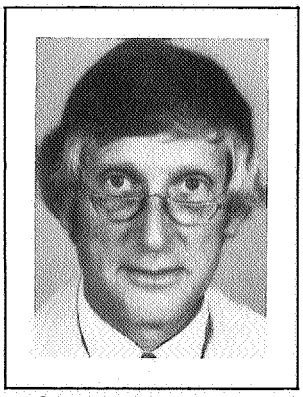
sciendo DOI: 10.2478/aoj-1985-0010



Maxillary control with functional appliances: some clinical observations

John R. Heath, M.D.Sc.(Melb) L.D.S., F.R.A.C.D.S.
Melbourne, Victoria.

Abstract:
Accepting that the activator appliance can be used successfully to correct the occlusion by modifying the relationship of the dentitions and modifying growth characteristics of maxilla and mandible, what are the limitations of the appliance in the treatment of Class II division I cases? How can we overcome these limitations to avoid the undesirable sequelae? Clinical experience with the Classical European Activator leads to the conclusion that this appliance does not provide adequate control of the position of the maxilla, and of the maxillary dentition. Unfavourable mandibular rotation may be induced. Excessive display of upper incisors may be increased. Similarly anterior high pull headgear attached to fixed appliances may also produce undesirable rotation of maxillary structures, particularly in patients showing dolichofacial characteristics. A combination of these two treatment modalities has been developed by Dr. U. Teuscher of Zurich. This article in essence represents an analysis of clinical results in which the activator with anterior high pull headgear was used in patients chosen from the author's practice. The aim is to help the clinician appreciate the far reaching potential of the Teuscher appliance. Because the objective of this article is motivational, references are provided that should enable the clinician to manufacture and use the appliance, and to integrate the concept into their overall management of our Class II division 1 cases.

Reference: Aust. Orthod. J. 9(2): 219-225 (1985).

Key words: Activator, Teuscher, anterior high pull headgear, centres of rotation, vectors of force.

INTRODUCTION

The Class II division I problem is often associated with inadequate horizontal mandibular development, less often with excess horizontal development of the maxilla. Added to this, vertical divergence of the face due to excess vertical development of the maxilla, results in difficulty in producing an attractive profile where ramus growth is inadequate, because mandibular growth is directed downward rather than forward. These problems have been overcome in part by the utilisation of high pull vectors of extra-oral traction. However, it has still remained difficult to produce an acceptable profile for patients who have a divergent face anteriorly. The more generalised acceptance of orthognathic surgery has given us a means of modifying the relationships of basal mandibular and maxillary structures, so that after growth has ceased, orthodontists have not needed to resort to the practice of dentoalveolar compensation, with its associated functional, aesthetic, and physiological stigmata, to produce correct occlusal relationships. Until recently there has been a tendency to delay orthognathic surgery until growth is all but completed, so that in this approach, currently applied to patients who present late for treatment, the potential for modification of growth has not been utilised to advantage.

Concomitant with the development of improved diagnostic and therapeutic surgical skills, there has been an increasing awareness of a potential for modification of growth and development, by the use of functional appliances. The orthodontic literature currently abounds with articles related to functional appliances. Three recent publications by Graber et al. (1984,1985) are indicative, and are recommended for those who wish to gain a general appreciation of the various systems available. The purpose of this article is to give readers the benefit of some of the author's experience, to enable them to circumvent the natural tendency to experimentation, and to show how a new concept has evolved that should allow an integration of growth modification with functional appliances, into the overall orthodontic management of our Class II division I patients. Credit must be given to Dr. Teuscher of Zurich for his masterly analysis of the shortcomings of some previous functional appliances, and the development of the mechanism that he evolved.

Teuscher's original publication 'A Growth Related Concept --' (Teuscher 1978) stresses the importance of the concept, rather than the mechanism. In essence, the basic appliance used is the European activator. The short comings of this appliance will be analysed briefly in this article. The activator conceivably enhances mandibular growth. To the basic activator is added an anterior high pull head gear mechanism which allows inhibition of vertical maxillary growth. Indeed vertical and sagittal maxillary growth may be reversed. ***This allows a totally new dimension of control, particularly useful in cases with a divergent mandible.*** The appliance is best used in the mixed dentition period, prior to the time when banding treatment is performed. It is much better tolerated and accepted than is the classical activator. The reader is referred to the original article; and to chapter 7 by Stockli and Teuscher in Graber and Swain (1985) for a detailed explanation of the evolution of the concept, the manufacture and clinical management of the appliance, and to an analysis of further case histories to support the concept.

THE ACTIVATOR

The basic European activator corrects the occlusion by encouraging mandibular growth, whilst effectively moving the maxillary dentition distally on its base. In the process, the upper incisor segment is uprighted, and instead of the normal downward and forward growth of A point, the forward component is restrained.

Let us consider three favourably growing cases treated with the activator.

Figure 1. S.B., a patient with low anterior face height and low mandibular plane angle will experience minimal uprighting of the upper incisors.

Figure 2. S.M., even with a more divergent face, and a higher mandibular angle, incisor uprighting is minimal if extensive mandibular growth can be encouraged. In this case maxillary growth has been minimal, and the aesthetic result is acceptable.

Figure 3. J.F., however, is one with high anterior face height and low mandibular angle, and growth is more vertical. The mandibular plane does not open, but

as we produce bite opening the lower buccal segment teeth are encouraged to erupt, to achieve a levelling of the functional occlusal plane as detailed by Woodside in chapter 9 (Graber and Neumann, 1984). In the process the upper incisor segment is noticeably elongated and uprighted. The resultant increase in inter-incisor angle makes bite opening difficult. The aesthetic result is poor.

Apart from the skeletal configuration, other physiological and manipulative factors are involved in determining the nature of the response, but the results, whilst predictable, can still be aesthetically undesirable, due to the inability to control vertical tipping of the maxillary dentition and associated uprighting of the upper incisors.

INCORPORATION OF HIGH PULL HEADGEAR

Teuscher analysed these responses and recognised the need for improved control of the maxillary component. His appliance allows control of upper incisor angulation.

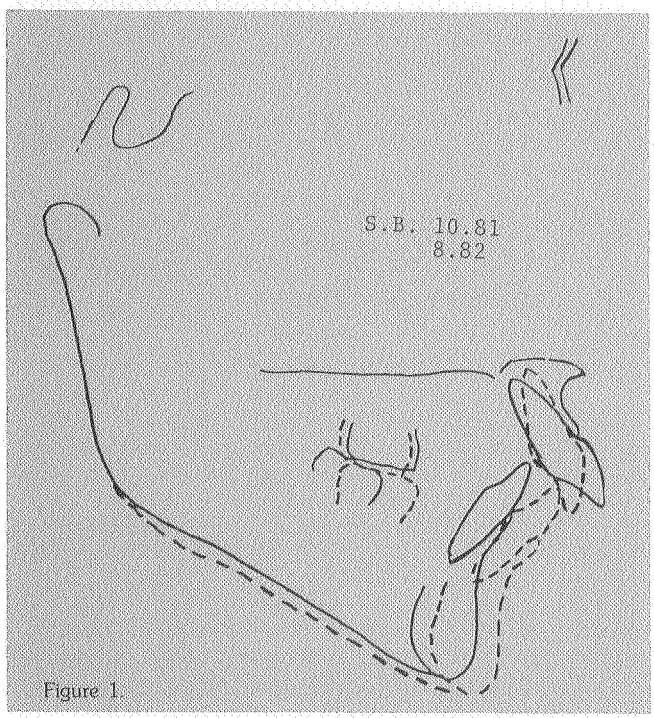


Figure 1.

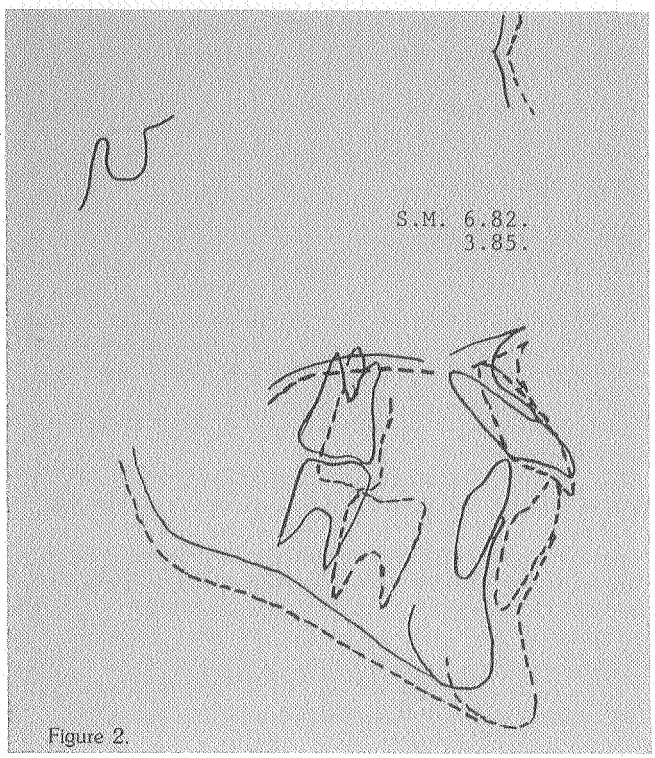


Figure 2.

It allows the entire upper dentition to be tipped up in the incisor area, to be held where it is on the maxillary base, or to be moved selectively backward on base. These controls are possible by variations in direction and magnitude of headgear force application. Perhaps we are also able to restrain maxillary growth, although this remains to be investigated. The integration of these orthopaedic methods into our overall management plan for growing children with Class II division I problems, helps to control many of the difficulties associated with the management of high angle cases, those with mandibular deficiency, and with moderate degrees of vertical maxillary excess.

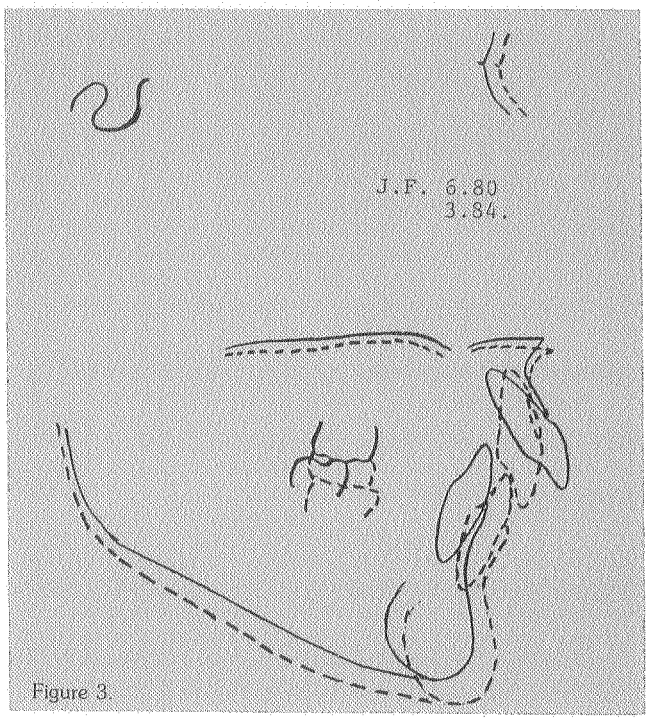


Figure 3.

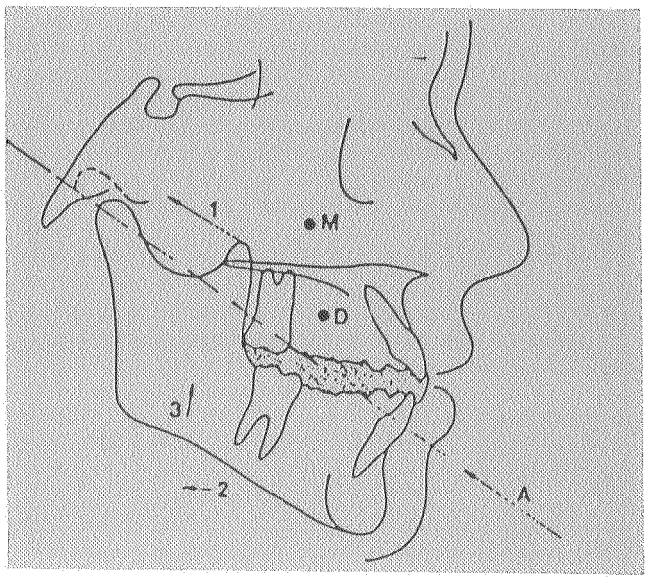


Figure 4. Intermaxillary force initiated by the bite registration; combined action of the retractors and elevators of the mandible. The arrows represent force vectors. 1, Horizontal portion of the musculus temporalis. 2, Suprahyoid musculature. 3, Musculus masseter and musculus pterygoideus medialis. A, Addition of vectors 1, 2 and 3. Vector A affects maxillary dentition and the midfacial complex. A reciprocal vector to A exerts force on the mandibular dentition. D, Assumed position of the centre of resistance of the maxillary dentition. M, Assumed position of the centre of resistance of the maxilla. Note that the path of A is below D and M.

Basic to Teuscher's philosophy is the acceptance of clinically established centres of rotation of maxillary dentition, and of maxilla. The Basic Activator exerts forces that result in the responses detailed in *Figure 4.*

Application of high pull headgear redirects forces so that the resolved vectors produce the effects shown in *Figure 5.*

Conversely, the activator with high bite registration produces the effects shown in *Figure 6.*

Application of these concepts is detailed in the cases which follow.

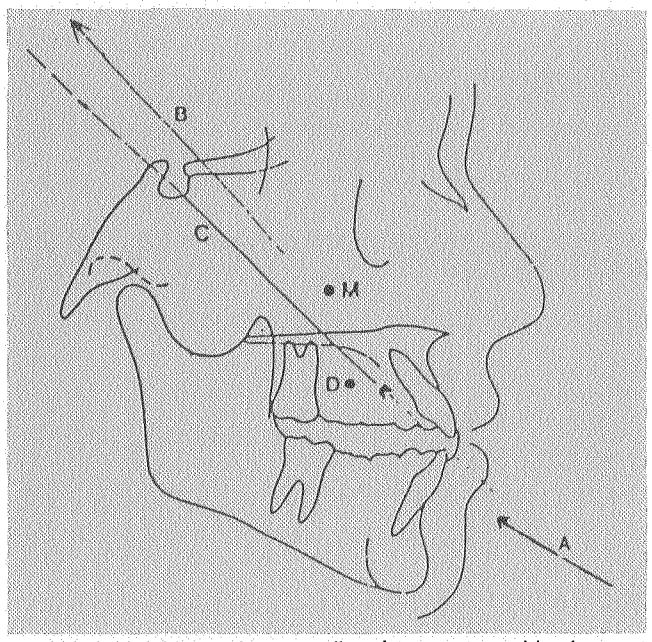


Figure 5. Addition of intermaxillary forces generated by the musculature and of extra-oral forces, both acting on the nasomaxillary complex. A. Same vector as in Figure 4. B. Extra-oral force vector. C. Addition of vectors A and B. D. Assumed position of the centre of resistance of the maxillary dentition. M. Assumed position of the centre of resistance of the maxilla. C acts on the maxillary dentition and on the midfacial complex. Note that the path of C runs between D and M. As in Figure 4, a force vector reciprocal to vector A acts on the mandibular dentition.

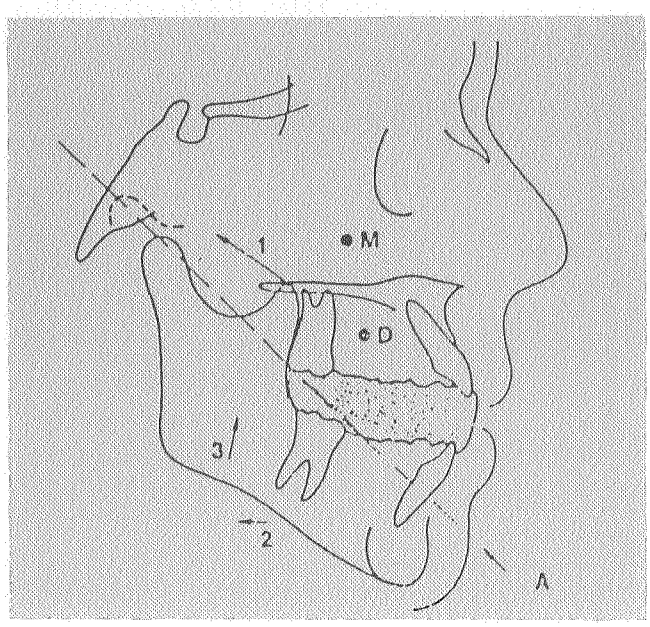


Figure 6. Influence of a high bite registration on the intermaxillary force vector A determined by the musculature. In comparison with the analogous Figure 4, the following differences can thus be observed: the greater height of the bite registration leads to slight elongation of arrow 3; the path of A is steeper and shows greater eccentricity in relation to D and M.

(Figures 4, 5, 6 and titles reprinted from Am.J.Orthod. September 1978, by courtesy of the Editor).

CLINICAL RESULTS

Figure 7. N.J. This patient is a controlled epileptic and rather difficult to manage. She had no crowding and was treated in the mixed dentition period. At commencement she had an overjet of 11.5mm. Note the reduction in SNA, the depression of the upper incisors, and the counter clockwise mandibular rotation.

Figure 8. F.C. This patient had marked hypoplasia of the enamel of the first molars so that these teeth were restored temporarily to allow treatment to proceed. The first molars were extracted on May '85 and treatment continues, to retain the improvement achieved during the transitional stage. Full banding will be required at a later stage. Note the divergent mandible and the slight counter clockwise mandibular rotation during treatment. The upper incisor segment has elongated slightly but improvement has occurred in upper lip level. The lower incisor segment has elongated, to compensate for the mandibular growth and the restrained vertical development of the maxillary incisor segment.

Figure 9. C.C. It will be seen from the figures that the lower incisors were at 99 degrees at the beginning of treatment. SNGoGn was 35 degrees, SNA 82 degrees, SNB 77 degrees. The potential for mandibular advancement was limited by the forward position of the lower incisors, whilst the upper canines were displaced forward over the lateral incisors. It was decided to extract four first premolars to allow the upper canines to move distally; lower fixed appliances were fitted for four months, to allow retraction of the lower labial segment into the extraction spaces. With the lower incisors uprighted, the potential for mandibular advancement has been enhanced, before treatment with the high pull headgear activator. Mandibular advancement is restricted

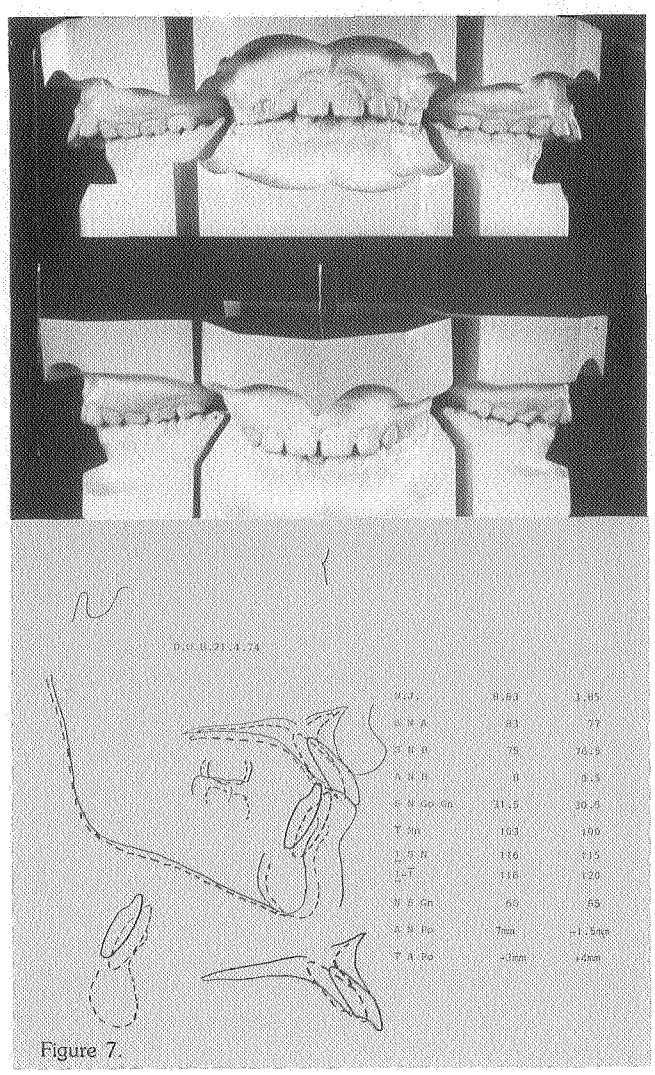


Figure 7.

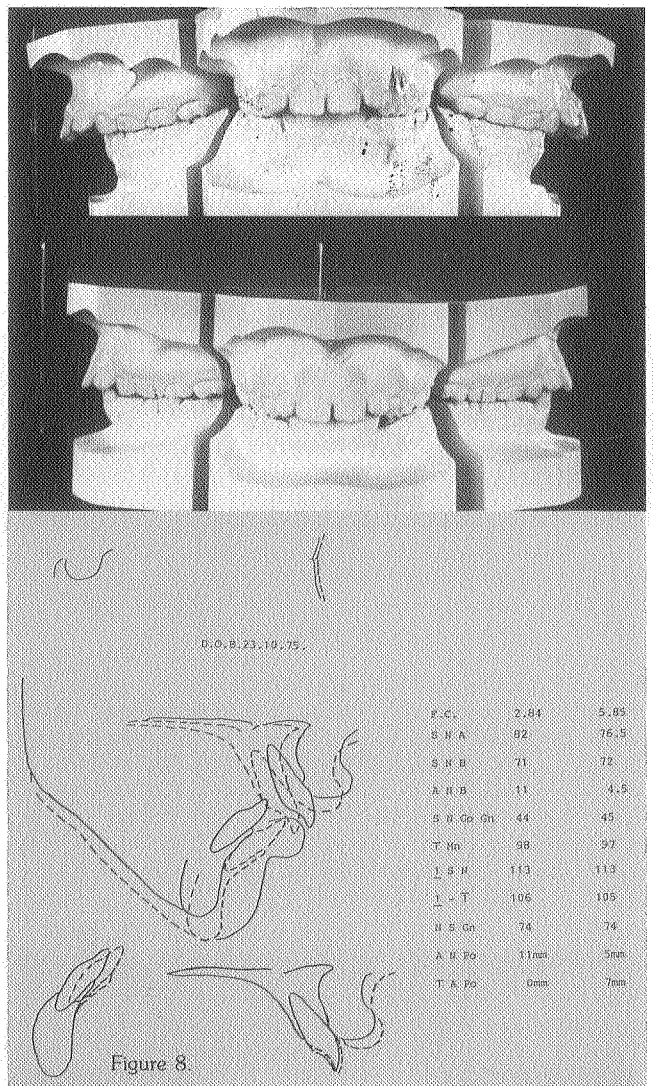


Figure 8.

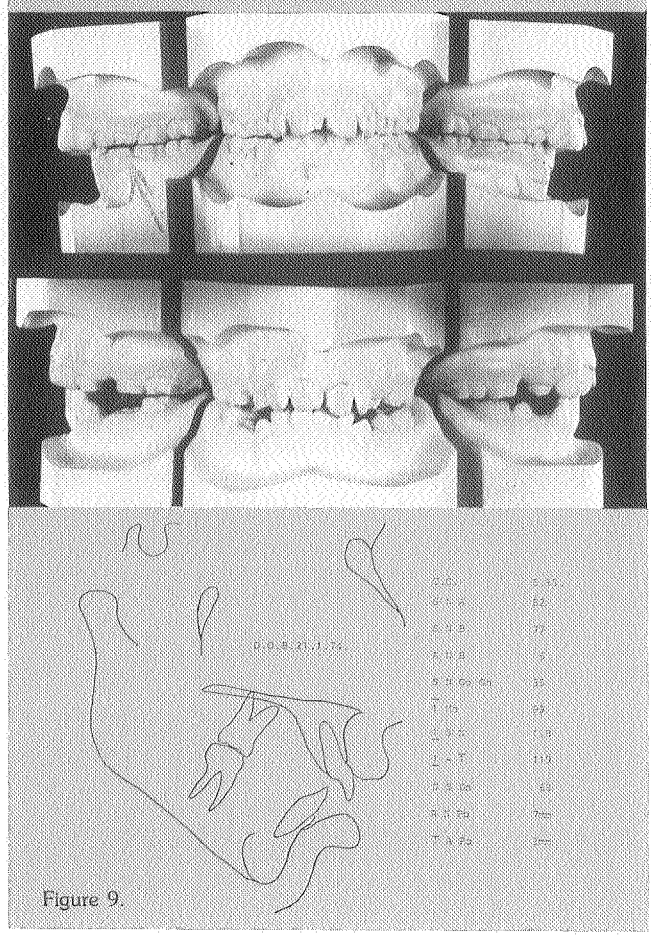


Figure 9.

when incisors come into occlusion, whether due to excessive proclination of lower incisors, or to the presence of palatally inclined upper central or lateral incisors. Lower fixed appliance treatment is proceeding now whilst the Teuscher activator is being worn at night.

Figure 10. N.D. A thumb sucking habit had produced retroclination of lower incisors and proclination of upper incisors, along with palatal collapse of the upper left buccal segment into crossed bite. A quad helix appliance was fitted in the upper arch to produce lateral expansion, a lower lingual expansion arch to produce AP expansion. After three months, the Teuscher activator was fitted to produce the final correction of the Class II problem. It is anticipated that no further treatment will be necessary in this case.

Figure 11. P.K. was dentally precocious. An extreme Class II division 1 problem existed, with 14mm overjet, a divergent mandible, and crowding. It was planned essentially to extract four first premolars in this

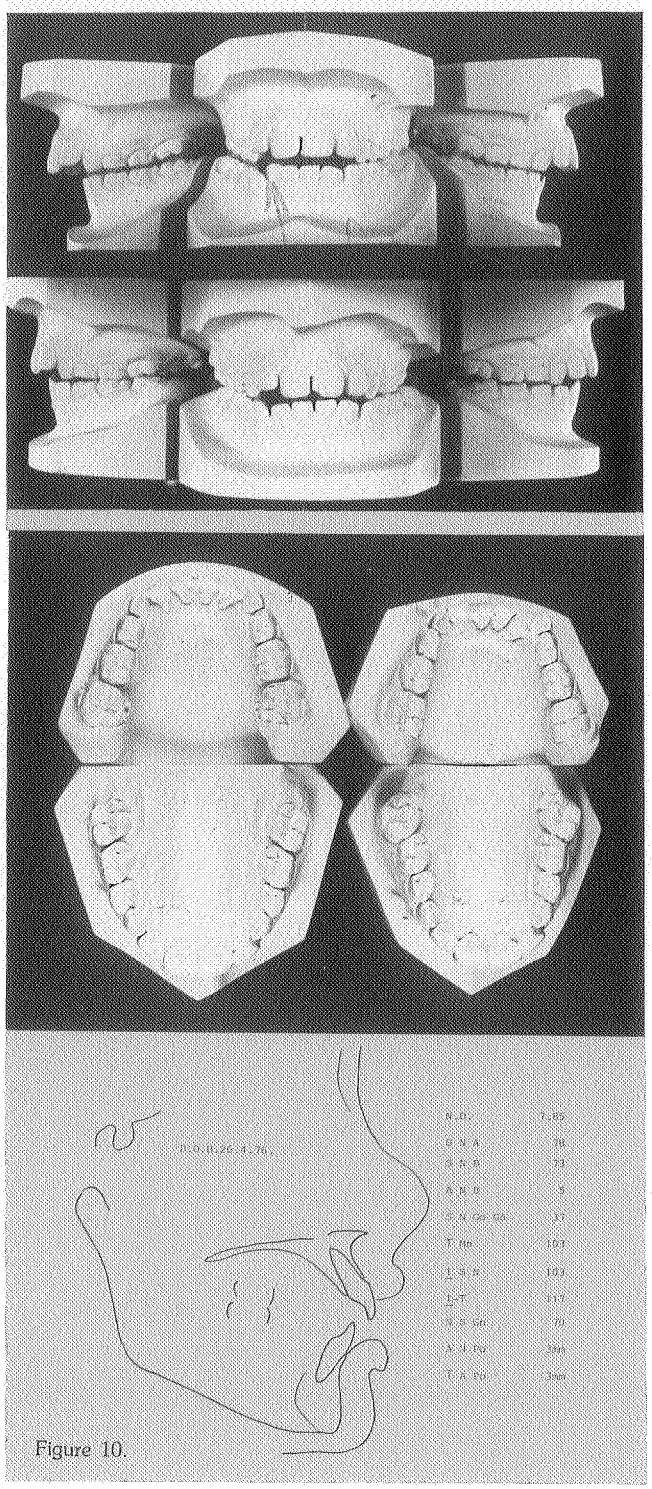


Figure 10.

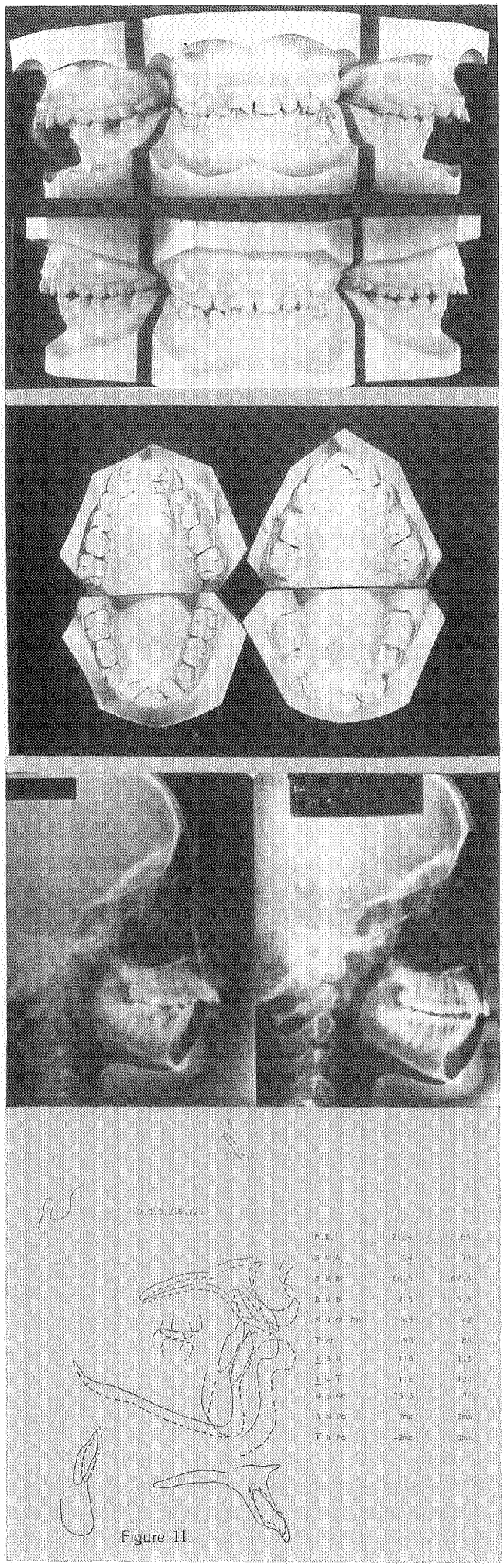


Figure 11.

case, but initially to endeavour to correct the mandibular deficiency, and to produce some retraction of the maxillary dentition with the Teuscher activator before full fixed appliance treatment. The tracings show how the maxillary incisor segment has been effectively depressed some 4mm, and that this has been compensated by elongation of the lower incisor segment. There has been minor counter-clockwise rotation of the mandible and favourable mandibular growth. The modification of the position of the maxillary dentition has resulted in a marked improvement in upper lip line and concomitantly in upper incisor display. The radiographs show this more clearly *(Figure 11c)*. A root canal filling in an upper central incisor is a good marker to show how much the incisors have depressed. The models show how the buccal relationship has been corrected. Naturally, this is an interim report on progress. Four first premolars were

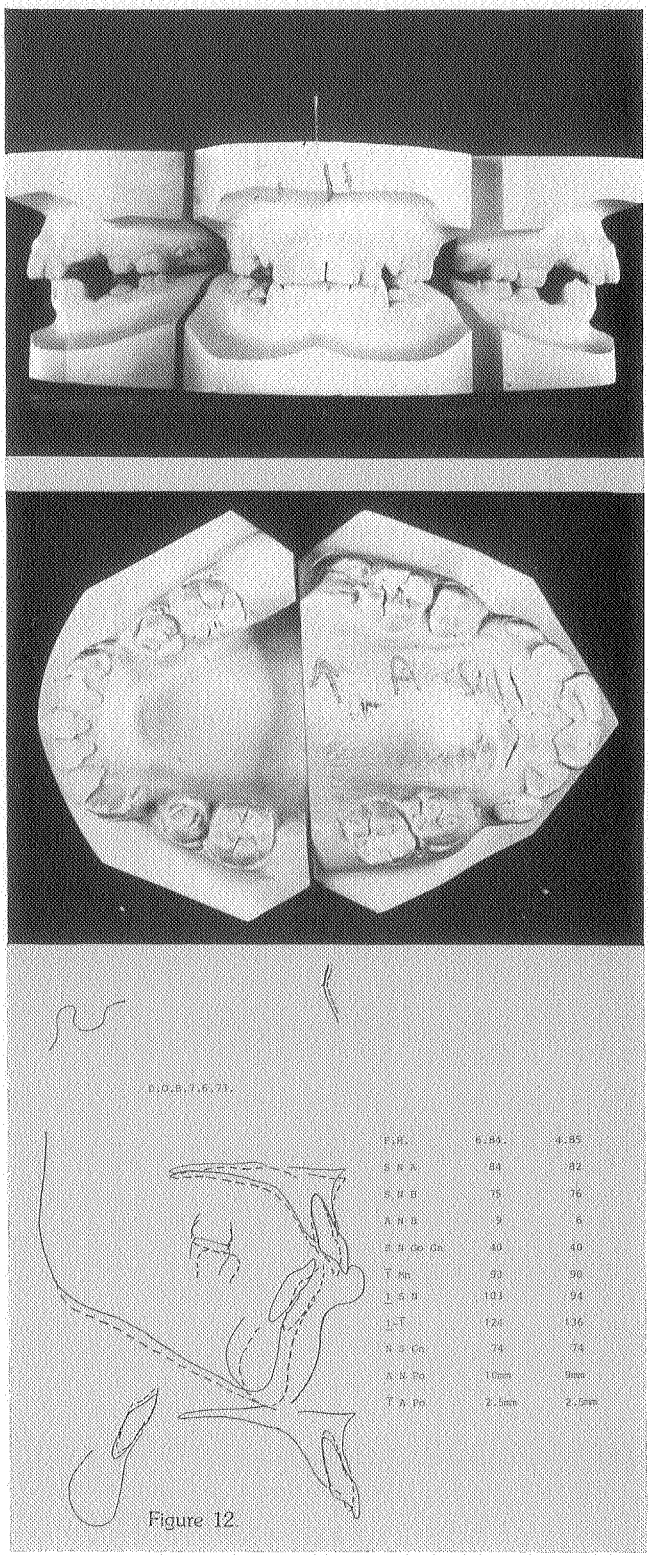


Figure 12.

extracted in May 85 and appliance wearing continued. It is planned to fit fixed appliances in February 86. Here the overjet was too great to allow adequate mandibular advancement with one appliance, so that the lower half of the appliance was reregistered in a more forward position in January 85. This is a simple procedure and is often done. One must beware of advancing the mandible more than 6mm in one attempt, particularly in high angle cases, for fear of inducing clockwise mandibular rotation.

Figure 12. F.H. had upper canines displaced forward over the incisors. The face was long, vertically, and if a simple activator had been used it was anticipated that vertical growth would have resulted in excessive upper incisor uprighting and elongation. Four first premolars were extracted early to allow spontaneous tooth movement whilst the headgear assisted activator was worn. The tracings show favourable adjustment of basal relationships, and a similar 'rocking upward' of the incisor segments, upper and lower, as was shown in the previous case. The models show spontaneous drift of upper canines during the activator treatment. Treatment will be completed using fixed appliance.

Figure 13. N.K. had a quite severe Class II division I problem with relatively upright and slightly crowded upper incisors. The upper lip was 4mm up the upper incisors at commencement, so that incisor depression was desirable. As well, encouragement of mandibular growth was required to facilitate lip closure by bringing the bony bases from which the lips function into a more favourable anteroposterior relationship. The models and radiographs show how these objectives have been achieved. Four second molars were extracted when the third molar bifurcation formation began, to relieve crowding innate in the arches. Subsequently, headgear has been fitted to upper molars and the upper arch banded to allow correction of interdigitation, and production of space to align the slightly crowded upper labial segment. This case fulfilled the author's criteria for extraction of second molars, criteria that will be considered in a subsequent article.

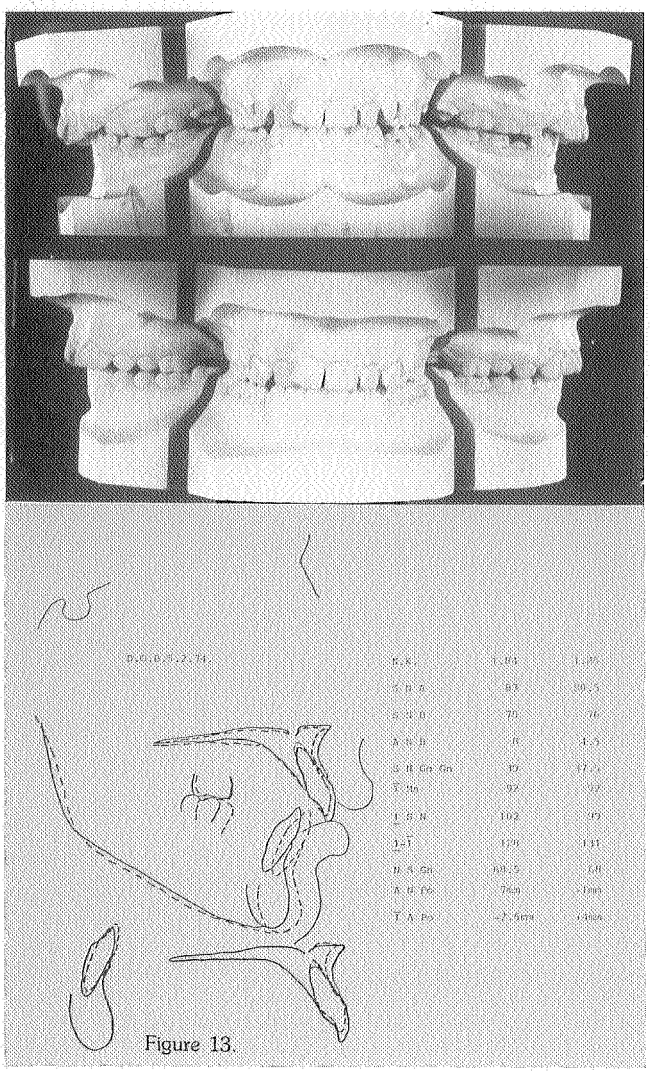


Figure 13.

DISCUSSION

Whilst cephalometric assessment of each case is essential in the early diagnostic stages, it is perhaps more important to think in terms of how the use of the Teuscher activator is to be integrated into the overall treatment plan. As has been shown, fixed appliance treatment may precede, or may be planned to follow functional treatment.

Cephalometric assessment should be aimed at estimating the anteroposterior position of the maxilla, of mandible, and of dentitions. This assessment will then indicate if the case is one in which mandibular growth is to be encouraged, maxillary growth redirected, or dentitions repositioned on their bases. Encouragement of mandibular growth can be contraindicated in the case with a strong chin button. It should be utilised in a case where the maxilla is normal in position. Restraint of maxillary growth is exercised if maxillary development is excessive in either horizontal, or vertical dimension. Control is exercised by various force modifications. In essence, the effect on maxillary structures is controlled by varying the magnitude and direction of the extra-oral force vector. Referring back to Teuscher's analysis of centres of rotation, it will be understood that the extra-oral force vector is not only influenced by the operator but also by the morphological features of the patient, such features as mandibular divergence, skull morphology influencing direction of pull; and the balance of muscular forces.

The effect on mandibular position is influenced in part by control of maxillary structures as detailed. However, the major influence is exercised by varying the working bite registration. Minimal advancement is required to induce condylar growth. Advancement should not exceed 6mm. In high angle cases, bite opening should be minimal, usually limited only to providing enough space for insertion of headgear tubes and torquing springs. Conversely in low angle cases, with deep bite tendency, more bite opening is indicated to allow encouragement of vertical development of lower buccal segments. These latter cases present minimal difficulties, the Teuscher appliance having been designed more specifically to cope with the problem of the more divergent face types.

Wearing the appliance for twelve hours each night is adequate, the waking hours being used to condition the patient to accepting the appliance prior to sleep. One may expect a quicker response than in cases using the activator alone. One should monitor changes in interdigitation, and overjet overbite relationships. Patients often are encouraged by the reduction in upper incisor display, produced as the upper incisors are depressed relative to the upper lip. Whilst this can be a positive motivating factor we should be cautious in our optimism, as there is often a compensatory lengthening of the lower incisors. This effect can result in the upper incisors being moved up beyond the control of the lower lip, the converse effect to that produced by the activator in the vertically growing patient.

PRACTICAL CONSIDERATIONS

Experience with the appliance and the concept justify innovative modifications, and these are well documented in Graber & Swain (1985) 'Current Principles and Techniques'. There are a few basic facts that should be appreciated to allow proper use of the appliance.

1. The upper incisor torquing springs are essential, to counteract the effect of the high pull headgear. These springs, though they may appear passive, do considerable

work. They allow the use of the varying degrees of control implied in this article.

2. From the tips of the upper incisors, acrylic must extend 2mm up on the labial, and 3.5mm on the palatal, to allow correct operation of the torquing springs.

3. The labial acrylic over the lower incisors must extend to the gingival level, and the occlusal details of the lower buccal segments must be retained where possible.

4. Any variation from these three principles must be planned before appliance construction. Labial or lingual movement of upper or lower incisors with appropriate springs should be organised and performed observing the principles outlined by Teuscher.

Following the practice outlined we may expect ready acceptance of the appliance by our mixed dentition patients, and in turn hope to facilitate management of some of our more difficult problems. *Conceptually, if we could manipulate the maxillary buccal segments vertically, as we have shown possible with the labial segment, then we might hope to be able to produce more counter clockwise rotation of the mandible.* Maybe also we can conceive of influencing maxillary basal structures more with our therapy. These are concepts that require further investigation.

ACKNOWLEDGEMENT

Appreciation is due to Dr. V.C. West for his helpful advice and criticism and to the Photographic Department of the Faculty of Dental Science for their assistance in preparing slides and photographs.

REFERENCES

GRABER,T.M. and NEUMANN,H.F. (1984)
Removable orthodontic appliances
Second Edition, W.B.Saunders Co.
GRABER,T.M.and SWAIN,B.F. (1985)
Orthodontics: Current principles and techniques
C.V.Mosby Co.
GRABER.T.M., RAKOSI,T. and PETROVIC,A.G. (1985)
Dentofacial orthopedics with functional appliances
C.V.Mosby Co.
STOCKLI,P.W. and TEUSCHER,U.M. (1985)
Combined activator headgear orthopedics
Graber and Swain, Chapter 7:405-483
TEUSCHER,U.M. (1978)
A growth related concept for skeletal Class II treatment
Amer.J.Orthod. 74:258-275

Based on a paper given to a weekly meeting for the staff and post graduate students at the Royal Dental Hospital of Melbourne

Dr. John R. Heath
2a Wills Street
Hawthorn East
Victoria 3123