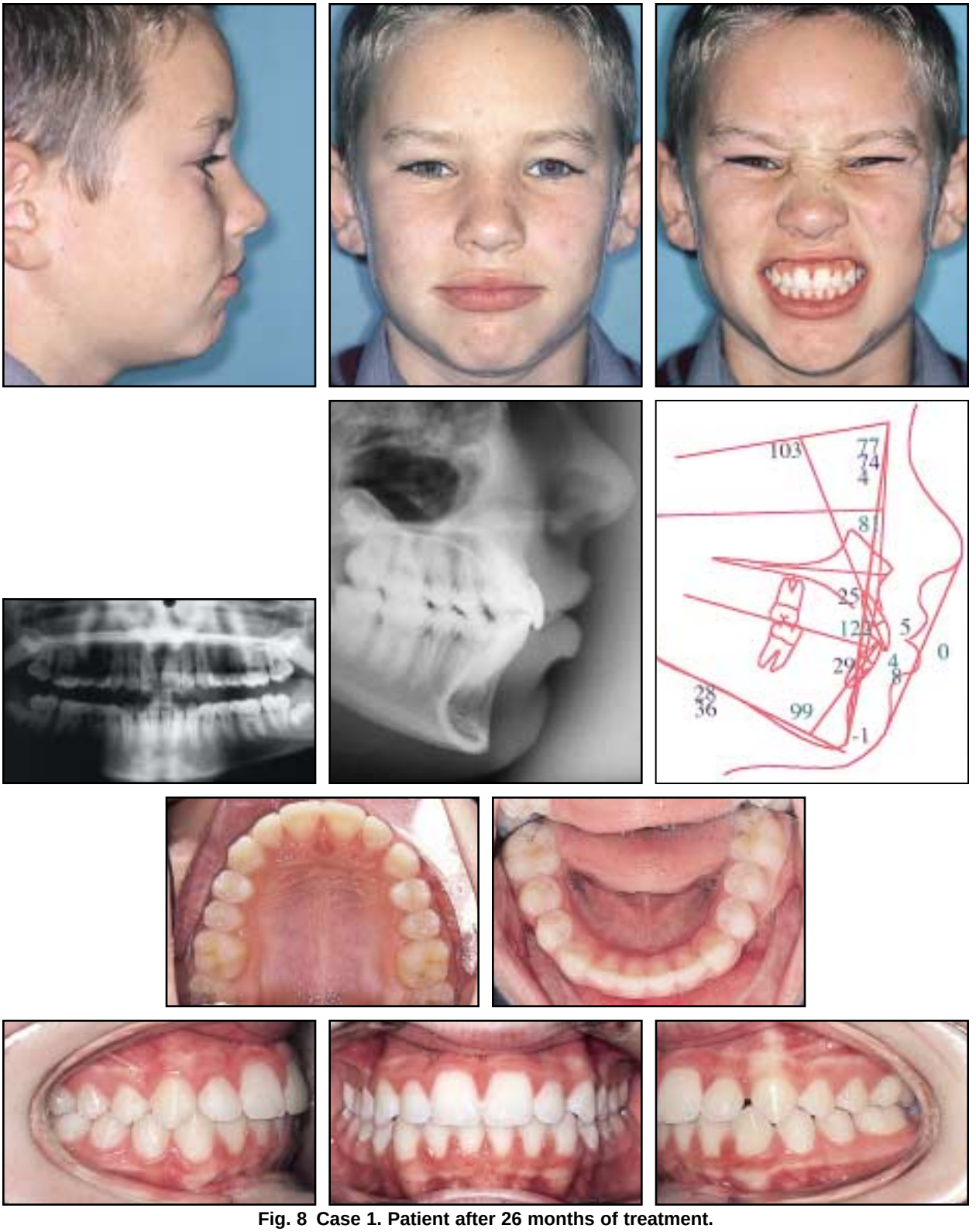

Fig. 8 Case 1. Patient after 26 months of treatment.

cerned about her daughter's overcrowding. The patient had a narrow smile with poor lip support, and her profile was flat to concave (Fig. 9). She had a Class II buccal occlusion with a slightly excessive overbite; the upper midline was deviated to the left, and the lower to the right. There was severe crowding, with the upper left canine impacted in the line of the arch, and both arches

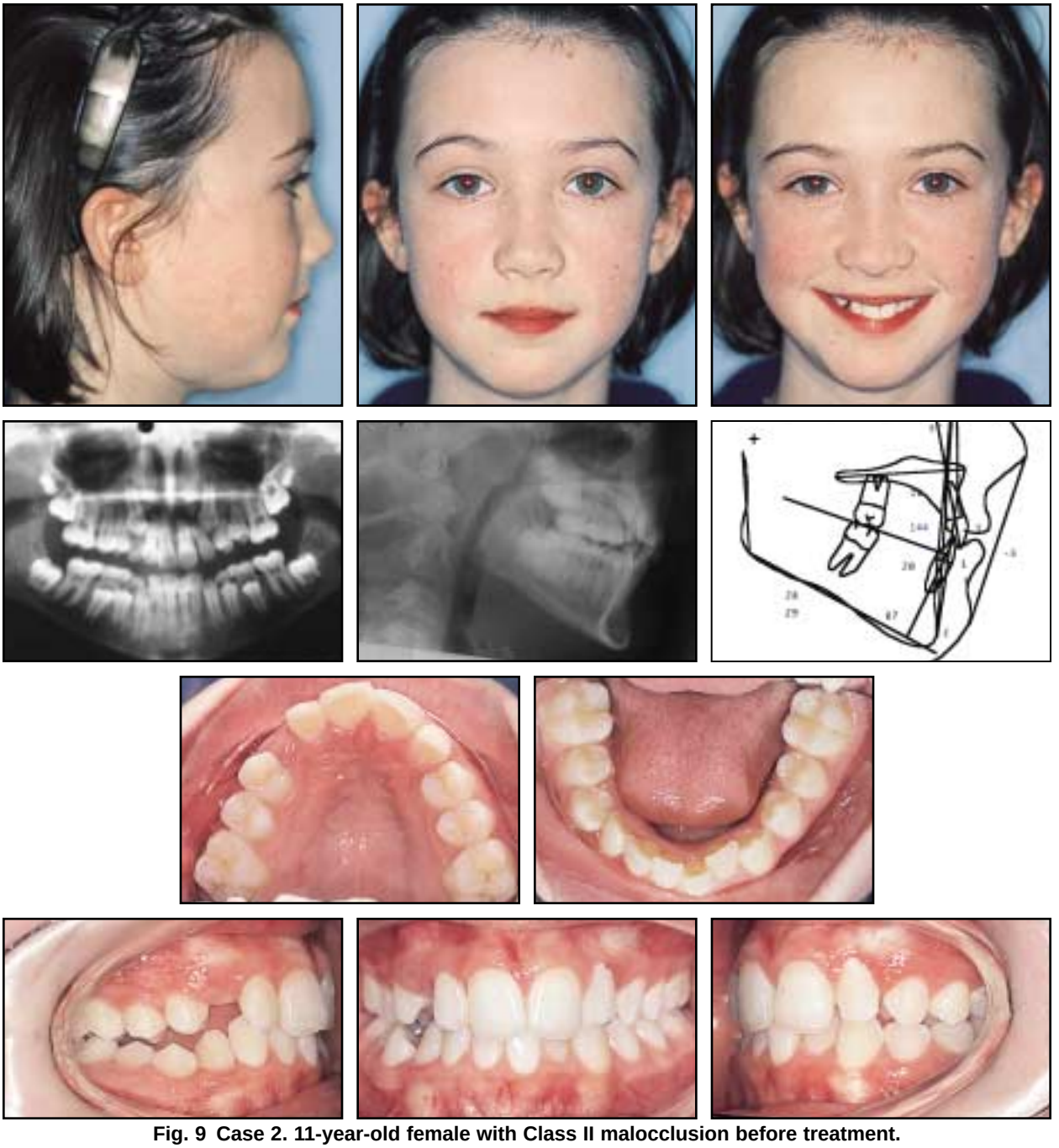

Fig. 9 Case 2. 11-year-old female with Class II malocclusion before treatment.

were constricted. The buccal and labial segments were lingually inclined. A panoramic radiograph showed that all permanent teeth were present except the third molars.

Considering the patient's narrow smile and poor lip support, we felt a nonextraction ap-

Fig. 10 Case 2. Upper removable appliance, supported by headgear, and lower lip bumper in place.

Fig. 11 Case 2. After eight months of treatment, before removal of right first premolar clasp.

proach would produce the most esthetic facial results. Passive and active uprighting would be used to correct the lingually inclined teeth and to increase arch length and width.

The four first molars were banded; a transpalatal bar was fitted in the upper arch, and a lip bumper in the lower. The upper right first molar rotation was corrected first, followed by the upper left first molar. After three months, an upper removable appliance was placed, supported by headgear, to distalize and upright the first molars (Fig. 10). Elastics from the cuspid hooks of the Kloehn facebow were used to control forward movement of the upper anterior teeth. Class

Fig. 12 Case 2. Occlusion after four months of drifting and passive uprighting.

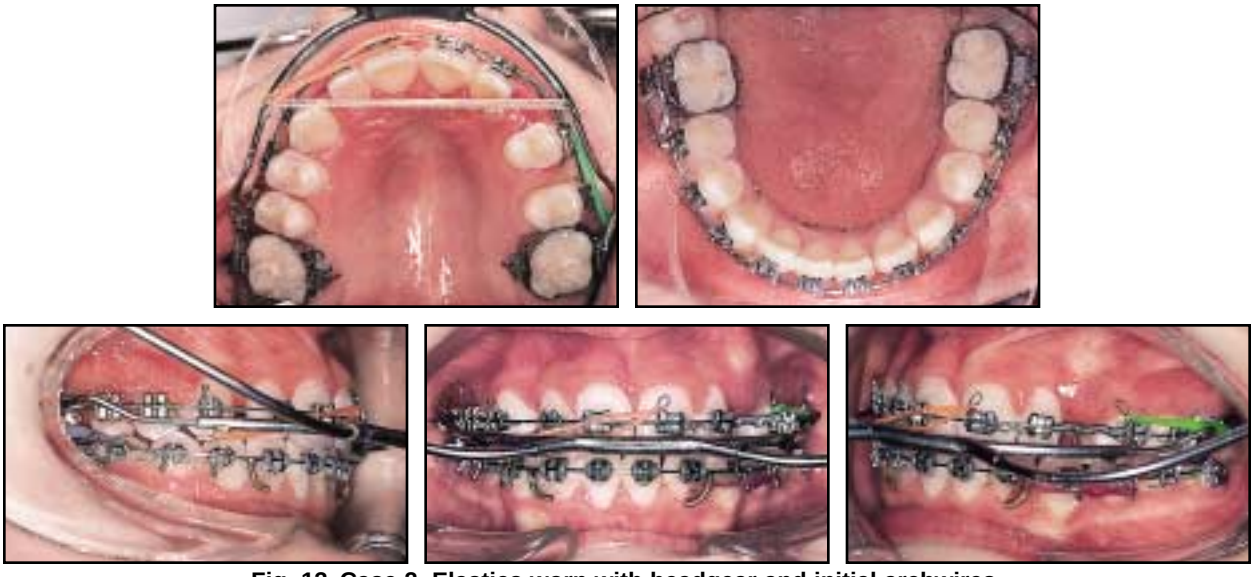

Fig. 13 Case 2. Elastics worn with headgear and initial archwires.

Fig. 14 Case 2. Upper left canine bonded after 24 months of treatment.

III elastics were attached to the lip bumper to upright the lower first molars.

Five months later, the first molars were in a Class I relationship, and the clasp on the upper right first premolar was removed to allow spontaneous drifting (Fig. 11). After another four months, the right buccal segment was nearly in a Class I relationship (Fig. 12). Passive uprighting provided enough space to correct the alignment in the lower arch.

Fourteen months into treatment, the upper and lower arches were bonded with Roth-prescription brackets from second premolar to second premolar. The initial archwires were .016" × .016" nickel titanium in the lower arch and .016" nickel titanium in the upper, with a compressed nickel titanium coil spring used to open space for the upper left canine (Fig. 13). A 4mm intra-arch elastic was attached from the cuspid hook on the right side of the Kloehn facebow to the upper left central incisor to correct the midline; another 4mm elastic was worn from the upper left first molar to the upper left first premolar to open space for the upper left canine. These elastics were worn only with the headgear.

Ten months later, the upper left canine was bonded for final alignment (Fig. 14). After 30 months of treatment, the fixed appliances were removed, and retainers were delivered (Fig. 15). Future extraction of the third molars is planned.

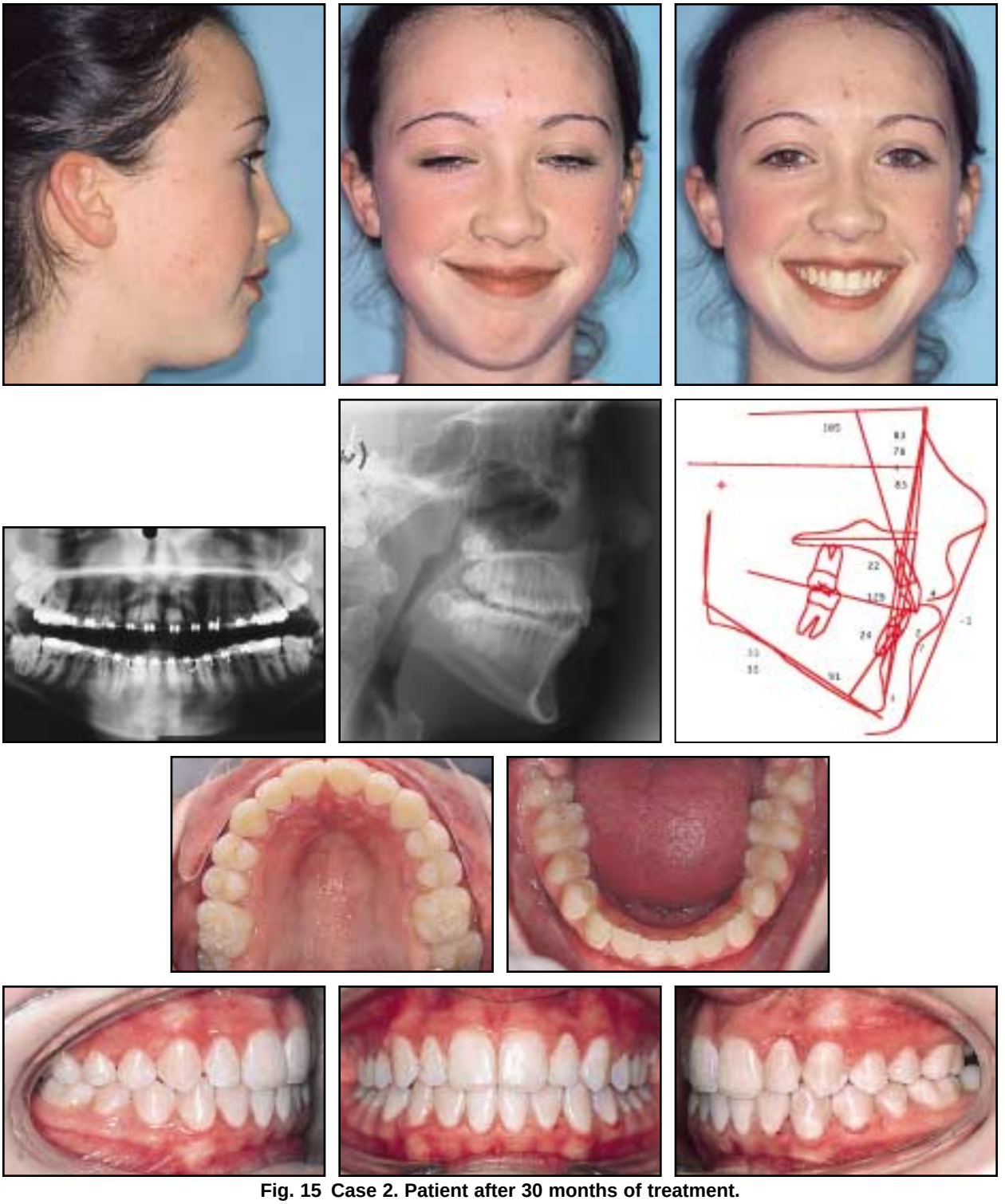

Fig. 15 Case 2. Patient after 30 months of treatment.

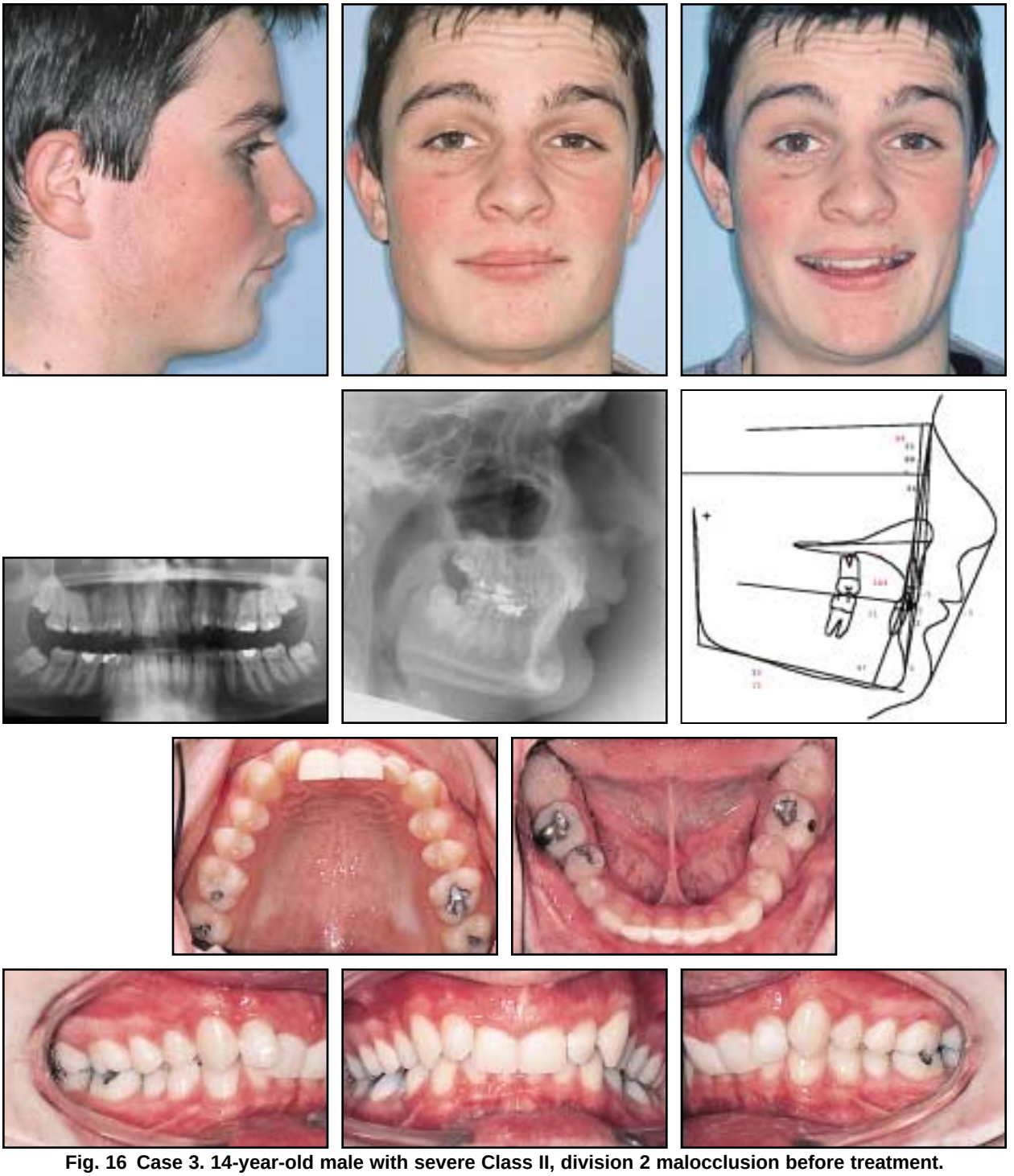

Fig. 16 Case 3. 14-year-old male with severe Class II, division 2 malocclusion before treatment.

Case 3

A 14-year-old male was referred by his general dentist because of his deep bite; the patient was also concerned about his buccally placed canines. Clinical examination revealed a strong brachyfacial tendency, a retrusive mandible, and a severe Class II, division 2 malocclusion (Fig. 16). The upper incisors were retroclined and overerupted, the upper buccal segments were constricted, and the upper molars were mesially rotated.

The treatment objectives were to actively upright the maxillary buccal and incisal segments and to correct the mesial molar rotations, while encouraging mandibular growth. A twin-block functional appliance was placed, with a midline expansion screw to upright the buccal

Fig. 17 Case 3. After 14 months of twin-block treatment and maxillary expansion.

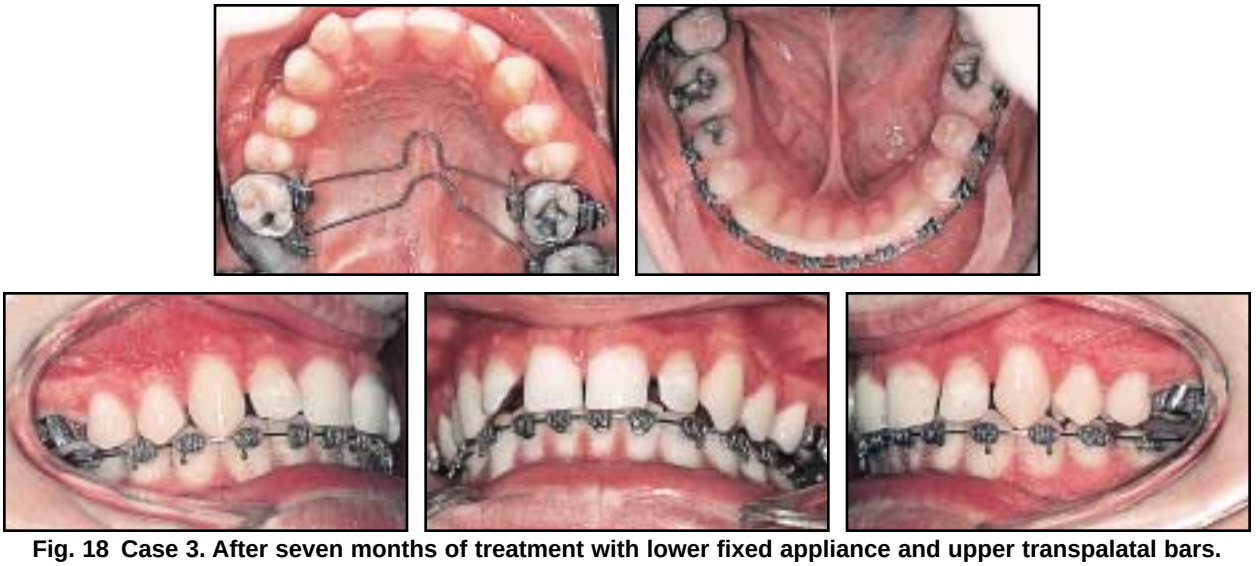

Fig. 18 Case 3. After seven months of treatment with lower fixed appliance and upper transpalatal bars.

Fig. 19 Case 3. Finishing archwires with exaggerated curve of Spee in upper arch and reverse curve in lower arch.

segments. Finger springs were used to actively upright the incisors, leveling the maxillary occlusal plane. After 14 months, the mandible had been brought forward, and there was occlusal contact with the lower second molars and lower incisors (Fig. 17).

The lower arch was then bonded, and the lower second molars and upper first and second molars were banded. An archwire sequence of .016" × .016" nickel titanium, .020" × .020" nickel titanium, and .019" × .025" stainless steel was used to extrude the lower premolars and first molars; transpalatal bars were used to correct the mesial upper molar rotations (Fig. 18). A holding

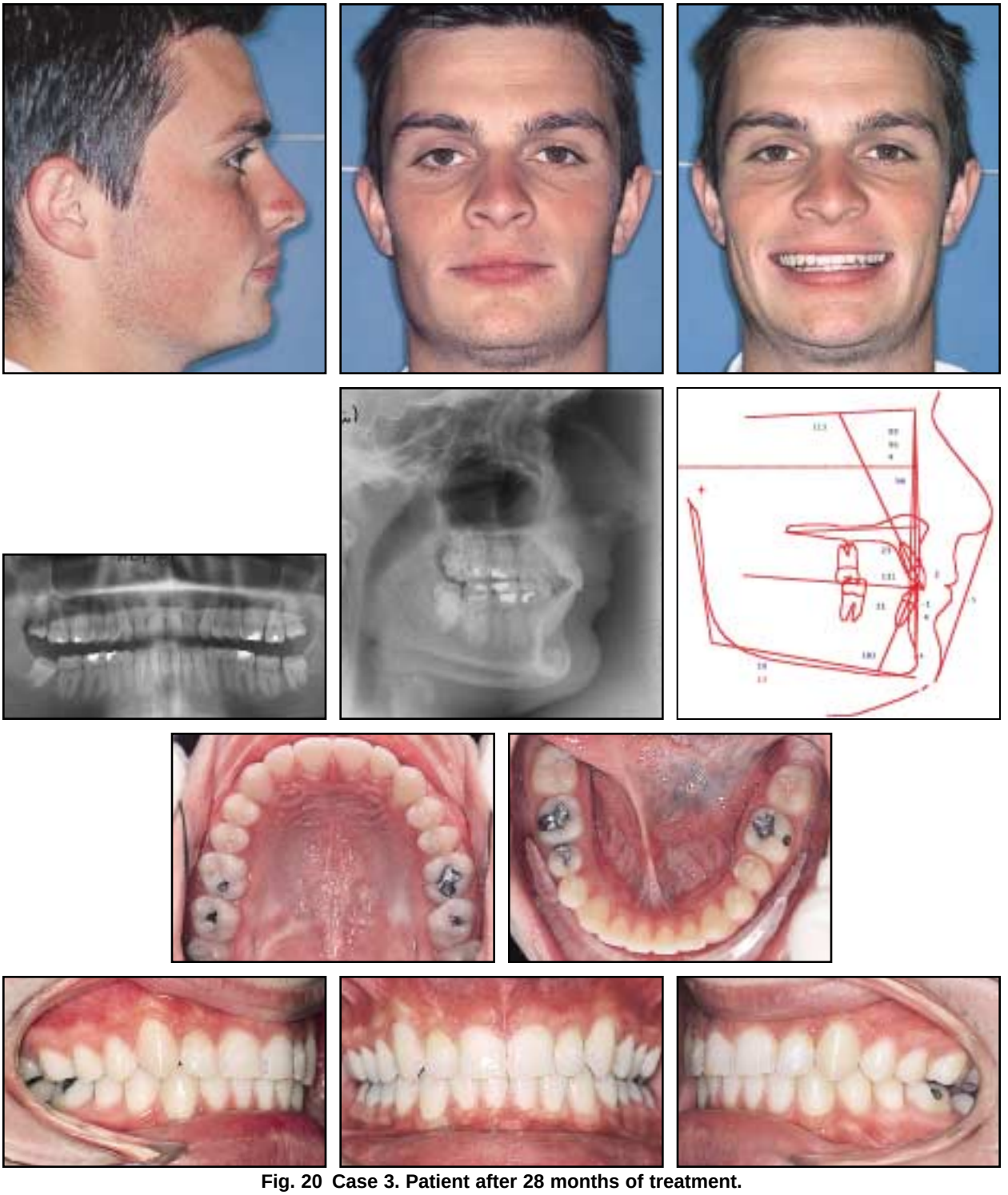

Fig. 20 Case 3. Patient after 28 months of treatment.

appliance was also used in the upper arch during this seven-month period.

The upper incisors, canines, and premolars were then bonded, and the same archwire sequence was used. The final archwires had an exaggerated curve of Spee in the upper arch and a reverse curve in the lower (Fig. 19).

A good occlusion was achieved in 28 months of total treatment (Fig. 20). Fixed appliances were removed, and upper and lower retain-

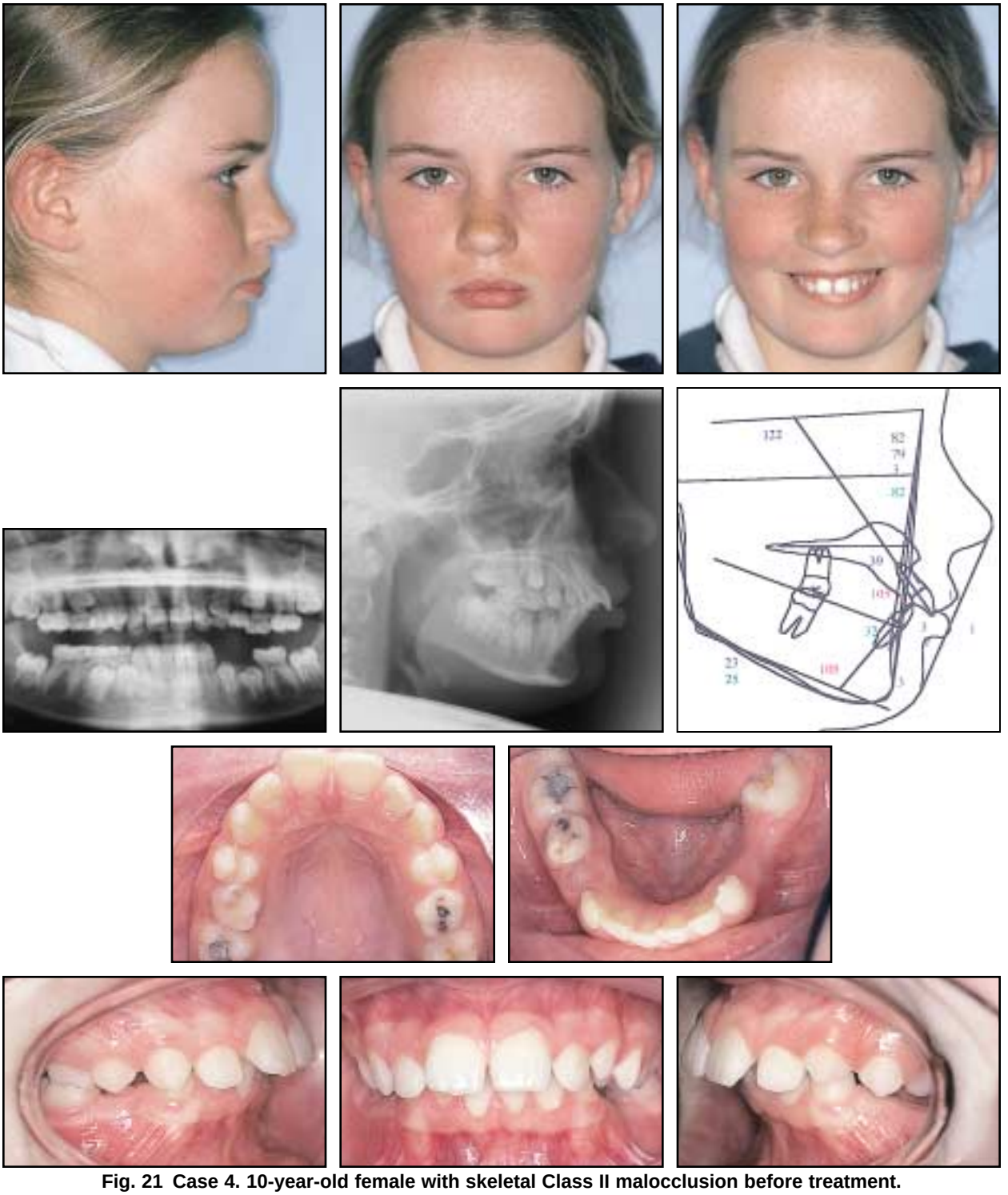

Fig. 21 Case 4. 10-year-old female with skeletal Class II malocclusion before treatment.

ers were fitted.

Case 4

A 10-year-old female presented with the chief concern of protruding teeth. She had a moderately convex profile, with a retrusive chin, an everted lower lip, and an 8mm overjet (Fig. 21). There was no arch-length deficiency or crowding, but the upper first molars were mesial-

Fig. 22 Case 4. Herbst appliance with stainless steel crowns and transpalatal bar on upper first molars and acrylic capping on lower incisors, placed after nine months of treatment.

ly rotated. The buccal segment occlusion was Class II; the lower incisors were proclined, and the lower left first molar had tipped mesially following premature loss of the second deciduous molar.

To correct the skeletal discrepancy, the first requirement was to upright the lower incisors and thus to encourage forward growth of the mandible. The four first molars were bonded, and a transpalatal bar was inserted to correct the mesial upper molar rotations. A lip bumper was used to actively upright the mesially tipped lower first molars and to allow passive uprighting of the buccal segments, which would provide space to upright the proclined lower incisors.

After five months of treatment, a cervical headgear was delivered, and the lower arch was bonded. Class III elastics were worn with the headgear from the upper first molars to the lower labial segment. When the headgear was not worn, intra-arch elastics were attached from the lower first molars to the lower labial segment. The lip bumper was kept in place as an anchor unit.

Four months later, the lower arch was aligned, all spaces were closed, and the lower incisors were upright. The lower fixed appliances and upper first molar bands were then removed. A Herbst** appliance was worn for nine months, using stainless steel crowns and a transpalatal bar on the upper first molars and a lower acrylic splint with incisor capping (Fig. 22).

The initial .014" nickel titanium upper archwire was followed by an .020" stainless steel wire for space closure and an .019" × .025" stainless steel finishing wire. After 30 months of active treatment, the upper fixed appliances were removed, and retainers were delivered (Fig. 23).

At age 16, more than two years post-treatment and more than a year post-retention, the patient's results remained stable (Fig. 24).

REFERENCES

1. Keim, R.G.; Gottlieb, E.L.; Nelson, A.H.; and Vogels, D.S. III: 2002 JCO Study of Orthodontic Diagnosis and Treatment Procedures, Part 1: Results and trends, J. Clin. Orthod. 36:553-568, 2002.
2. Cummins, D.M.; Bishara, S.E.; and Jakobsen, J.R.: A computer assisted photogrammetric analysis of soft tissue changes after orthodontic treatment, Part II: Results, Am. J. Orthod. 108:38-47, 1995.
3. Bishara, S.E.; Cummins, D.M.; Jakobsen, J.R.; and Zaher, A.R.: Dentofacial and soft tissue changes in Class II, division 1 cases treated with and without extractions, Am. J. Orthod. 107:28-37, 1995.
4. Cassidy, K.M.; Harris, E.F.; Tolley, E.A.; and Keim, R.G.: Genetic influence on dental arch form in orthodontic patients, Angle Orthod. 68:445-454, 1998.
5. Foley, T.F. and Duncan, P.G.: Soft tissue profile changes in late adolescent males, Angle Orthod. 67:373-380, 1997.
6. Moore, T.; Southard, K.A.; Casko, J.S.; Qian, F.; and Southard, T.E.: Buccal corridors and smile esthetics, Am. J. Orthod. 127:206-213, 2005.
7. Clark, W.J.: *Twin Block Functional Therapy: Applications in Dentofacial Orthopaedics*, Mosby-Wolfe, London, 1995, pp. 10-11.
8. Proffit, W.R. and White, R.P. Jr.: *Surgical Orthodontic Treatment*, Mosby, St. Louis, 1990, pp. 340, 349.
9. Walther, D.P. and Houston, W.B.J.: *Walther's Orthodontic Notes*, 3rd ed., John Wright & Sons, Bristol, England, 1976, p. 23.
10. Dugoni, S.A.: Early mixed dentition treatment: Post retention evaluation of stability and relapse, Angle Orthod. 65:311-320, 1995.
11. Cetlin, N.M. and Ten Hoeve, A.: Nonextraction treatment, J. Clin. Orthod. 17:396-413, 1983.
12. Nevant, C.T.; Buschang, P.H.; Alexander, R.G.; and Steffen, J.M.: Lip bumper therapy for gaining arch length, Am. J. Orthod. 100:330-336, 1991.
13. Osborn, N.S.; Nanda, R.S.; and Currier, G.F.: Mandibular arch perimeter changes with lip bumper treatment, Am. J. Orthod. 99:527-532, 1991.

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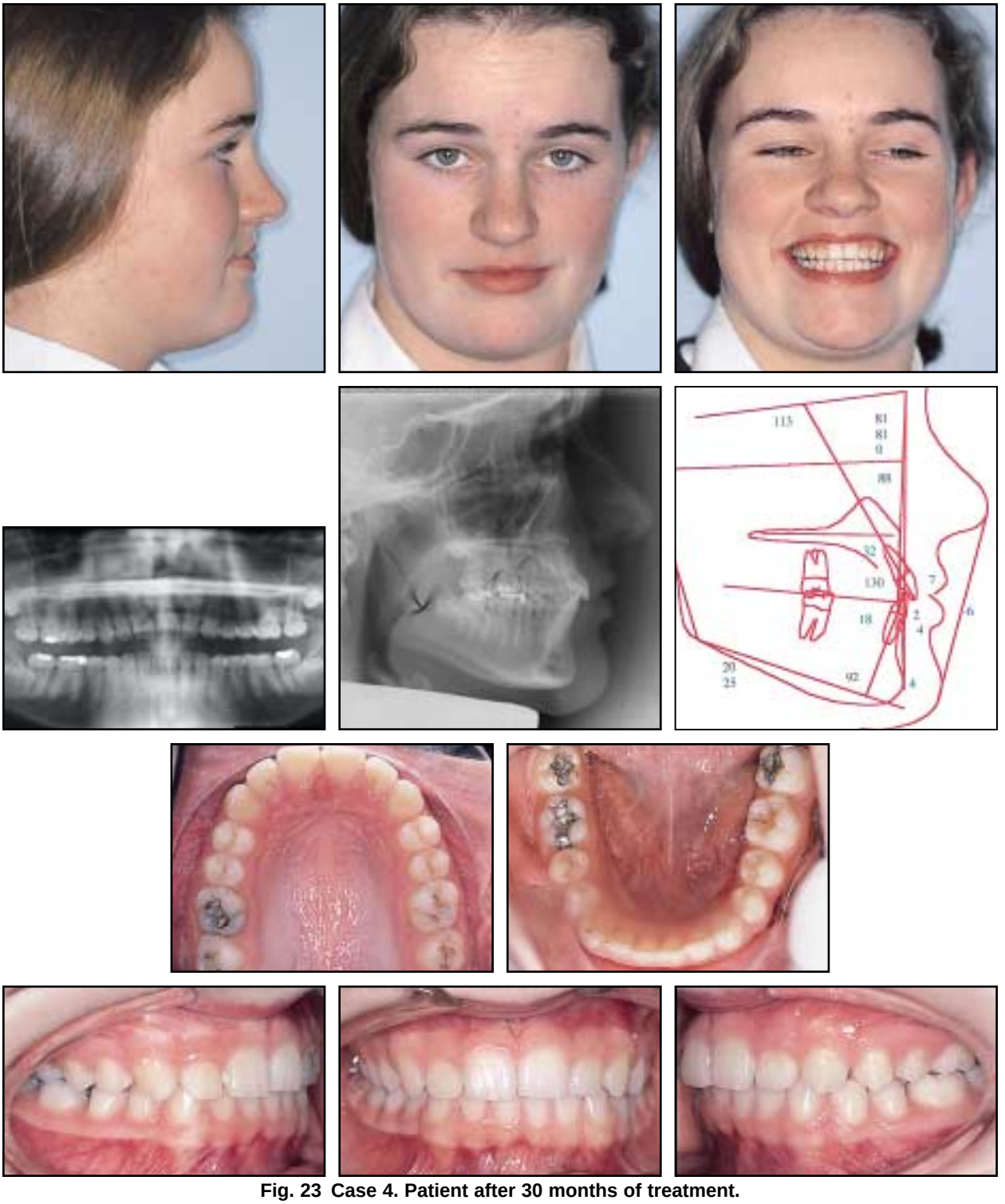

Fig. 23 Case 4. Patient after 30 months of treatment.

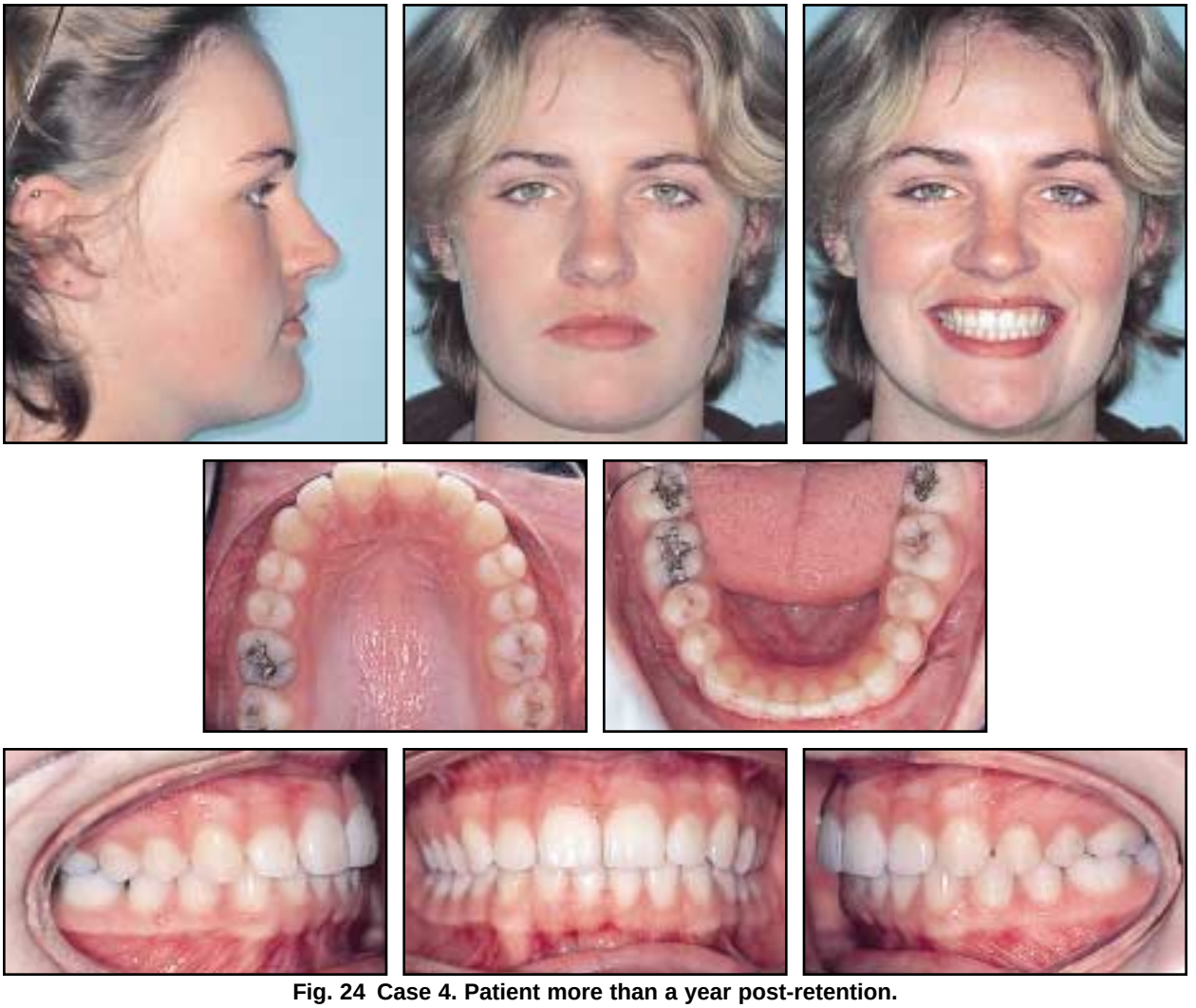

Fig. 24 Case 4. Patient more than a year post-retention.

14. Frankel, R.; Muller, M.; and Falck, F.: The uprighting effect of the Frankel appliance on the mandibular canines and premolars during eruption, Am. J. Orthod. 92:109-116, 1987.
15. Hime, D.L. and Owen, A.H. III: The stability of the arch-expansion effects of Frankel appliance therapy, Am. J. Orthod. 98:437-445, 1990.
16. Walther, D.P. and Houston, W.B.J.: *Walther's Orthodontic Notes*, 3rd ed., John Wright & Sons, Bristol, England, 1976, p. 47.
17. Van der Linden, F.P.G.M.: *Facial Growth and Facial Orthopaedics*, Quintessence, London, 1986, pp. 202-211.
18. Graber, T.M. and Swain, B.F.: *Orthodontics: Current Principles and Techniques*, Mosby, 1985, pp. 606-611.
19. Graber, T.M. and Swain, B.F.: *Orthodontics: Current Principles and Techniques*, Mosby, 1985, pp. 128-154.
20. Park, Y.C.; Chu, J.H.; Choi, Y.J.; and Choi, N.C.: Extraction space closure with vacuum-formed splints and miniscrew anchorage, J. Clin. Orthod. 39:76-79, 2005.
21. Battagel, J.M.: The use of tensor analysis to investigate facial changes in treated Class II division 1 malocclusions, Eur. J. Orthod. 18:41-54, 1996.
22. Ghafari, J.; Shofer, F.S.; Jacobsson-Hunt, U.; and Markowitz, D.L.: Headgear versus functional regulation in the early treatment of Class II division 1 malocclusion, Am. J. Orthod. 113:51-61, 1998.
23. Mills, C.M. and McCulloch, K.J.: Treatment effects of the twin block appliance: A cephalometric study, Am. J. Orthod. 114:15-24, 1998.
24. Toth, L.R. and McNamara, J.A. Jr.: Treatment effects produced by the twin block appliance and the FR-2 appliance of Frankel compared with an untreated Class II sample, Am. J. Orthod. 116:597-609, 1999.