

SPECIAL ARTICLE

For four sixes

Paul Jonathan Sandler, BDS(Hons), MSc, FDSRCPS, DOrth, MOrth,^a Robert Atkinson, BDS(Hons), LDSRCS, FDSRCS,^b and Alison Margaret Murray, BDS, MSc, FDSRCPS, DOrth, MOrth^c

Chesterfield, UK

This article reviews the literature on orthodontic treatment involving extraction of first molars and highlights many of the clinical considerations when treating such cases. Case reports illustrate the potential problems and indicate some solutions. (*Am J Orthod Dentofacial Orthop* 2000;117:418-34)

Orthodontic cases involving the extraction of permanent first molars are thought to be technically more difficult to treat and that even a good result is in some way a compromise. Many cases that would benefit from this approach because of the doubtful long-term prognosis of the molars are treated with the extraction of healthy premolars (Fig 1). The avoidance of first molar cases may be due to a number of factors including the following: operator comfort with premolar extraction cases, lack of experience in handling molar extraction cases, and the inter-dependence for patients between endodontists, orthodontists, and crown and bridge specialists. This last factor is rarely an issue in the United Kingdom but may increase in the future as Specialist Registration has in 1998 become a reality.

The extraction of first permanent molar teeth accounts for a considerable proportion of cases treated within the National Health Service. An analysis of patients referred to consultant orthodontists found that nearly 12% of all extraction cases involved first permanent molars.¹

The aim of this article is to discuss a rationale for extraction of first molars and to highlight some of the problems and pitfalls that surround provision of appliance therapy for these cases.

LITERATURE REVIEW

Approaches to first molar extraction cases range between unbridled enthusiasm claiming that the extraction of all 4 first permanent molar teeth at the age of 10½ years prevented not only malocclusion but also dental decay and pyorrhea² to total skepticism suggesting that significant occlusal disturbance, an increase in caries, and detrimental change in facial contour and appearance were all inevitable as a result of this intervention.³

^aConsultant Orthodontist, Royal Hospital Chesterfield.

^bSenior House Officer, Royal Hospital Chesterfield.

^cConsultant Orthodontist, Derbyshire Royal Infirmary.

Reprint requests to: Paul Jonathan Sandler, BDS (Hons), MSc, FDSRCPS, DOrth, MOrth, Consultant Orthodontist, Royal Hospital Chesterfield, Calow, Chesterfield, S44 5BL United Kingdom; e-mail, JonSandler@aol.com.

Copyright © 1999 by the American Association of Orthodontists.

0889-5406/99/\$8.00 + 0 8/1/97617

doi.10.1067/mod.2000.97617

“First permanent molar extractions doubling the treatment time and halving the prognosis” was the phrase coined by Mills.⁴ This statement may have been correct when orthodontics involved removable appliances but now has little relevance. On the other hand, Daugaard-Jensen⁵ suggested that first molar cases are no more time consuming than 4 premolar cases and in many cases offer distinct advantages in terms of anchorage management. Houston et al⁶ suggested that children undergoing first permanent molar extractions often had a deprived social background and that they showed a reduced interest in their dental care. This often presented difficulties in providing anything other than the most basic of orthodontic treatment thus inevitably leading to an orthodontic compromise.

Space closure after the extraction of the first permanent molar teeth has been studied in some detail and has led to conclusions that satisfactory closure of spaces was best achieved on children and young adults.⁷ Adults showed less bone apposition when moving second molar teeth into the narrowed space, and poor maintenance of the closed space and, in some cases, resorption of the second molar roots was also noted. Other authors⁸ concluded that significant if not always complete closure could be achieved with the roots of the second molar teeth moving almost twice as far as the crowns. They agreed that most cases showed a crestal bone loss mesial to the second molars posttreatment but suggested that root resorption of the second molars was only minimal.

Extraction of unopposed maxillary first permanent molars after the removal of the mandibular counterpart was thought to prevent the likely over eruption of the maxillary tooth.⁹ Compensating extractions were not automatically advised after the loss of the maxillary first permanent molar because space closure in the mandibular arch was more problematic.

The effect of various extraction patterns on provision of space both anteriorly and posteriorly within the arches was discussed in some detail by Williams and Hosila.¹⁰ They highlighted the fact that first molar extraction cases are likely to have less effect on the profile than premolar



Fig 1. Premolars extracted despite limited prognosis of first molars.



Fig 2. Gentle forces essential regardless of the method of space closure.



Fig 3. Nance button palatal arch will maximize intraoral anchorage.

extraction cases. Also in their cases involving first molar extractions there was about a 90% chance of successful third molar eruption compared with approximately 55% chance with cases involving premolar extractions.

CLINICAL INDICATIONS

There are many clinical situations in which extraction of first permanent molars should at least be considered and these can be summarized as follows:

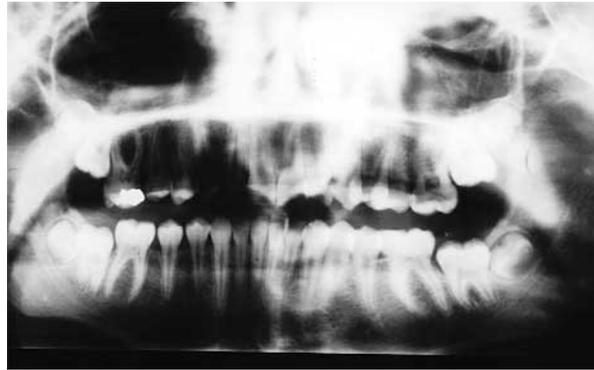


Fig 4. Upper second molars almost completely replace first molars regardless of timing of extraction.

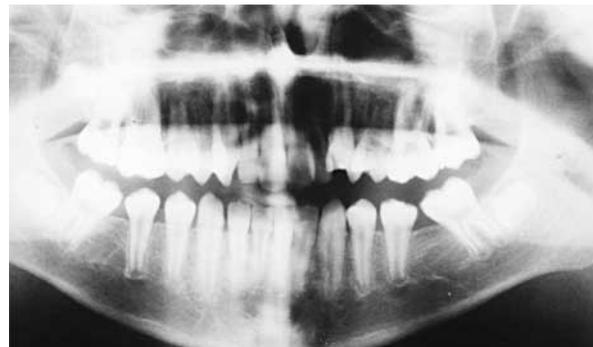


Fig 5. Timing of lower first molar extraction is important if spontaneous space closure is desired.



Fig 6. Class 2 elastics to lingual of lower molars to counter lingual roll.

- Extensively carious first molars
- Hypoplastic first molars
- Heavily filled first molars where premolars are perfectly healthy
- Apical pathoses or root treated first molars
- Crowding at the distal part of the arches and wisdom teeth reasonably positioned
- High maxillary/mandibular planes angle
- Anterior open bite cases

Whether first molars are extracted is dependent on many factors, including the patient's attitude to fixed appliance therapy, the standard of oral hygiene, the amount and site of crowding, and the presence or absence of other permanent teeth. The patient's suitability for this invariably lengthy course of fixed appliance therapy must be considered to ensure that the benefits of treatment far outweigh the potential risks.

POTENTIAL PROBLEMS **Lower Arch Space Closure**

Space closure is perhaps the most challenging aspect of first molar extraction cases. When the lower second molars are subjected to a mesially directed force, there is always a tendency for them to both tilt mesially and roll lingually. This tendency can be reduced by the use of full size (19/25)

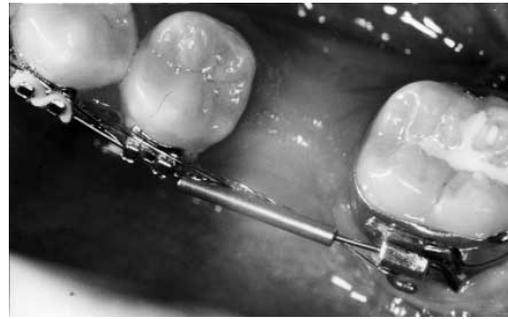


Fig 7. Stainless steel tubing prevents arch wire distortion and movement.



Fig 8. Distal twister aids turning in of arch wires

stainless steel arch wires. Active space closure should rarely be attempted before the patient has full alignment of all the lower teeth and is in this full-sized working arch wire.

The new McLaughlin, Bennett, Trevisi, (3M Unitek; Monrovia, Calif) prescription should help the molar position during space closure in that they are specifically designed to reduce molar lingual roll considerably. The second molar prescription has 10° lingual crown torque, which is some 20° to 25° less torque than other popular prescriptions.

When using either traction ligatures or nickel titanium coil springs, space closing forces should always

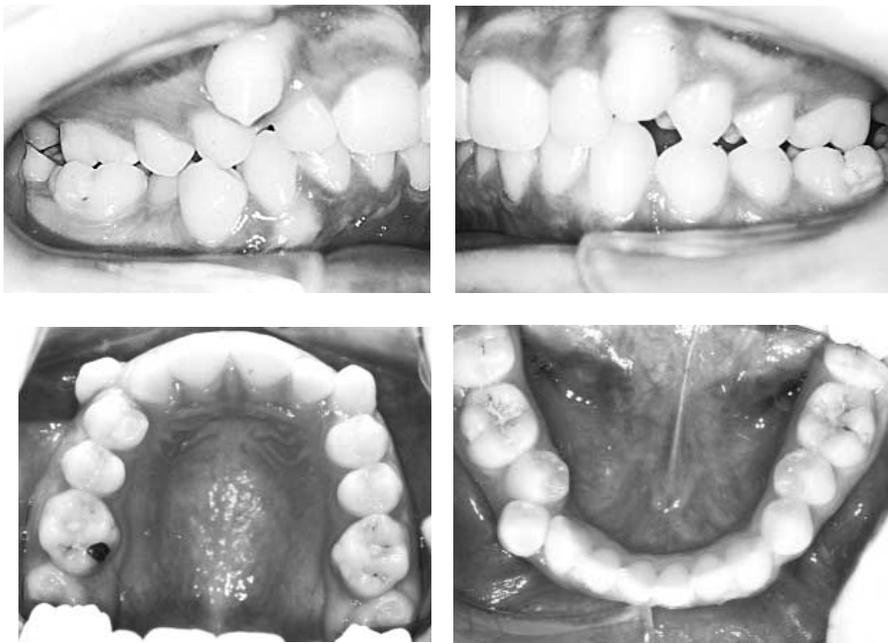


Fig 9. Con'd

often does not provide much more than a few millimeters either side of the arch to relieve anterior crowding or to correct an increased overjet. If a reasonable amount of the extraction space is required, consideration should be given to provision of a palatal arch with Nance button on the second molars (Fig 3). This should provide several extra millimeters of space on either side of the arch compared with cases where anchorage was not reinforced.

If all the first molar space is required either for relief of crowding or overjet reduction, headgear must be provided to the upper second molars to prevent them moving mesially. In these cases, the patient's compliance with headgear will determine the ultimate success or failure of treatment. This must be borne in mind when carrying out the formal space analysis; if much more than 8 mm of space is required on either side, some other approach to treatment may need to be considered.

Timing of Extractions

If the upper second molars are unerupted at the time of extraction of the upper first molars, they will almost completely replace them, thus contributing little space for correction of the malocclusion (Fig 4). It has been suggested that effective distalization of upper premolars with a removable appliance can be achieved if the first molars are extracted early.¹¹ This method, however, depends totally on superb patient cooperation with the patient wearing the headgear for at least 12 to

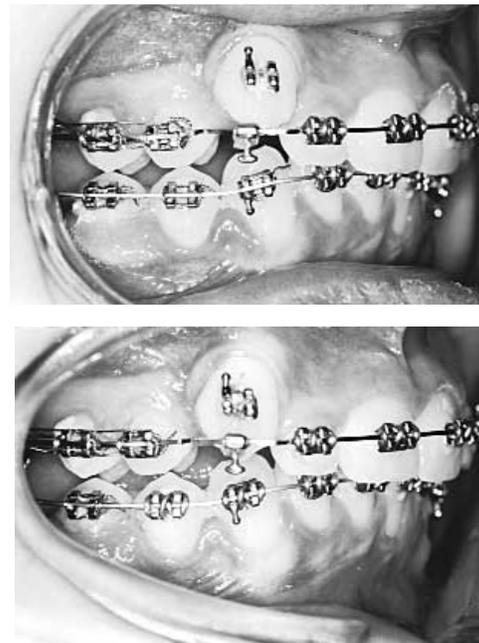


Fig 10. Power chain to move the canine occlusally.

14 hours per day. Anything short of this and most if not all the space provided by the extractions will be lost.

If there is a space requirement in the upper arch therefore, extraction of the first molars must be delayed until the second molars have erupted sufficiently to

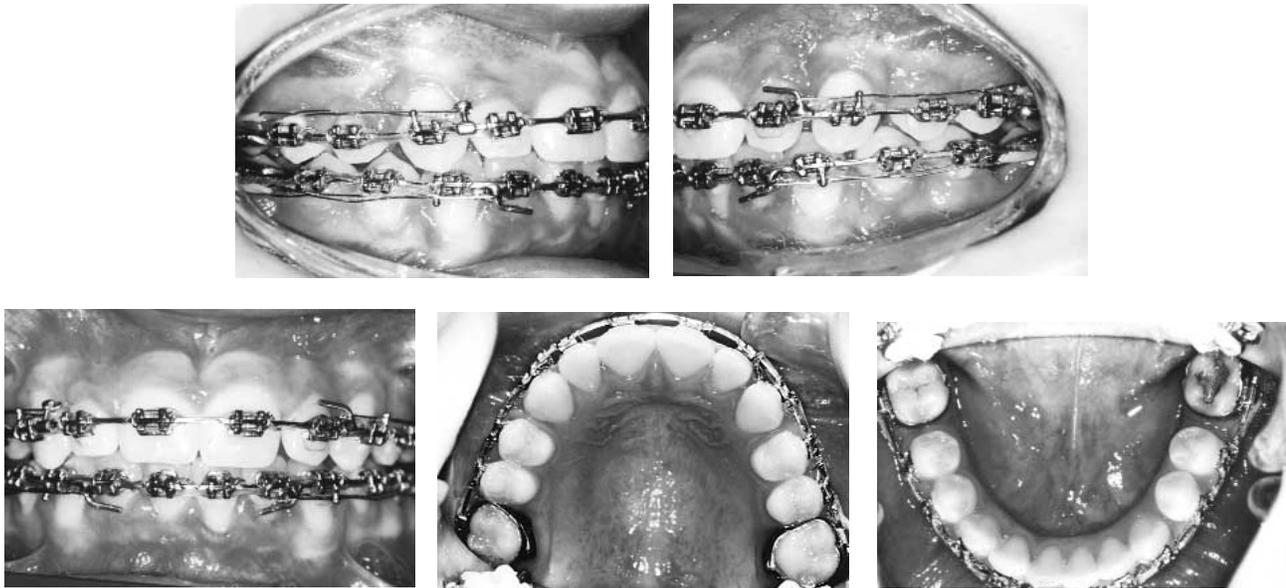


Fig 11. 19/25 stainless steel working arch wires.

allow a palatal arch with Nance button or headgear to be placed. With modern medicaments and pulp management techniques, it should be possible to delay extractions and keep first molars in almost every case that will direct the second molars into their normal position. This will subsequently provide useful space after extraction of the first molars.

If space requirement in the upper arch is minimal, earlier extraction will allow “nature” to assist with much of the space closure. The second molars are often quite high and only need to alter their eruption pathway slightly more mesially to allow them to erupt almost into the first molar sockets.

In the lower arch, timing of extractions is also critical. It is unlikely that the lower second molars will completely replace the lower first molars after their extraction as they have a much more vertical path of eruption. If little or no space is required in the lower arch for correction of the malocclusion, it is often advisable to extract lower first molars early, when the bifurcation dentine on second molars is calcifying and the roots are about half formed. This will maximize spontaneous space closure in the lower arch thus minimizing retraction of the lower labial segment, which is an undesirable side effect often seen during space closure (Fig 5).

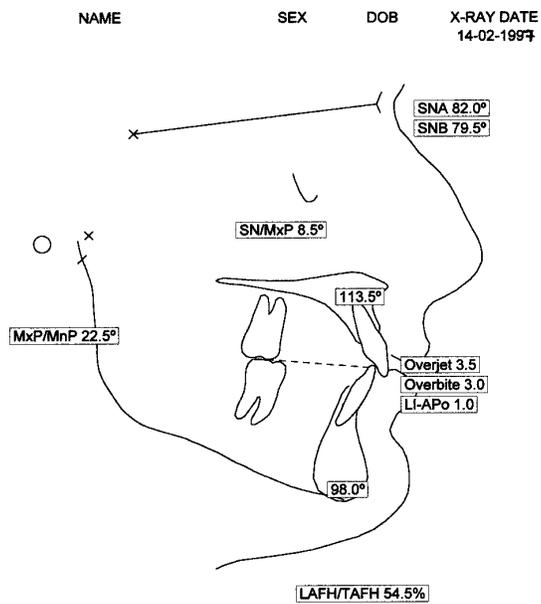
If, after space analysis, it is calculated that all the lower first molar space is required for relief of crowding, a lingual arch may be necessary until the premolars and canines have been retracted sufficiently to allow incisor alignment.

Root Paralleling

Toward the end of treatment, if there is any doubt whether root positions exist, an Orthopantomogram can be taken to assess whether the long axis second premolars and second molars are reasonably parallel. If 8 to 9 mm of space has been closed between the second premolar and second molar, there is always a slight tendency for divergence between the two roots and gentle tip back bends may be placed if necessary in the final rectangular wires to fully correct the root positions. Once space is closed and the crowns are correctly positioned, a dead ligature should be placed across the extraction spaces to hold them closed for a few months. This keeps these teeth in position while the gingival fibers reorganize and the bone around the teeth matures in the hope that this will minimize any tendency for the extraction spaces to reopen.

Class II Elastics

If Class II elastics are being used in first molar extraction cases, there is an increased tendency for lingual roll of the lower second permanent molars. Class II elastics should not be used until the patient is in a full-sized (19/25) stainless steel arch wire and, if necessary, buccal crown torque is applied to the lower molars. Another possibility is to run the Class II elastics from a lingual cleat on the lower molar bands, thus providing some lift to the lingual surface of the lower molars thus reducing any tendency to lingual roll (Fig 6).



Arch Wire Problems

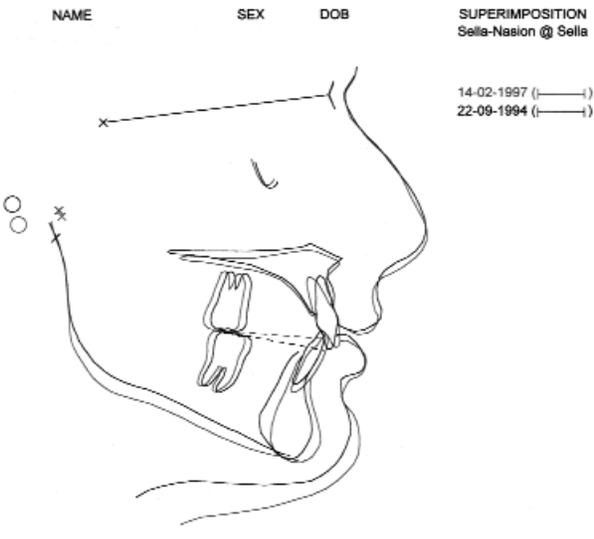


Fig 12. Final records of case 1.

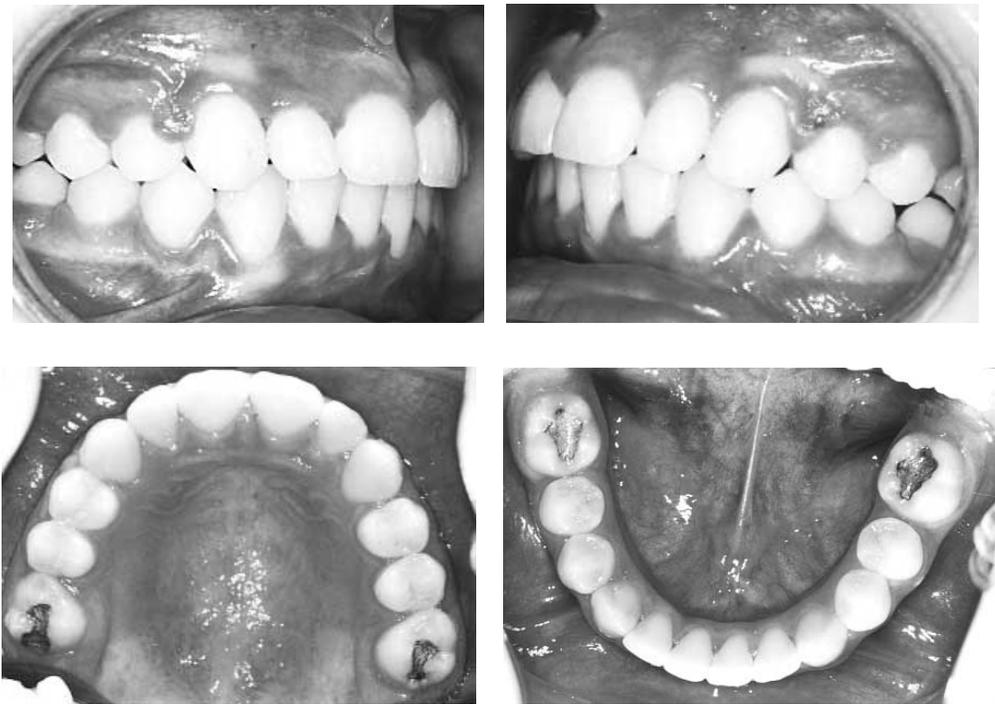


Fig 12. Con'd



Fig 13. Pretreatment records of case 2.

Arch Wire Problems

The long span of arch wire between the second premolar and the second molar can lead to problems such as trauma to the soft tissues as well as deflection of the arch wire during mastication. This arch wire distortion can, on occasion, cause movement leading to the wire coming forward out of one tube and moving distally and piercing the cheek on the opposite side. Introduction of deflections and asymmetries into the arch will at the very least delay progression of treatment. The above consequences can all be avoided by placing 0.9

mm internal diameter stainless steel tubing over the arch wire in the extraction space. The tube should be only 1 to 2 mm short of the interbracket span for maximum rigidity of the arch wire section but also allowing some alignment and movement of the teeth (Fig 7).

In addition, the arch wires up to but excluding the full-sized rectangular stainless steel should be annealed and turned down or in at the end. An instrument called a "distal twister" (Instrument number 001-505, American Orthodontics, Sheboygan, Wis), which hooks over the annealed end of the wire, allows this to be done with ease (Fig 8).

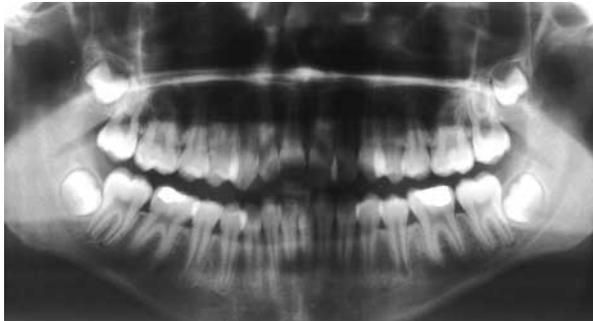
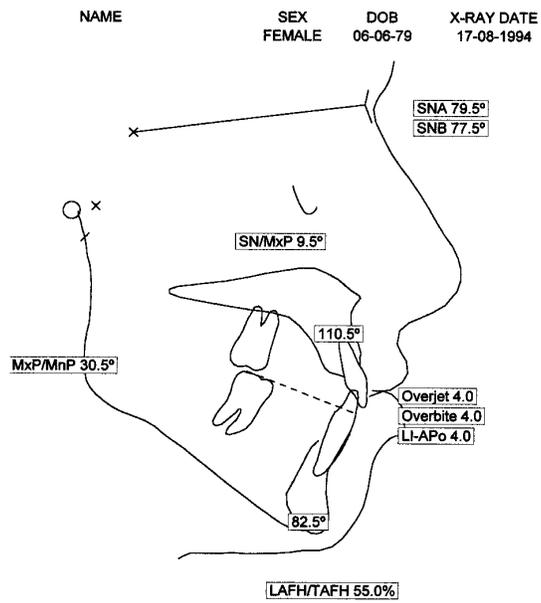


Fig 13. Con'd

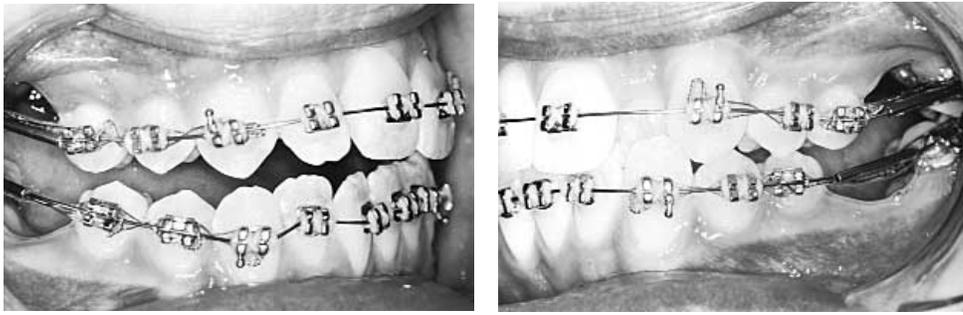


Fig 14. Stainless steel tubing to protect the arch wire



Fig 15. 19/25 stainless steel working arch wires, spaces almost completely closed, Class II elastics for lateral open bite.

CASE REPORTS

These cases are used to illustrate the kind of result that can be expected with careful case management after extraction of 4 first molars.

Case Report 1

The patient presented at 12 years of age¹¹ with a Class II Division II incisor relationship on a skeletal I base. There was severe crowding in the upper labial segment with almost complete exclusion of the upper right canine and partial exclusion of the upper left canine. The lower buccal segments were moderately crowded. Dental examination revealed caries in 3 of the 4 first molar teeth and an OPT radiograph showed the presence of third molars (Fig 9).

As the first molars were carious we decided to extract them. Careful anchorage management should allow sufficient space for relief of crowding, alignment of the labial segment teeth, and full correction of the malocclusion.

We placed fixed appliances in January 1995 and progressed from 0.016 nickel titanium through to 18/25 nickel titanium to 19/25 steel. Full-sized stainless steel arch wires were in place by the middle of 1995 at which stage push coil was used to reopen space for the upper right canine. We did not attempt space closure on the arch wires before the 19/25 stainless steel arch wires to minimize dumping or arch distortion in the extraction areas. Lengths of 0.9 mm internal diameter stainless steel tubing were used in the extraction sites on both of the aligning arch wires to make the arch wire more rigid thus preventing distortion during mastication. To aid correction of the upper right canine, a crimpable hook was placed on the arch wire in an inverted position and elastic chain attached to it from the bracket on the canine (Fig 10).

Once the anterior teeth had been fully aligned onto the 19/25 arch wire, space closure was commenced. Traction ligatures were used in all 4 quadrants and renewed every 6 weeks until full space closure was achieved (Fig 11). We removed the stainless steel arch

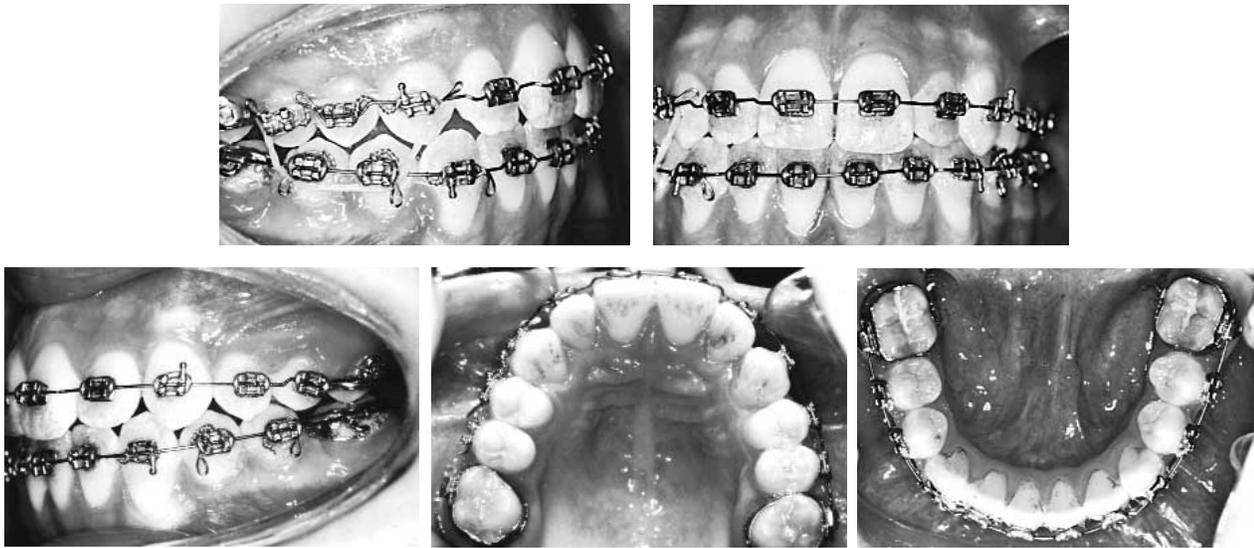


Fig 16. 0.014 stainless finishing wires for fine detailing of tooth position.

wires every second visit to check arch wire coordination and to place gentle reverse curve in the lower arch and increased curve in the upper arch. We removed the appliances in August 1996, therefore, the total duration of active treatment to fully correct this malocclusion was 19 months (Fig 12).

Cephalometric analysis revealed a small favorable change in the sagittal relationship of the jaws as a result of the 1° decrease in SNA and 1° increase in SNB. There was a small decrease in the maxillary-mandibular planes angle during treatment and superimposition demonstrates some forward mandibular growth that is most welcome. There was marked improvement in the inclinations of the incisors with a concomitant improvement in the interincisal angle. The OPT radiograph taken 12 months after treatment showed a marked improvement in the position of the third molars that are expected to erupt into a more than acceptable position over the next few years.

Case Report 2

The patient presented at 14 years of age in full permanent dentition with a Class III incisor relationship on a Class I skeletal base. There was moderate crowding of the upper labial segment and mild to moderate crowding of the lower labial segment. The lower first molars had been restored, and the OPT revealed the presence and good morphologic characteristics of third molars (Fig 13).

We decided that extraction of first molars would provide sufficient room for correction of the malocclusion and would also leave the patient with a completely healthy dentition. Flexible nickel titanium arch wires were used to provide initial alignment of the anterior teeth with the exception of the upper left lateral incisor.

Stainless steel tubing protected the wire in the extraction spaces during this alignment phase (Fig 14). We progressed to an upper 19/25 stainless steel arch wire, then a nickel titanium pushcoil was used to reopen space for the upper lateral incisors.

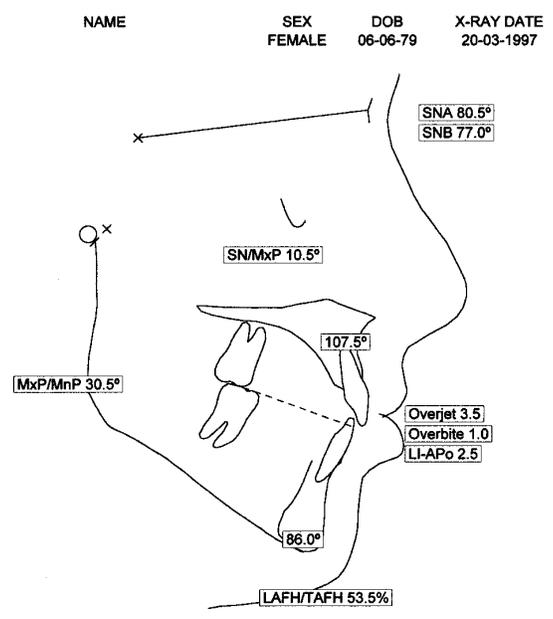
Vertical box elastics with a slight Class II element were used in the buccal segments on a 19/25 upper and 18/25 nickel titanium lower arch wire to encourage closure of the lateral open bites that developed during the course of treatment (Fig 15). Full space closure was achieved on 19/25 stainless steel arch wires. For the last 3 months of treatment, a 0.014 high tensile stainless steel wire was used to allow final positioning of the teeth (Fig 16). The overjet, overbite, and buccal segment relationship was corrected in a period of 28 months (Fig 17).

Cephalometric analysis revealed a small change in the sagittal relationship of the jaws, but the maxillary-mandibular planes angle appeared not to change as a result of treatment. Superimposition demonstrated a counter-clockwise mandibular rotation largely due to the inherited growth pattern but also as a consequence of the extrusive nature of the orthodontic treatment. The upper incisors ended up 3° retroclined compared with the start and the lower incisors nearly 3° more proclined although not as far ahead of APo.

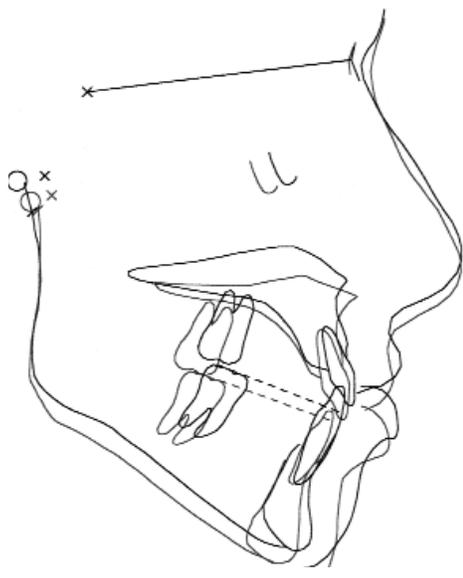
The third molars are in an excellent position post-treatment and are expected to erupt normally in the near future.

Case Report 3

This young man presented at 11 years of age with a Class III incisor relationship on a Class III skeletal base with a markedly increased mandibular planes



NAME	SEX	DOB	SUPERIMPOSITION
	FEMALE	06-06-79	Sella-Nasion @ Sella



20-03-1997 (|---|)
 17-08-1994 (|---|)



Fig 17. Final records of case 2.

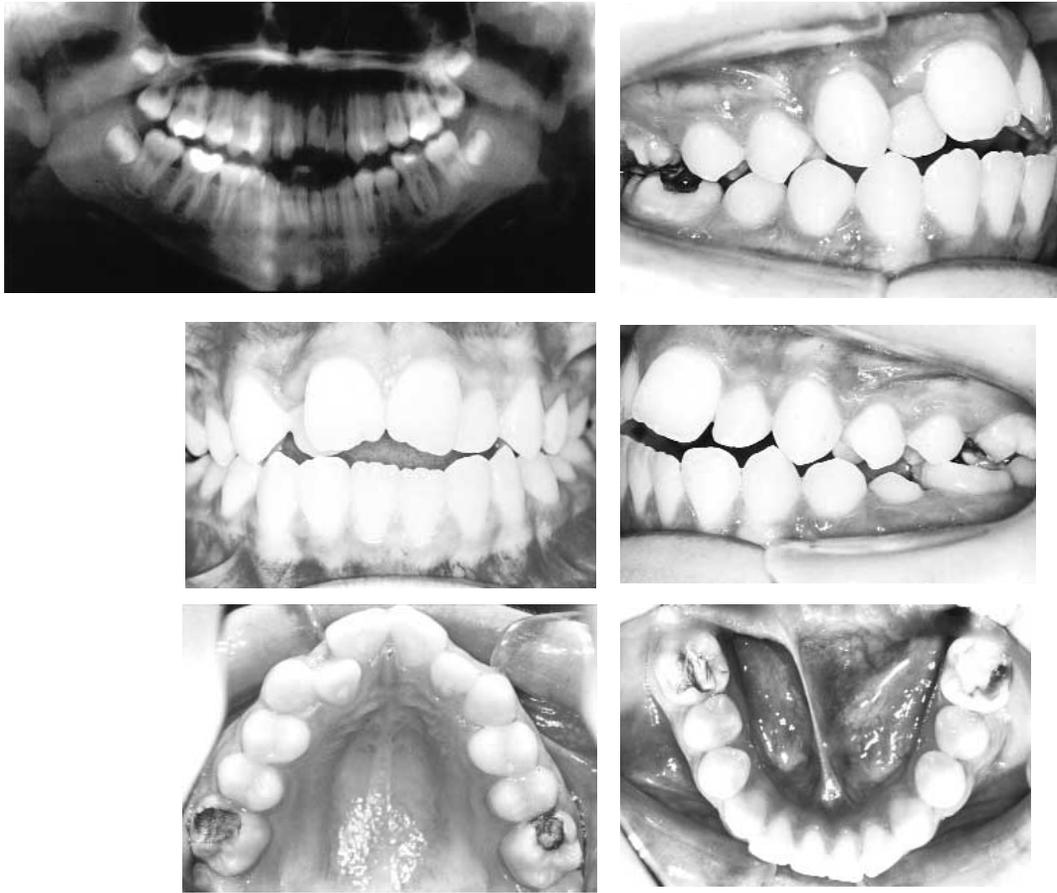


Fig 18. Con'd.

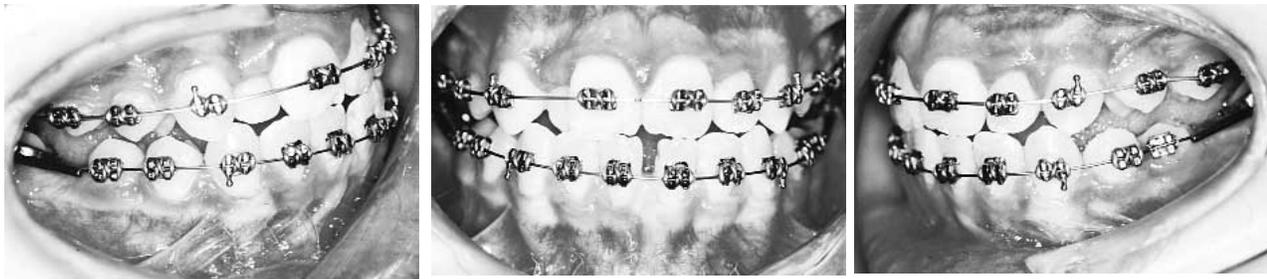


Fig 19. 0.016 nickel titanium for initial alignment, tubing to protect arch wire.

angle of 44° . He was in the permanent dentition with a normally inclined upper labial segment, a proclined lower labial segment, and an anterior open bite of 3 mm. The upper and lower right first molars were very heavily filled, and the lower left first molar was very heavily decayed (Fig 18).

We appreciated that this young man would be a difficult case to treat and that the prognosis for successful closure of the anterior open bite was limited with orthodontics alone. However, the patient was not inter-

ested in considering any form of orthognathic surgery. A decision was made to attempt to get as much correction as possible with orthodontic therapy alone.

We felt that posterior extractions may help with closure of the anterior open bite and that in this high angle case space closure was unlikely to be a major problem. We decided that the patient would benefit from the removal of all 4 first molars to relieve the crowding in the upper labial segment and to improve the interarch relationships.

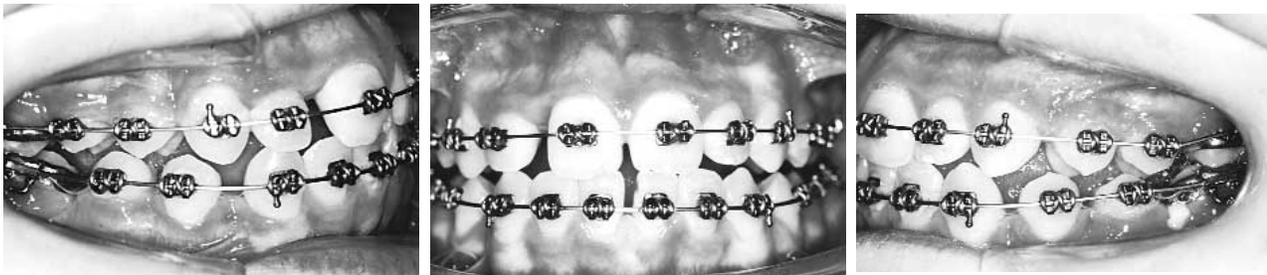


Fig 20. Second stage alignment with 18/25 nickel titanium.



Fig 21. 19/25 stainless steel working arch wires to achieve space closure.

We placed the appliances in December 1994 (Fig 19). We made very slow progress through flexible (0.016) and 18/25 nickel titanium arch wires (Fig 20) as cooperation with treatment was not really forthcoming, and the patient had 17 breakages repaired during his course of treatment. We finally progressed up to 19/25 stainless steel. At each appointment chlorhexidine varnish was applied to the upper incisor brackets in the hope that this would reduce enamel damage during treatment (Fig 21). Elastic traction ligatures were regularly replaced and space closure eventually achieved. After 1 visit in 0.014 stainless steel finishing wires to finalize tooth positions (Fig 22), we finally removed the appliances in July 1997. Active treatment time for correction of the malocclusion was 2½ years. We felt that this was acceptable in view of the number of breakages and the many failed appointments.

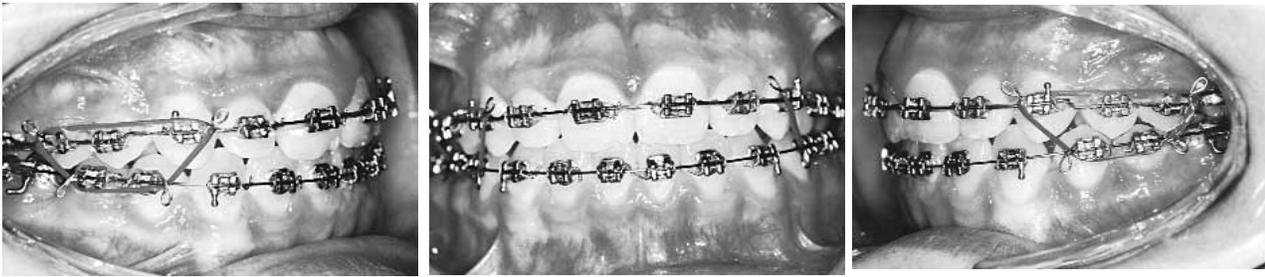
Final intraoral photographs show reasonable buccal segment interdigitation, correction of the labial segments and correction of the anterior open bite (Fig 23). Essix upper and lower retainers were used, and the overbite correction will be monitored over the next few years.

Near the end of treatment, cephalometric analysis shows slight retroclination of the upper labial segment and retroclination of the previously proclined lower labial segment that was necessary to close the anterior open bite. The mandibular planes angle did not increase during treatment although the lower anterior facial height proportion increased slightly. Superimposition shows closure of the anterior open bite and a moderate change in the jaw positions, which is largely in a vertical direction.

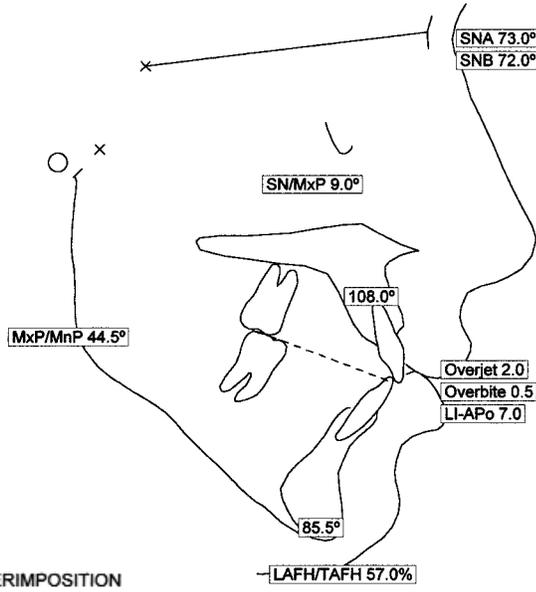
An OPT radiograph taken 2 months before debonding shows good root paralleling and some slight root resorption on the distal root of both lower second molars. The treatment had been unnecessarily prolonged as a result of the poor patient cooperation, and this will have contributed to the root resorption. The upper second molars were in a reasonable position to the upper second premolars and there should now be sufficient room for the third molars to erupt into the mouth.

SUMMARY

Even with careful planning and execution of treatment any orthodontic case involving the extraction of first



NAME SEX DOB X-RAY DATE
 05-08-1996



NAME SEX DOB

SUPERIMPOSITION
 Sella-Nasion @ Sella

05-08-1996 (———)
 31-08-1994 (———)

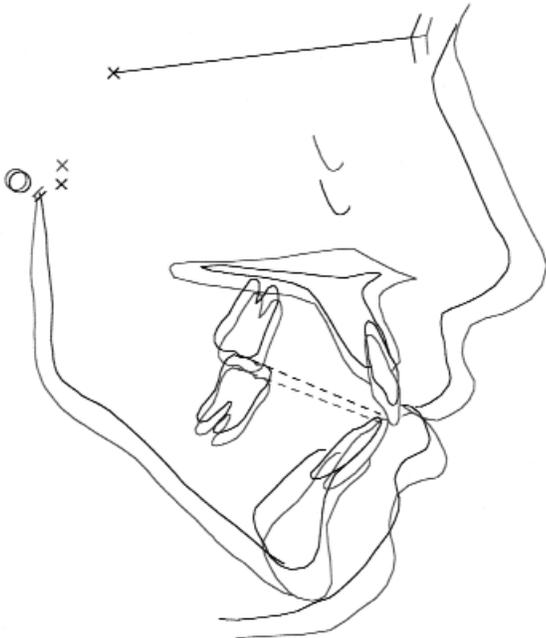


Fig 22. Finishing on 0.014 stainless steel, near end of treatment radiographs.

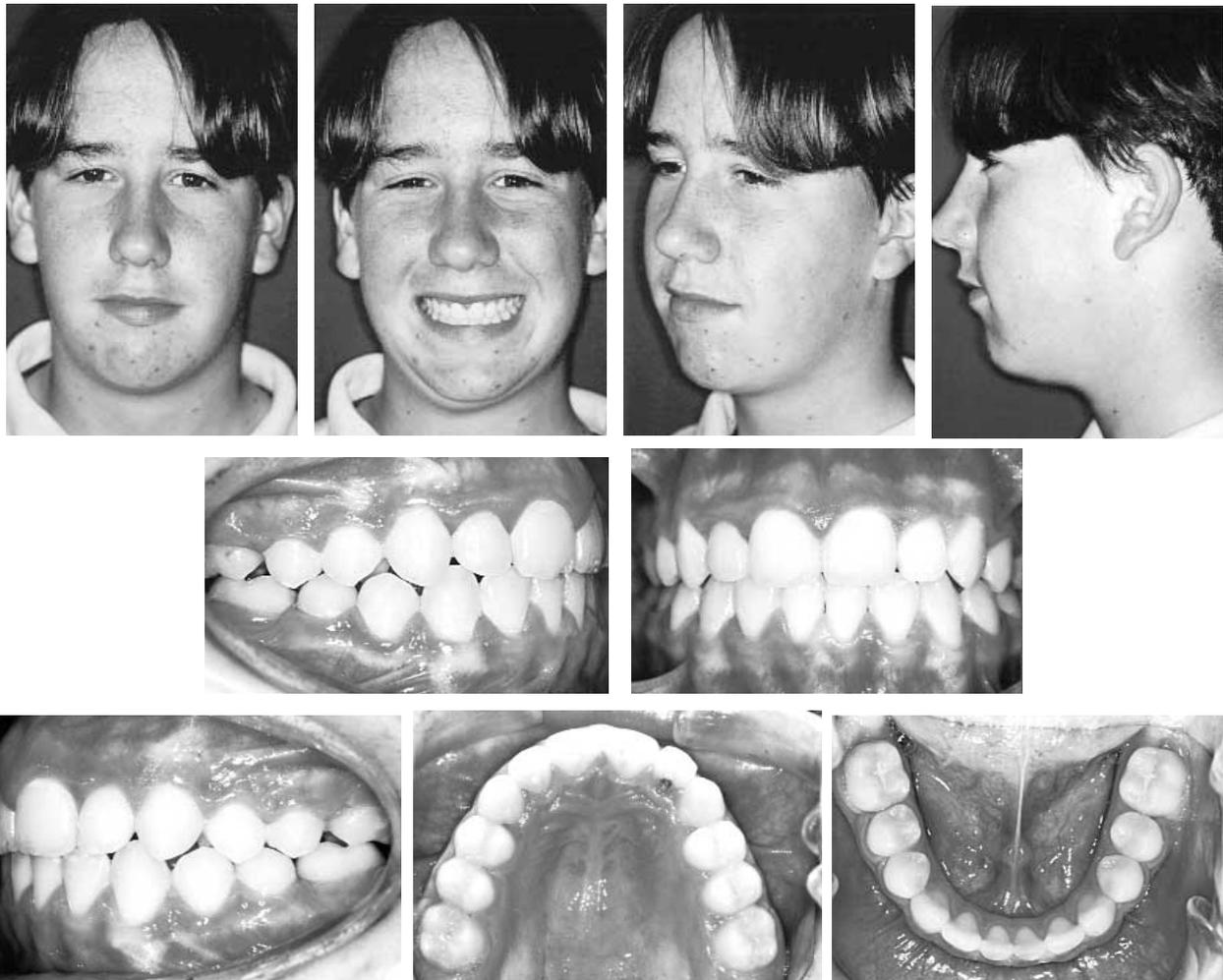


Fig 23. Final photos of case 3.

molars will almost certainly take between 6 and 9 months longer than an equivalent case in which 4 premolars are extracted. Careful case assessment must be undertaken before treatment to ensure that the benefits of treatment will outweigh any potential disadvantages of this extended treatment. A knowledge of the potential problems with first molar cases will allow the necessary action to be taken before many of these problems arise.

REFERENCES

1. Bradbury AJ. A current view on patterns of extraction therapy in British health service orthodontics. *Br Dent J* 1985;159:47-50.
2. Wilkinson AA. The first permanent molar again. *Br Dent J* 1940;8:269-84.
3. Salzmann JA. A study of orthodontic and facial changes and effects on dentition attending the loss of first molars in five hundred adults. *J Am Dent Assoc* 1938;25:892-905.
4. Mills JRE. Principles and practice of orthodontics, 2nd edition, New York: Churchill Livingstone; 1987. p. 123-5.
5. Daugaard-Jensen I. Extraction of first molars in discrepancy cases. *Am J Orthod* 1973;64:115-36.
6. Houston WJB, Stephens CD, Tulley WJ. A textbook of orthodontics, 2nd edition, Oxford: John Wright; 1992. p. 196-9.
7. Stepovich ML. A clinical study on closing edentulous spaces in the mandible. *Angle Orthod* 1979;49:227-33.
8. Hom BM, Turley PK. The effects of space closure of the mandibular first molar area in adults. *Am J Orthod* 1984;4:457-69.
9. Mitchell L. An introduction to orthodontics, Oxford, England: Oxford University Press; 1996. p. 26-8.
10. Williams R, Hosila L. The effect of different extraction sites upon incisor retraction. *Am J Orthod* 1976;69:388-410.
11. Orton H, Carter NE. Initial management of first molar extraction cases. *J Clin Orthod* 1988;22:230-8.