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Middle ear effusion: An orthodontic perspective

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Abstract
Deviations in facial form are discussed. On the basis of previously published hypotheses, it is suggested that oropharyngeal development may be influenced by the posture, and function of the tongue, lips, and jaws. Attention is drawn to the relationship between a firm tongue to palate swallow, and the pump action of the palatine aponeurosis, which it is suggested is necessary for the aeration of the Eustachian tube. The pump action appears to be reduced in long faced adenoidal children, but clinical evidence suggests that it can be regenerated by early Orthotropics (growth guidance) aimed at directing facial growth forward, instead of downward. Any reduction in the height of the face, facilitates an improved lip seal, without which the downward pattern of facial growth is likely to continue. On occasions when these objectives are achieved it would seem that sufficient room is created to align all 32 teeth, with excellent facial form, and little otolaryngological pathology.

Introduction

Hippocrates in his sixth book of epidemics states 'Among those individuals whose heads are long shaped, some have thick necks strong members and bones, others have strongly arched palates; thus teeth are disposed irregularly, crowding one on the other, and they are molested by headaches and otorrhea.'

One of the oldest debates in history has centred around the relative contributions of 'inheritance' and the 'environment' to the development of the individual. While there is a natural tendency to consider the growth of skeletal structures as genetic, environmental factors do at times appear to have an influence on bony form. For instance it is known that considerable variations exist in the bones of identical twins, and nowhere is this more obvious than in the facial skeleton. To quote the original research of Horowitz *et al.* (1960) on 35 pairs of twins: 'Highly significant hereditary variations occur in anterior cranial base, mandibular body length, total face height, and lower face height.'

Otolaryngologists would recognize that variations of these particular structures are commonly associated with year-round nasal obstruction (Nove, 1952; Timms, 1974; Meredith, 1988a,b) recurrent bacterial maxillary sinusitis, adenotonsillar hypertrophy, otitis media with effusion, and recurrent bacterial otitis media, and also of course, with dental malocclusion and facial maldevelopment. It might be expected that an adequate facial skeleton would be a strong selective factor in our struggle for survival, and yet Dickson (1970) in an assessment of several surveys concluded: 'Malocclusion is, and has been for many generations passed, an almost universal state in *Homo sapiens.*' In these circumstances it becomes important to separate what might be considered as 'normal', from what should perhaps be called 'natural'. For instance, dental crowding and the disproportionate jaws that so often accompany it, is certainly normal, but in evoluntionary terms probably unnatural.

There is both subjective and objective support for the view that oro-facial malformations may be increasing in frequency, especially in highly cultured societies. Corruccini *et al.* (1983) studied children of different social backgrounds within a single interbreeding population in Northern India, where social contrasts are often extreme. The children from high social groups, were five times as likely to have projecting upper teeth as those from low social groups. There are many similar examples, for instance civilized man has cusps, while his predecessors quickly wore their teeth flat, and ascending ear infections have become endemic in modern industrialized societies.

Few biologists believe that the changes in the oropharynx, and the undoubted reduction of jaw size since the development of urban living some 20,000 years ago can be related to any genetic change, and it might be helpful to consider some of the epigenetic factors that could be responsible.

Clinical evidence would suggest that the development of the facial bones can be influenced by a number of environmental influences such as nasal obstruction (Fig. 1), jaw posture (Fig. 2) or tongue posture (Fig. 3). A factor common to all these examples is open mouth posture, and associated with this the face grows downwards instead of forwards, accompanied by substantial anatomical change. It is obvious that changes in the hard tissues of such magnitude, must be mirrored by corresponding changes in the adjoining soft tissues of the ear, nose, and throat. Pathology apart, this pattern of growth also seems to be associated with snoring, and obstructive sleep apnoea.

Many previous workers have suggested that chronic open mouth postures appear to encourage downward instead of forward growth of the face, (Hannuksela,

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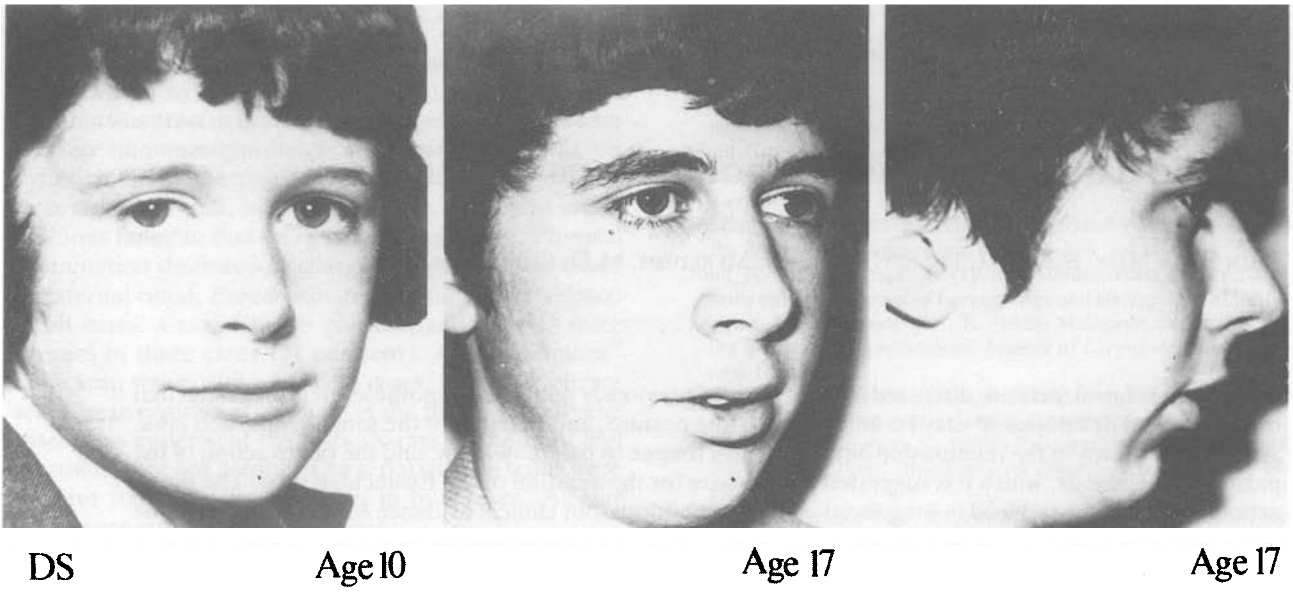

FIG. 1
A 10-year-old boy who developed nasal stenosis at the age of 14. Note the downward growth. He continued to keep his mouth open although the stenosis was corrected surgically. *Functional Orthodontist,* **4:** 37–433, 1987.

1981; Mew, 1981; Shapiro and Shapiro, 1984; Bresolin *et al.,* 1984). This was demonstrated in Figs. 1–3, in which the cheeks and chins appeared to have fallen back, leaving the eyes and nasal skeletons prominent. While in the past such variations have been considered genetic, the examples just considered might suggest that epigenetic factors could exercise a considerable influence on the growth of the dentofacial skeleton (Mew, 1987), even to the extent of the facial differences illustrated in Fig. 4, in which a constructed 'natural face' is compared with five others displaying common variations.

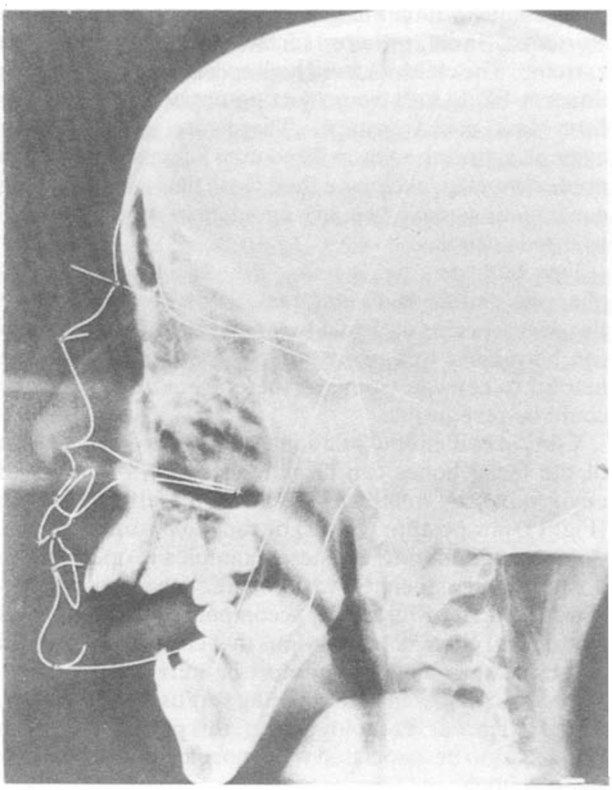

FIG. 2
A 12-year-old girl, who developed muscular dystrophy. Her inability to close her mouth was associated with about 2 inches of downward growth at the pogonion in comparison with average growth of her age group. *American Journal of Orthodontics,* **74:** 1978.

Otolaryngological implications

Such a perspective, if it were true, might be expected to have a profound impact on the anatomy of the nose and pharynx. Unfortunately, it is difficult to measure such variations scientifically, the most widely used tool being cephalometric radiographs, which are often not accurate enough to identify the precise nature of the changes.

It has also proved difficult to relate upper airway compromise to respiratory function. Vig *et al.* (1981) have shown that an open mouth posture is not necessarily a sign of mouth breathing. Bresolin *et al.* (1984) demonstrated that children who were considered to be mouth breathers, had significantly longer faces. While the newly born are compulsive nasal breathers, a short period of nasal obstruction may destroy their natural lip seal for ever. For instance, the boy in Figure 1 has maintained his mouth open posture, although his nasal obstruction had been satisfactorily corrected.

Thomas *et al.* (1987) found major changes in nasal resistance with complete loss of the nasal cycle in patients who have had tracheotomies. Timms (1986) found that a close relationship exists between nasal resistance and narrow maxillae and has shown that rapid expansion of the mid palatal suture improves the nasal airway. Liphook (1981) reported that rapid expansion appeared to improve a conductive hearing loss, secondary to otitis media with effusion.

Despite these findings there is justified scepticism amongst otolaryngologists concerning the value of maxillary expansion, and together with adenoidectomy and tonsillectomy the long-term advantages of expansion have been found to be variable. This is surprising because the research has convincingly shown (Skieller,

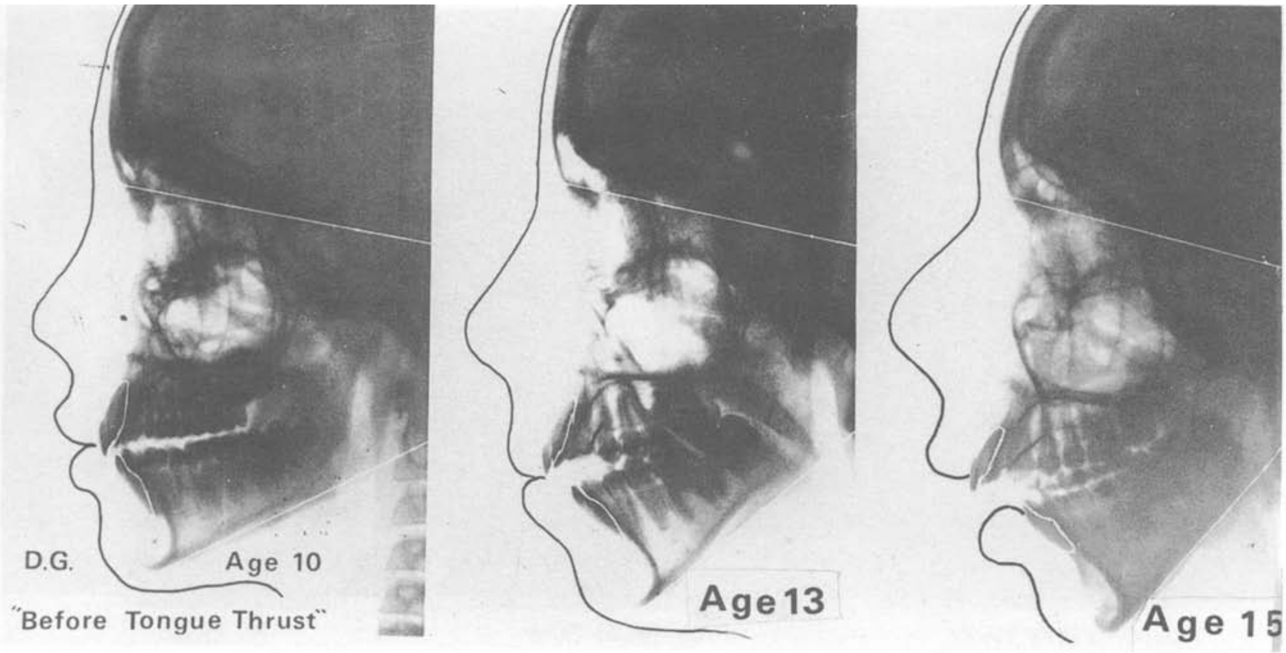

FIG. 3

A 10-year-old girl who developed a tongue between tooth posture, and swallow. Note that her horizontal ramus shortened by over one-third in the following four years. *British Journal of Orthodontics,* **8:** 203–211, 1981.

1964) that expansion achieved by sutural growth becomes permanent after three months, any relapse being restricted to the teeth and alveolus.

Adenotonsillar hypertrophy is commonly associated with downward rather than forward growth of the dentofacial skeleton (Linder Aronson *et al.,* 1986; Harvold and Vargervic, 1987) and the so-called 'adenoidal face'. In addition, sufferers often have a history of otitis media with effusion together with other ear, nose, and throat problems. In the past, such conditions were thought to

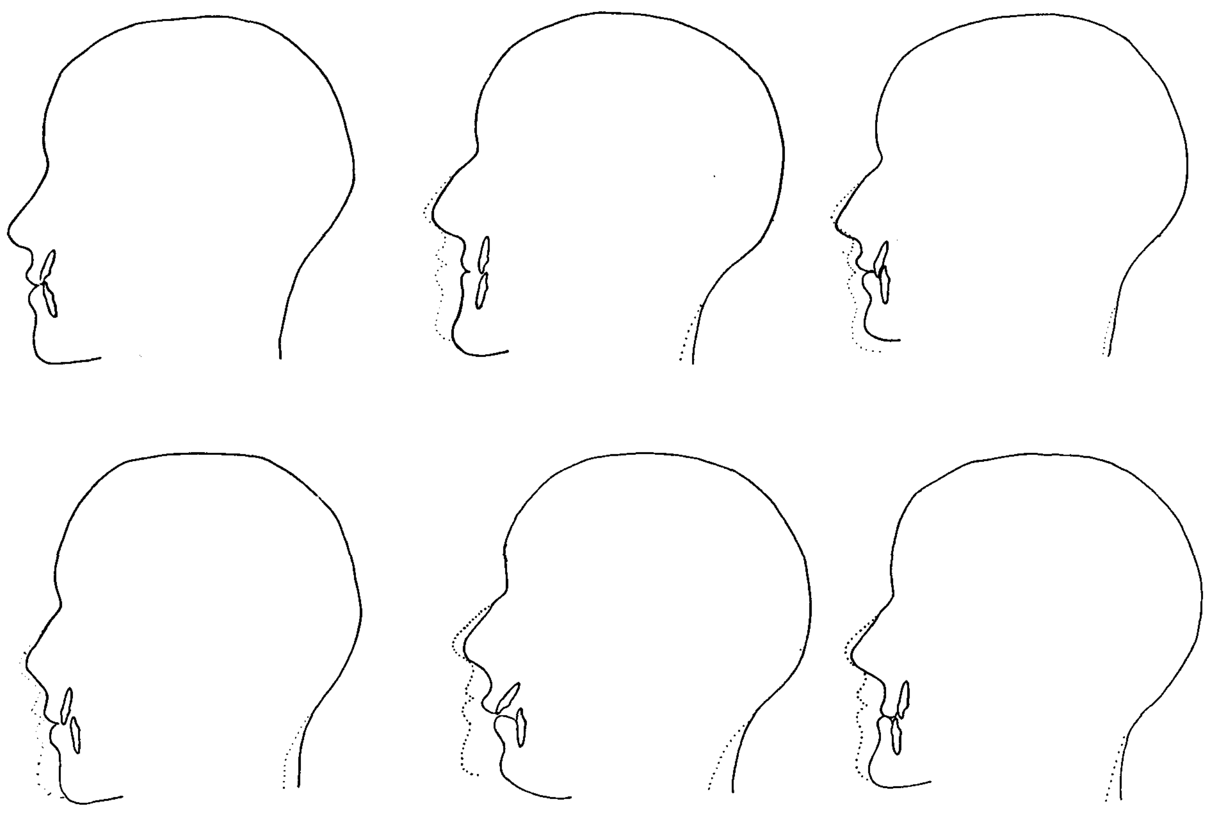

FIG. 4

An artist's impression of contrasting patterns of facial growth. 'Natural' growth is represented on the top left, while the other five outlines show some common deviations. Note the change in head posture, which maintains the vertical profile despite the lack of forward growth of the maxilla, and mandible. This disguises the shortfall making the nose appear large by comparison.

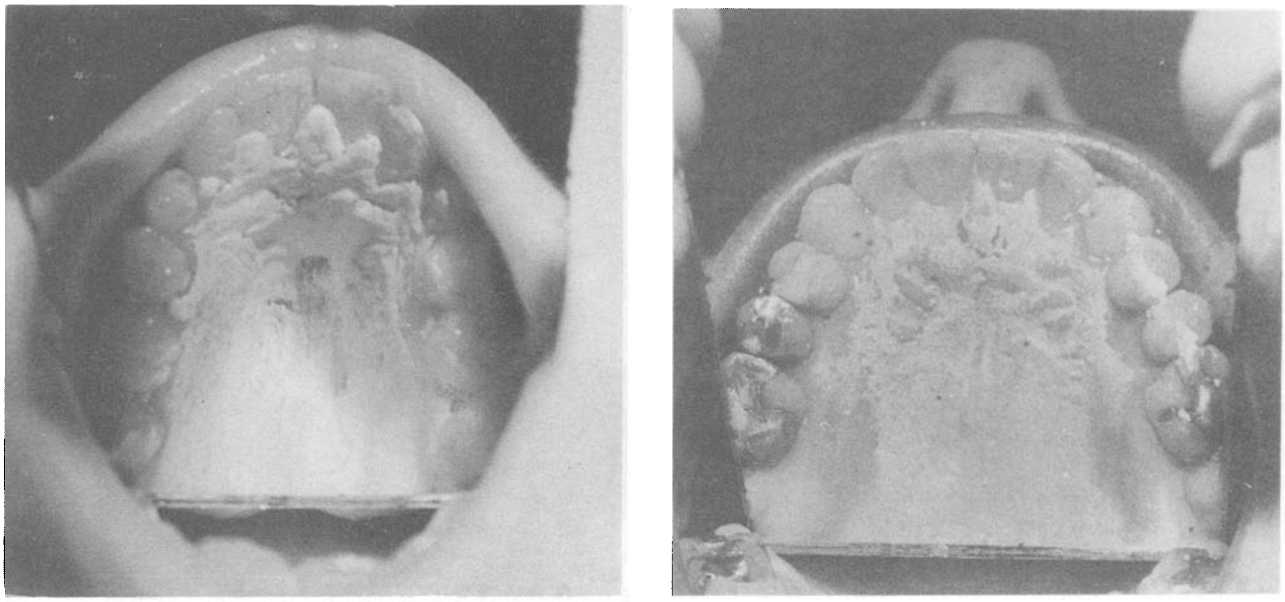

FIG. 5
Indicator paste remaining on the palate following a tongue between tooth swallow (left) while areas of contact are shown after a correct tongue to palate swallow (right).

be associated with poor skeletal growth of genetic origin. However, the evidence quoted above, together with recent developments in the clinical control of facial growth, would suggest that these are deviations from normal growth, which could be influenced with some predictability. Such an option could be of considerable value to otolaryngologists as well as dentists.

These techniques referred to as 'facial orthotropics (Natural Growth Guidance)' have been based on the premise (Mew, 1981) that most children who posture

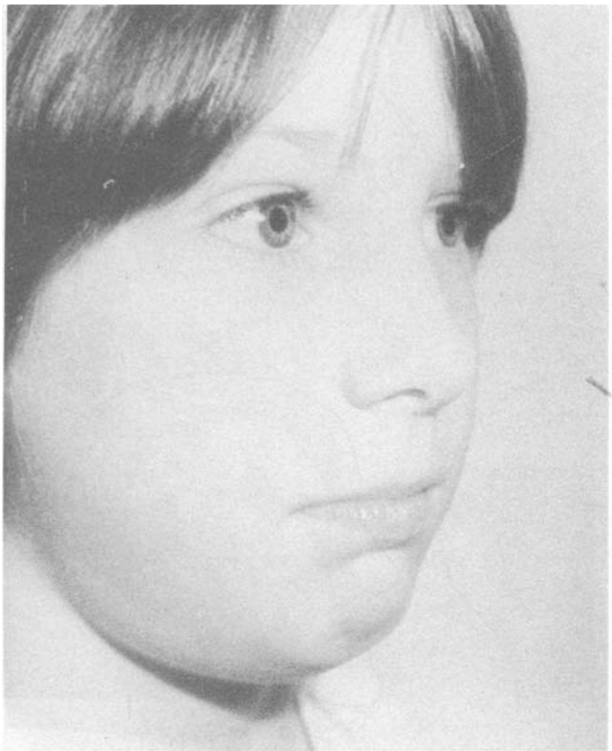

FIG. 6
A patient with a tongue between tooth swallow showing the hypertrophy of the Buccinator and Obicularis Oris Muscles.

with 'the tongue against the palate, the lips sealed and the teeth in or near contact' will develop broad palates, good looking faces and have few ENT problems. This pattern of oral posture is, in fact, rare in industrialized societies, but so are broad arches, straight teeth and forward growing faces.

Posture of this type is normally associated with sufficient muscle 'tone' to support the chin, and lips against the forces of gravity. This can easily be distinguished from the average 'adenoidal' or 'long face syndrome' children who will have flat sides of their faces because of lack of masseter muscle, and maxillary bone development. At the opposite extreme some children who clench their teeth, may have hypertonic and bulbous masseter muscles, with reduced facial height.

Patients with 'correct' oral posture will swallow with a firm contraction of the palatoglossus, and intrinsic muscles of the tongue. Such deglutition requires firm reciprocal contraction of the palatine aponeurosis against the dorsum of the tongue. Contraction of these muscles in conjunction with the palato-pharyngeus also reduces the depth of the tonsillar crypt. The principal muscle of the aponeurosis is the tensor palati, a major portion of which arises from the cartilage of the pharyngotympanic tube. As a result, each firm swallow pulls the cartilage forward, while the salpingopharyngeus rotates it down and back. This alternately opens and closes the tube, causing a column of air to move up and then down. The regular opening and closing of the Eustachian tube serves both to aerate it, and equilibrate the middle ear pressures.

Rix (1946) pointed out that the majority of people swallow 'incorrectly' with their tongues between their teeth. This involves a sucking action of the teeth, which can be recognized in severe cases by their resultant lingual tilting, with a narrow high palatal arch. Such a pattern requires little contraction of the elevator muscles of the mandible, and a reduced contraction of the palatine aponeurosis, with a resulting loss of the pump action on the Eustachian tube and tonsillar crypt. Use of indicator

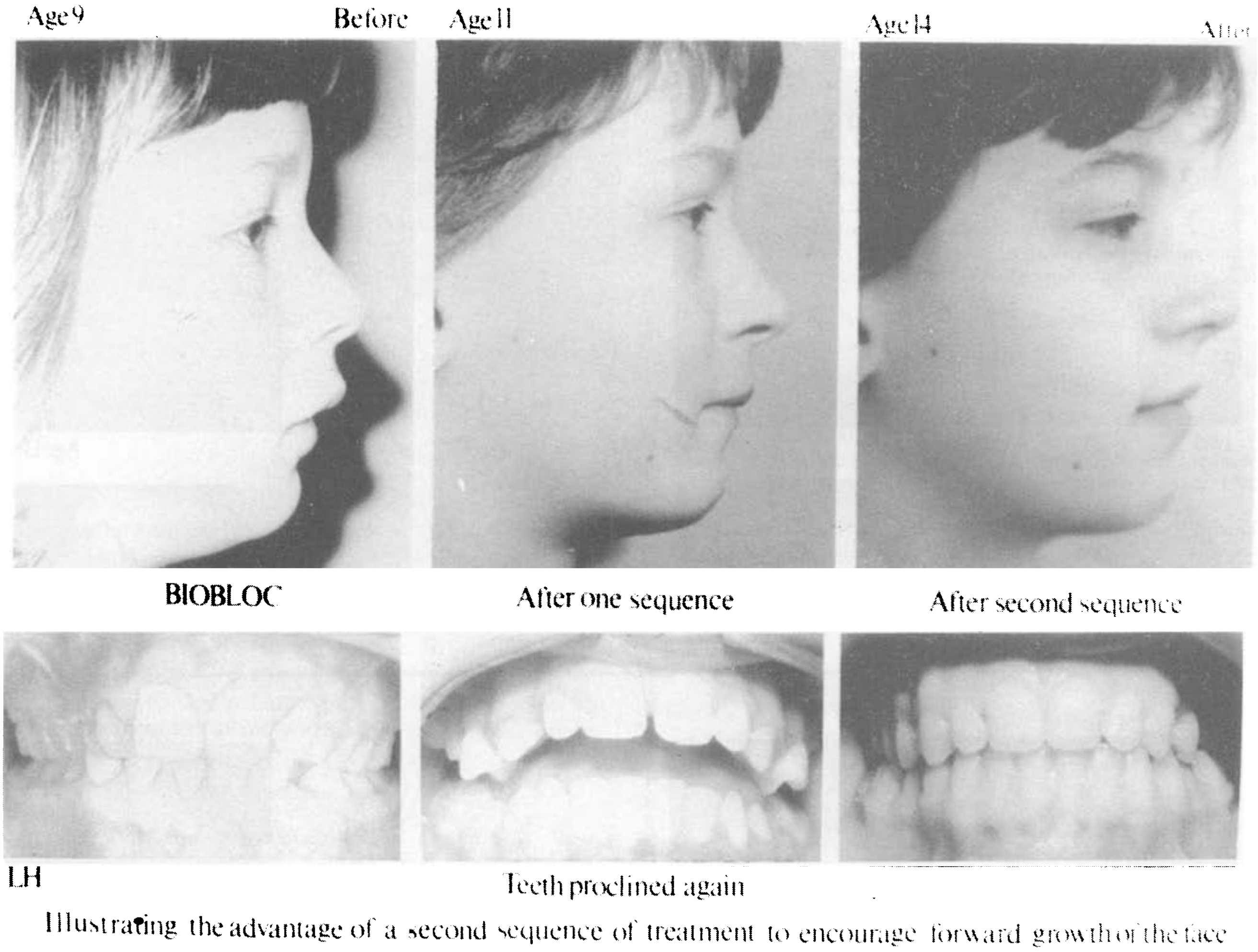

FIG. 7

A girl who received two sequences of orthotropic treatment. Note how the maxilla and upper teeth are taken forward before the mandible is brought forward to support them by means of postural appliances.

paste shows that many such patients swallow with their tongue hardly touching the palate (Fig. 5). It is not difficult to recognize these patients by the muscle bulges in the orbicularis oris, mentalis, and buccinator (Fig. 6) which provide the 'incorrect' seal against which the tongue sucks. This pattern of swallowing is fairly constantly associated with lingually inclined teeth, and an undersized maxilla, so that the nose by contrast appears prominent. Such patients will often have ototolaryngological problems, similar to those in the open mouth group.

Clinical application

Evidence suggests that conventional orthodontic treatment has a tendency to increase the length of the face (Lundstrom *et al.* 1987), possibly because little attempt is made to influence oral posture. This may be one of the reasons why a number of clinicians are adopting a more preventative approach, and attempting to influence growth patterns by improving oral posture. This is sometimes referred to as 'Natural Growth Guidance' or 'Orthotropics' (Mew, 1979). The treatment is partly mechanical and partly postural, aiming initially to provide room for the tongue, and then to train the patient to keep the mouth closed with the tongue resting against the palate. Hopefully any reduction in facial height will assist in achieving the necessary resting lip seal.

This initially involves semi-rapid (1 mm per week) expansion of the palate, which seems experimentally and clinically more satisfactory than rapid expansion (3 to 4 mm per week) (Mew, 1977). As the two halves separate the whole maxilla moves forward, and if necessary the upper teeth are also proclined. This sometimes enables the mandible to be brought forward a substantial distance (Figs. 7 & 8), and the patient is then trained to keep their mouth closed by means of appliances attached to the teeth which have extensions that contact the gingival mucosa if they forget to do so (Fig. 9). The discomfort should be transitory, and provided the correct posture is maintained, the forward growth will become permanent. Previous experience at correcting oral posture has not proved particularly rewarding, as exercise schedules are rarely adhered to and training appliances such as a tongue cribs often produce alternate aberrations. However, in this instance the training is reenforced by special appliances which ensure 'correct' tongue, jaw, and lip postures are maintained. The recommended age of commencement varies with the severity but the options reduce after the eight year old growth spurt.

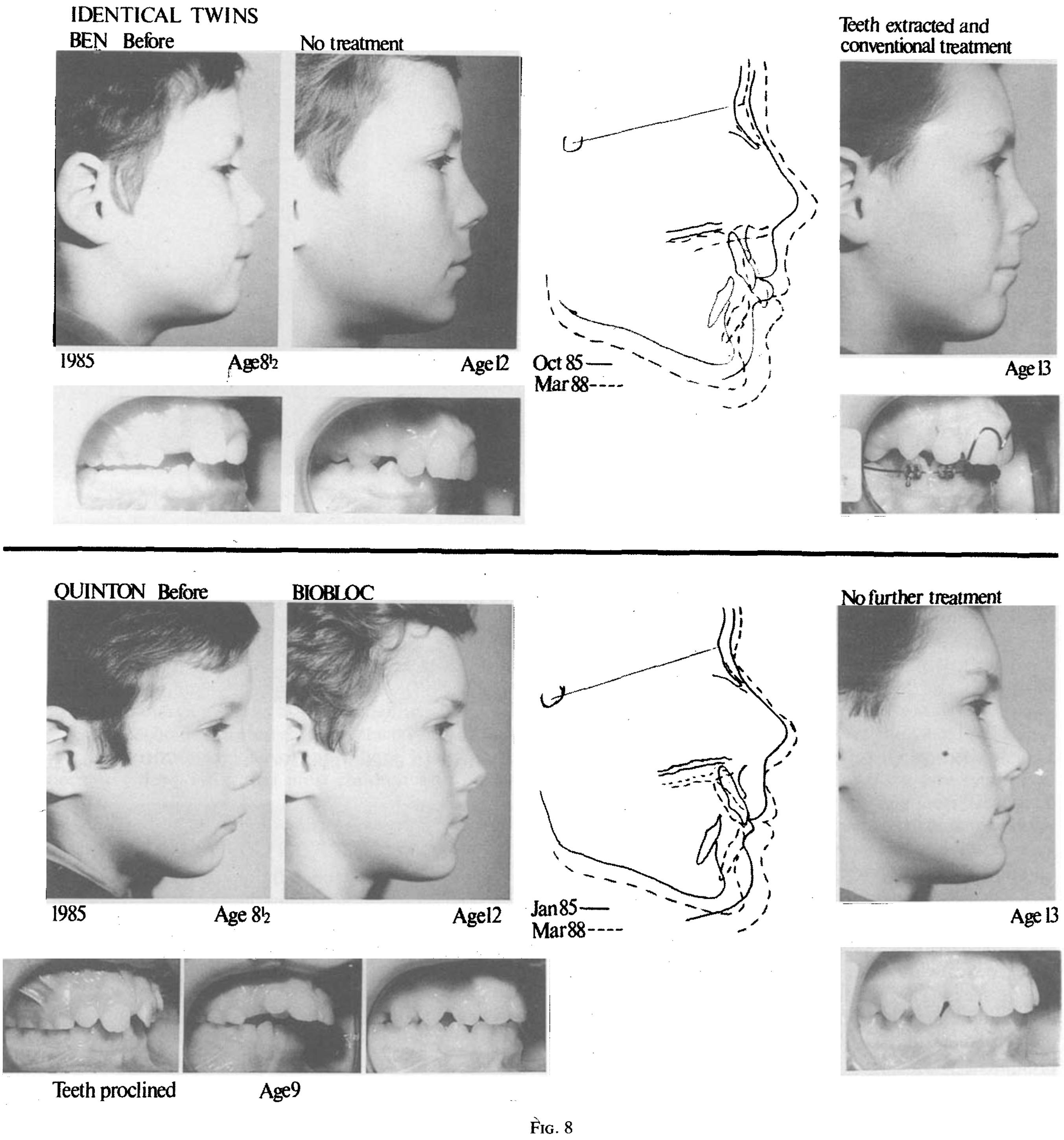

FIG. 8

Identical twins treated different ways. Ben (upper left aged 8½) received no treatment until he was 12½. He was then treated by extractions followed by conventional fixed and removable appliances (upper right). Quintan was treated by orthotropics when aged 8½. Despite the overjet the upper teeth were first taken forward to reduce facial height, before the mandible was advanced by means of postural appliances (lower centre). He has received no further treatment. Note the downward growth of Ben's face following the commencement of conventional treatment (top right).

Otolaryngologists become familiar with the facial appearance of patients who normally have cause to visit them. Yet following successful growth guidance, the face may be of a type that is rarely seen in ENT offices. (Figs. 7 & 8).

It is this aspect of treatment that could be of value to otolaryngologists, because if the objectives are achieved, the development not only tends to result in a natural improvement in nasal respiration, but the enforced postural training also increases the resting oral muscle tone. This together with the firmer contractions when swallowing may provide the ENT advantages that have been discussed.

While these appliances (Fig. 9) are normally provided by orthodontists, there is no reason why other professionals should not familiarize themselves with the techniques, especially for use with patients whose primary problem is slack posture and poor lip seal. For under-

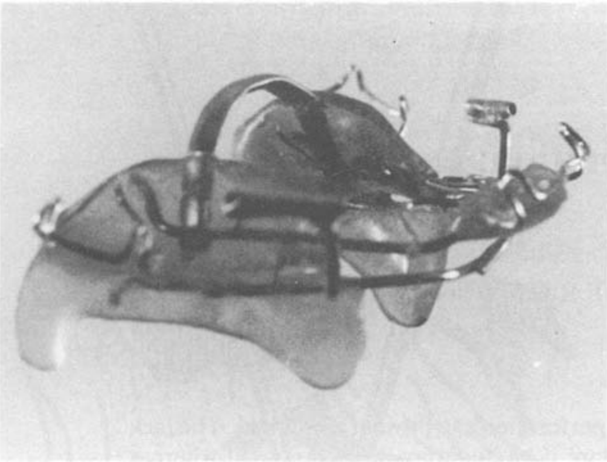

FIG. 9

standable reasons, these appliances have also been helpful in the treatment of sleep apnoea. When successful the improvement of ear, nose and pharyngeal pathology goes beyond that which we have come to expect using other methods.

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References

Bresolin, D., Shapiro, G. C., Shapiro, P. A., Dassel, S. W., Furukawa, C. T., Pierson, W. E., Chapko, W. E., Bierman, C. W. (1984) Facial characteristics of children who breathe through the mouth. *Pediatrics,* **73:** 622–625.

Corruccini, R. S., Kaul, S. S., Chropra (1983) 'Epidemiological Survey of Occlusion in North India'. *British Journal of Orthodontics,* **10:** 44–47.

Dickson, G. C. (1970) The natural history of malocclusion. *Dental Practice,* **20:** 216.

Hannuksela, A. (1981) The effect of moderate and severe atopy on the facial skeleton. *European Journal of Orthodontics,* **3:** 187–193.

Harvold, E. P., Vargervik, K. (1987) Experiments on the interaction between orofacial function and morphology. *Ear, Nose, Throat Journal,* May, **66 (5):** 26–39.

Horowitz, E. P, Oxbourne, R. H., de George, F. C. (1960) Cephalometric study of craniofacial variations in adult twins. *Angle Orthodontist,* **30:** 1–5.

Linder-Aronson, S., Woodside, D. G., Lundstrom, A. (1986) Mandibular growth direction following adenoidectomy. *American Journal of Orthodontics,* **89:** 273–283.

Liphook, T. (1981) Conductive hearing loss, and rapid maxillary expansion. *American Journal of Orthodontics,* **80:** 325–331.

Lundstrom, A., Woodside, D. G., Popovich, F. (1987) Panel assessments of facial profile related to mandibular growth direction. *European Journal of Orthodontics,* **9:** 271–278.

Meredith, G. W. (1988a) Surgical reduction of hypertrophied inferior turbinates. *Plastic and Reconstructive Surgery,* **81:** 891–897.

Meredith, G. W. (1988b) Airway and dentofacial development. *American Journal of Rhinology,* **2:** 33–41.

Mew, J. R. C. (1977) Semi-rapid expansion. *British Dental Journal,* **143:** 301–306.

Mew, J. R. C. (1979) Biobloc therapy. *American Journal of Orthodontics,* **76:** 29–50.

Mew, J. R. C. (1981) The aetiology of malocclusion—can the tropic premise assist our understanding? *British Dental Journal,* **151:** 296–302.

Mew, J. R. C. (1987) Facial change induced by treatment. *Functional Orthodontist,* **4:** 37–43.

Nove, A. A. (1952) The restoration of normal breathing in asthmatic children. *Archives of Disease in Childhood,* **27:** 405–408.

Rix, R. E. (1946) Deglutition and the teeth. *Dental Record,* **66:** 103.

Shapiro, G. C., Shapiro, P. A. (1984) Nasal airway obstruction and facial development. *Clinical Review of Allergy,* **2:** 235–25513.

Skieller, V. (1964) Expansion of the midpalatal suture by removable plates analysed by the implant method. *Transactions of the European Orthodontic Society,* 143–158.

Thomas, E. H., Cole, P., Gullane, P. J., Kassell, R., Kamino, D. (1987) The nasal cycle after laryngectomy. *Acta Otolaryngologica,* **103:** 111–116.

Timms, D. J. (1974) Some medical aspects of RME. *British Journal of Orthodontics,* **1:** 127–132.

Timms, D. (1986) The effect of rapid maxillary expansion on nasal resistance. *British Journal of Orthodontics,* **13:** 221–228.

Vig, P. S., Sarver, D. M., Hall, D. J., Warren, D. W. (1981) Quantitative evaluation of nasal airflow in relation to facial morphology. *American Journal of Orthodontics,* **79:** 263–272.

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