Chapter 22: Orthodontics

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The relationship between dentistry and the speciality of otolaryngology is a close one. They share common ground, and pathology affecting one area encroaches on, or may arise from, conditions more immediately associated with the other speciality.

Orthodontics is a branch of dentistry that can be defined as a dental science concerned with genetic variations, development and growth of facial forms, and the manner in which these factors affect the occlusion of the teeth, and function of associated organs.

Growth and development

Growth of the face takes place at the circummaxillary sutures, and also by surface deposition. Growth is mainly in a forward and downward direction from the anterior cranial base. Interference with the growth of the cranial base will, therefore, have an influence on the development of the maxilla and mandible - the former because of its direct relationship to the cranial base, the latter due to aberrant position of the glenoid fossae.

The mandible moves downwards from the cranial base with bone formation at the condylar and coronoid processes. There is also surface deposition to the posterior borders of the ascending rami, with corresponding resorption of the anterior surface. Direction of growth of the mandible is important, and here environmental factors may play a part (posture of the head and mouth breathing).

In both jaws, alveolar bone keeps pace with the downward and forward growth of the maxilla and mandible, and also to provide support for the teeth.

Abnormalities of the cranium, for example Apert's syndrome, and facial complex, for example first arch anomalies, affect the relationship of the jaws and, in turn, the occlusion of the teeth.

Orthodontic treatment mainly takes place during the growing period of the individual and, therefore, an understanding of normal growth is important. However, growth is not fully predictable. Where pathology exists it is even more important to be able to assess the underlying cause, and carry out corrective measures at the appropriate time.

Aetiology of malocclusion of the teeth

Both inherited and environmental factors play a part in the establishment of malocclusion of the teeth. For many years genetic factors were considered to be more important. Recently, environmental factors have been gaining ground - but not to the exclusion of inherited ones. Whatever the underlying cause, the position of the teeth is mainly dependent on three factors:

(1) skeletal pattern;
(2) soft tissue morphology;
(3) ratio of tooth to jaw size.
Skeletal pattern

Differences in size, shape and position or adverse growth of the bones of the face and skull, whether due to inherited, environmental or pathological reasons, can result in an unfavourable relationship of the maxilla to the mandible. This may lead to malocclusion of the teeth. A controversy exists as to whether the inherent growth pattern has a greater influence on growth and development of the facial skeleton than the environmental factors put forward in the functional matrix theory (Moss and Salentijn, 1969). This theory postulates that bony growth of the face is greatly influenced by soft tissues and changes in size of the spaces in the head, for example mouth, sinuses, pharynx. A comparison is made with the cranium which is influenced by normal and pathological changes within it, for example hydrocephalus.

In discussion the relationship of the maxilla to the mandible, three planes must be considered:

1. anteroposterior (sagittal) plane;
2. vertical plane;
3. transverse plane.

Adverse position of, or growth, in any one plane, or a combination of planes, will contribute towards the establishment of a malocclusion of the teeth.

(1) The most commonly observed and measured plane is the anteroposterior plane. This and the vertical plane can be judged clinically and by special radiographic techniques. It is important to be able to assess whether the underlying skeletal problem is due to the position of the maxilla or mandible - or a combination of the two. These cephalometric radiographs can be taken at regular intervals to monitor growth. They also record changes to the position of the teeth, brought about by orthodontic treatment, and to the jaws by surgical procedures.

(2) Vertical anomalies will be discussed in more detail under Mouth breathing, but two main types of facial form are described - the broad short brachycephalic face, and the long thin dolichocephalic one. There may also be differences in proportion between the upper and lower facial heights. This must be taken into account when planning treatment for the correction of facial anomalies.

(3) Transverse relations are best assessed clinically. Basically, the upper jaw can be too wide or too narrow to match the too wide or too narrow lower jaw. Transverse basal bone discrepancies are compensated for in some cases by buccal and/or lingual tilting of the maxillary and mandibular teeth, and supporting alveolar bone. If this does not result in normal intercuspation of the buccal teeth, the result is what is termed 'a crossbite'. A severe example of this is where maxillary teeth occlude completely buccal to the lower teeth in a scissor-bite relationship, for example some thalassaemia patients suffer this due to expanded maxillary bone.

There is no clear evidence that orthodontic treatment can alter the skeletal pattern - the changes that take place are mainly in respect of the supporting alveolar bone.
Soft tissue morphology

Lips

The position of the teeth is also dependent on the soft tissue environment of the lips, cheeks, and tongue. There is debate as to whether the activity of the surrounding musculature is the main factor influencing this, or whether position and size of lips, tongue, etc, are of equal importance in guiding and maintaining the teeth in occlusion. Objective measurements are difficult - so most observations are subjective.

The position of the incisor teeth is governed by the lips anteriorly, and by the tongue posteriorly. Both activity and posture probably play a part in incisor position. The lower lip is probably the more important. Lip line is defined as the position on the upper incisors where the upper and lower lips meet. In a patient where the upper incisors are proclined, the lip line is low on the upper incisors, or the lower lip may even be behind the incisors at rest and during activity. Where the upper incisors are retroclined, the lower lip usually covers most of the crowns of the incisors during rest and activity.

The term 'competent' and 'incompetent' have been used to describe the morphology of the lips. By definition, lips that can be opposed with minimal muscular contraction, with the mandible in the rest position, are said to be competent. These are poor terms - no other valve or orifice in the body is termed 'incompetent' if it can achieve adequate opening and closing. A better method of describing the lip morphology would be to note how a lip seal is achieved, for example visible contraction of the orbicularis oris and mentalis muscles, with or without forward posturing of the mandible. The use of the tongue to help achieve a seal should also be noted as this may influence the orthodontic prognosis.

Where there is a habitual lack of a lip seal, it must not be assumed that the patient is a mouth breather. It is possible to achieve an anterior oral seal between tongue and lower lip and/or a posterior seal between dorsum of the tongue and soft palate.

Tongue

Size, position and activity are even more difficult to assess for the tongue than for the lips.

The tongue normally adapts to the size and form of the oral cavity but, in certain circumstances, appears not to be able to be accommodated. Examples are in Down's and Beckwith's syndromes, tumours of the tongue and hemifacial hypertrophy. In the case of Down's syndrome, the fault may be due to the small oral cavity, or to the tongue posture. The other three examples are true tongue enlargements.

Where the tongue is held habitually forward, there will be an interference with the developing occlusion - proclination of upper incisors and a tendency towards an anterior open bite.

Tongue posture may be influenced by anomalies such as a narrow upper arch, as seen in some repaired cleft palate patients - here the tongue position will be low. In mouth
breathing, the mandible is lowered, and the tongue again adopts a low position to facilitate breathing. Some believe that enlarged tonsils contribute to a forward tongue position. Regression in respect of size of the tonsils may allow the tongue to adopt a more normal position in the mouth. Enlargements of the tongue will interfere with the position of the teeth - unilateral examples demonstrate this clearly as seen in haemangiomata.

**Tongue activity**

In the new-born baby the tongue lies between the gum pads, and in contact with the lips anteriorly. Swallowing takes place with the tongue in this position. The eruption of teeth leads to a change from this infant type of swallowing to the adult form. Here the teeth are brought lightly together and the tongue is contained by the teeth and the alveolar processes. The infant type of swallow sometimes persists. Where it does, there may be an interference with the position of the teeth. The majority of children eventually adopt a normal swallowing behaviour; this allows for spontaneous correction of the occlusion unless other factors, such as digit sucking, gross anomalies of jaw relationship, or adverse soft tissue lip factors, prevent it. An atypical swallowing behaviour described as an endogenous tongue thrust, probably due to abnormal neuromuscular activity, is sometimes seen. Fortunately, this is not common. It is difficult to diagnose and sometimes only appreciated when treatment fails to produce a stable result. Some pointers are the force of the tongue thrust, and the extent of the resulting malocclusion. Also, an associated speech defect, such as a lisp, may help in diagnosis.

To summarize, the teeth are held in a balanced position between the soft tissues of lip and tongue. If the position of the teeth is altered, a new position of balance must be achieved, if a stable result is to be the outcome of treatment.

**Tooth tissue ratio**

The third important factor as a cause of malocclusion is the relation in size between the teeth and available bone to accommodate them. Unfavourable relationships will lead to crowding or spacing of the teeth. Crowding is a more common problem than spacing especially in the UK - possibly the result of a mixed population group. However, crowding is an aetiological factor that can be dealt with effectively by the extraction of teeth.

Evolutionary changes are slow in bringing about the reduction of teeth to match the jaw size. The full complement of teeth in man is 32. Missing permanent teeth are fairly common, third molars and upper lateral incisors being the most frequent to be absent. Where a number of teeth are absent the term 'hypodontia' or 'olidogontia' are used. This is seen in syndromes, such as ectodermal dysplasia and orofacial digital syndrome.

Extra teeth, called supernumeraries, are less of a problem. If interfering with the occlusion, they can be removed. The upper incisor region is the most common site.

There are a few other local anomalies that can lead to malocclusion: habits, such as dummy and finger sucking, can cause or aggravate the malposition of teeth. Early loss of deciduous teeth where crowding is present will lead to a loss of space at the site of the extraction, and may interfere or prevent eruption of the permanent successor. Occasionally
pathological conditions such as cysts or odontomes may interfere with the normal eruption of teeth. These can be dealt with by surgery.

Malocclusion is the result of many complex factors, and careful diagnosis and treatment planning are required in order to bring about a satisfactory and stable result. This will be discussed in the next section.

Classification of malocclusion and treatment objectives in orthodontics

Malocclusion will be discussed under the following headings:

1. dental base relationship;
2. dental arch relationship;
3. individual tooth position.

Dental base relationship

The dental base relationship is termed 'skeletal pattern'. It is most commonly used to describe the anteroposterior relationship, but vertical and transverse dimensions should also be taken into account. Anteroposterior relationships are divided into three groups - skeletal I, II and III.

Skeletal I is where there is a normal relationship between the maxilla and mandible, that is in fact where the maxilla is slightly anterior to the mandible.

Skeletal II is where the maxilla is placed anteriorly to the mandible. This may be due to a prominent maxilla or, more commonly, to a small and/or retrusive mandible.

Skeletal III is where the maxilla is placed posteriorly to the mandible and this can be due to a retrusive maxilla or prognathic mandible.

Cases which have a skeletal I dental base are usually easier to treat and have a better prognosis than those on skeletal II or III bases.

Dental arch relationship

Here we are dealing with the relationship of the teeth in one jaw to those in the opposing jaw, that is how they occlude.

The most widely used classification is one where the relationship of the upper and lower first permanent molars is used to classify the occlusion. This is called the Angle classification after Edward Angle. However, a more useful one which is simple and unambiguous is the British Standard Incisor Classification. This is a record of the relationship of the upper and lower incisor teeth.
As with skeletal pattern there are three divisions:

Class I is where the lower incisors occlude (or would meet, if not in contact) with the middle part of the palatal surface of the upper central incisors.

Class II is where the lower incisors lie posterior to the middle part of the palatal surfaces of the upper central incisors.

Class III is where the lower incisors lie anterior to the middle part of the palatal surfaces of the upper central incisors.

**Individual tooth positions**

Tooth positions can be further described in groups or individually. Inclinations of incisor teeth in the sagittal plane are described as being proclined or retroclined to average figures. Crowding or spacing of teeth is usually noted with specific reference to the site.

Rotations, malpositions and malformations of teeth are recorded, as this often gives an idea of the complexity of the problem when it comes to treatment planning.

It can, therefore, be seen that a malocclusion may involve malalignment of teeth within an arch and/or malrelationship between the arches.

**Treatment objectives**

The main objective of orthodontic treatment is to improve facial and dental aesthetics. In doing this, other objectives are achieved - better alignment of teeth allows for easier cleaning, overcomes traumatic irregularities and improves function. It is doubtful whether orthodontic treatment can greatly influence growth of the facial skeleton.

Claims and counterclaims are put forward as to the advantages of one type of appliance or technique over others, or whether treatment in the mixed dentition is better than in the early permanent dentition. Some operators advocate extractions, others non-extraction treatment. The fact that so much controversy exists points to considerable doubt in the understanding of the individual response to treatment. However, certain factors limit the scope of orthodontic treatment. Chief among these is the skeletal pattern. Where there is a severe discrepancy between maxillary and mandibular dental bases, a combined orthodontic/surgical approach is often indicated. Unfavourable soft tissue behaviour, such as an endogenous tongue thrust, points to a poor prognosis, and may limit treatment to the relief of crowding.

**Appliances**

Various types of appliance can be used. *Removable appliances* consist of a plastic base with wire auxiliaries to retain the appliance and to bring about the tooth movements. *Functional appliances* are a form of removable appliance where the orofacial musculature is used to bring about the tooth movements. *Fixed appliances* consist of bands and brackets cemented or bonded to the teeth; wires attached to the brackets adjust the position of the teeth.
Fixed appliances with direct attachments to individual teeth allow for more precise control of tooth movements. However, great skill and training is required in their use.

**Special groups of mutual interest**

In this section areas of special interest to the otolaryngologist and the orthodontist will be discussed. It is by no means intended that this should cover all aspects of mutual interest.

**Facial growth and mouth breathing**

The relationship between the growth of the face and the mode of respiration has been debated for many years. At the centre of the controversy is the issue of chronic nasal obstruction and mouth breathing. There is disagreement as to what degree of adenoidal enlargement should be defined as obstruction, and also the methods of assessing mouth breathing and the effect that obstruction and mouth breathing may have on the development of facial form.

A brief outline follows of the theories that have been put forward in respect of the effect that an impaired nasal airway has on dental development and facial form. This is a preliminary to the discussion of the problem.

1. An impaired nasal airways is a factor in producing the so-called 'adenoidal facies'. This is brought about by an alteration in the normal air currents and pressures in the nasal and oral cavities. The result is interference with downward growth of the palate, and associated facial form.

2. An impaired nasal airway results in mouth breathing. Mouth breathing is made easier by lower the mandible with the tongue kept low in the oral cavity. The result is that the maxilla, lacking the support of the tongue, is narrow and the teeth crowded. The lower and total face heights are increased.

3. An impaired nasal airway and mouth breathing do not produce deformities of the jaws and malocclusions. They do not result in the development of the adenoidal facies, that is facial form which is genetically determined.

When discussing mouth breathing, the problem is to assess whether the patient is a mouth breather. It has already been pointed out that a lack of lip seal does not necessarily mean that the patient is a mouth breather.

Vig and coworkers (1981) in North Carolina using sophisticated equipment established that there were few true mouth breathers in their adult study. They concluded that most people fell between two extremes of nasal and mouth breathing.

Linder-Aronson (1979), although agreeing that there are difficulties in diagnosing mouth breathing (except in cases of bilateral choanal atresia or insufficiency of nostrils), used subjective methods to assess mouth breathing in his studies.
Most observations are subjective. Some clinicians use a mirror to detect misting - or a wisp of cotton wool. These tests are perhaps best done with the patient asleep, but cannot be considered as objective.

**Adenoid size**

Adenoid size is usually assessed by orthodontists by the use of lateral skull radiographs. This has disadvantages as it only reflects the size of the nasopharynx and adenoid mass in two dimensions. However, Holmberg and Linder-Aronson (1979) have found a significant relationship between the size of the adenoids as measured on lateral skull radiographs and assessed clinically by nasopharyngoscopy.

**Tonsil size**

It is also difficult to be certain whether the size of tonsils interfere with respiration - unless grossly enlarged. Enlarged tonsils could result in forward posture of the tongue and lowering of the mandible. This would provide a more adequate oropharyngeal space for mouth breathing.

The question is, when does impairment with the normal pattern of breathing interfere with the development of the dentofacial complex.

The evidence is far from conclusive, particularly concerning at what level the ratio of oral to nasal respiration becomes an important aetiological factor.

The animal experiments of Harvold et al (1981) showed that, in primates with artificially obstructed nares, mouth breathing developed which in some cases led to alteration in skeletal pattern, dental occlusion and muscular activity. The skeletal changes seen consistently included an increased facial height and a steep gonial angle. Occlusal and muscular changes were less uniform.

Linder-Aronson (1979) has compared a group of children with obstructed nasal airways with a control group. He stated that the obstructed nasal airway group has certain characteristics: a narrow upper jaw with upright incisors and a tendency to crossbites and open bites. Following adenoidectomy and change from mouth to nose breathing, Linder-Aronson showed that normalization of arch width, inclination of incisors to the sella-nasion plane, and the depth of the nasopharynx took place. The steeper angle of the mandible to the rest of the face also improved. The other changes mentioned took place mainly in the first year following adenoidectomy, whereas the changes in the direction of mandibular growth took longer. There has been some criticism about Linder-Aronson's subjective method of assessing mouth breathing, and also the make-up of his control groups (Ryan et al, 1982). Linder-Aronson, however, says his results clearly support the view that disturbed nasal respiration can affect both facial morphology and the dentition. He is careful to point out that the changes that take place following the elimination of nasal obstruction must not be overrated. These may be small in relation to the genetic influences, and only indicate that the mode of breathing is one factor in a multifactorial complex which can alter facial growth. Linder-Aronson's diagram depicting the possible changes in mandibular posture resulting from nasal obstruction is of interest.
More recently, attention has been drawn to the possible effect of the mode of respiration and the vertical development of the face. In order to facilitate breathing, individuals with nasal obstruction may extend the head. This leads to stretching of the muscles and soft tissues of the neck, which in turn is said to result in a more vertical pattern of growth of the mandible and face (Solow, 1980).

The evidence relating the method of breathing to dentofacial form is inconclusive. It cannot reliably be predicted at what point mouth breathing, in excess of nasal breathing, is a significant aetiologica factor. It would, therefore, seem unwise at this stage for orthodontists to recommend surgery with the hope of bringing about favourable occlusal and growth changes. In turn the otolaryngologist should not completely exclude the possible effects that severe nasal obstruction may have on growth when assessing the indications for surgery in the growing individual.

**Rapid maxillary expansion: can orthodontists influence the pattern of respiration?**

Some years ago, mouth shields were recommended to encourage patients to achieve a lip seal, with the hope that this might lead to nasal respiration. A patent nasal airway was confirmed prior to the fitting. The result depended on the reason for the patient's inability to achieve a seal. However, in many cases the lack of seal was due to a disproportion between the size of the bony skeleton and the available soft tissue covering, that is a long-faced individual. Here the screen will not be successful in achieving a lip seal without considerable muscular effort, but might encourage a change from predominantly mouth breathing to nasal respiration.

A more generally employed orthodontic procedure used to improve the nasal airway is the method of rapid maxillary expansion.

This method of expansion is carried out by fitting metal cap splints or orthodontic bands to the maxillary teeth. The appliance incorporates a special screw between the two lateral segments. Conventionally when expanding an arch during orthodontic treatment using a screw-plate, the screw is turned a quarter or half turn per week. In rapid maxillary expansion, it is turned a half to three-quarters turn per day. Thus, in a 2-3 week period the maxillary arch can be expanded by 7 mm. In the non-cleft palate case, expansion leads not only to dentoalveolar movement, but also to separation of the midpalatal suture.

It is claimed that rapid maxillary expansion, by increasing the width of a narrow maxillary arch, reduces nasal resistance, and thus encourages nasal respiration. Rapid maxillary expansion is also said to correct septal deformities, by the lowering of the palatal vault which is attached to the septum.

Timms (1980) claimed that rapid maxillary expansion can have an effect on areas as remote as the pterygoid processes of the sphenoid.

The changes in the nasal airway resistance brought about by rapid maxillary expansion are said to improve respiratory physiology (Hershey, Steward and Warren, 1976). Claims are also made that, in selected cases, rapid maxillary expansion may be responsible for hearing improvement in those patients who have conductive hearing loss, due to middle ear and
eustachian tube problems, the expansion leading to changes in the muscle tension of tensor and levator palati muscles (Laptook, 1981).

The difficulty in recommending this procedure is twofold:

(1) the problem of stability of the expansion following the removal of the appliance;

(2) the method of assessing and recording the improvement in respiratory function.

In respect of the stability it is generally agreed that most cases relapse to a certain extent. The degree is a debatable issue.

Many of the claims regarding the improvement in nasal breathing are judged by subjective methods, and some by patient questionnaires.

Therefore the long-term effectiveness of rapid maxillary expansion must be treated with caution, but if carried out to treat an occlusal anomaly, it is probably vindicated, but only in very carefully selected cases.

**Cleft lip and palate patients**

This group of patients comes under the care of many specialists including the otolaryngologist and the orthodontist. Both therefore have a part to play from birth to maturity. The orthodontist is chiefly interested in how the timing and type of surgery will influence growth of the face. The otolaryngologist is concerned about how the timing and type of surgery will influence hearing, speech and growth.

Interference with postnasal drainage related to the cleft is known to result in ear problems. This has encouraged some plastic surgeons to carry out an early repair of the palate. Desai (1983) repairs the palate at 16 weeks and claims that this reduces middle ear problems dramatically without interfering with growth. The usual age for palatal closure is at about one year.

Otitis media with effusion in children aged 2-20 months with cleft palate diagnosed by myringotomy has been confirmed in a high percentage of cases in a multicentre prospective study (Grant et al, personal communication).

In the orthodontic field there is little that can be done in the early years of the child's life that can be of help to otolaryngologists.

There are claims that presurgical orthopaedic appliances promote better growth (Hotz and Gnoinski, 1979), improve feeding and, by encouraging more normal tongue behaviour from an early date, will in turn lead to improved speech (Huddart and Stuffins, personal communication, 1984). This latter claim must also depend on the skill of the surgeon in obtaining an adequate hard and soft palate repair. Presurgical orthopaedic appliances are acrylic plates fitted prior to lip repair, to encourage improved alignment of the divided palatal segments.
A frequent result of palatal repair is contraction of the maxillary arch. In the early teenage patient rapid maxillary expansion and bone grafting was a form of treatment advocated by plastic surgeons (Matthews, 1975). The claim was that, in the cleft palate case, expansion of the maxilla led to an improved nasal airway and that the bone graft stabilized the expanded segments. There are doubts about the efficacy of this in several respects.

First there is no valid evidence in the cleft patient that expansion leads to enlargement of the nasal cavities. It would appear that the nasal floor may rotate upwards as the alveolar bone and teeth move buccally (Rune et al, 1980). Second, the bone graft does not lead to stability of the expanded buccal maxillary segments (Plint and Nicholson, 1985, personal communication). So even if patients reported an initial improvement in breathing, this would not persist as a result of the expansion. Bone grafted maxillae, when not permanently retained by an appliance, relapse almost entirely to their pre-expansion positions (Plint and Nicholson, 1985, personal communication).

Finally, in cleft patients an additional problem exists in respect of the nasal airway - this is the commonly found deviated nasal septum. This, and deformed nares, are as likely to result in an impaired nasal airway as a narrow maxillary arch.

Two other bone grafting procedures have been carried out on cleft lip and palate patients with an alveolar defect. These are primary and alveolar bone grafting. The primary bone grafting was usually done at the time of the lip repair, or soon after. A small section of rib was removed and wedged into the alveolar gap. It was hoped that this would stabilize the maxillary segments and also provide bone for teeth to migrate into. Unfortunately, this has not proved to be successful in many cases. The research work of Robertson and Jolleys (1968) in Manchester and Friede and Johanson (1974) in Gothenburg has shown that grafting interfered with growth of the maxilla. However, there are still some units that advocate this procedure, reporting success in terms of migration of teeth into the grafted area, without interference with growth (Rosenstein et al, 1982; Nordin et al, 1983).

The alveolar bone grafting technique was first suggested by Boyne and Sands (1972) and has been developed by the Oslo unit (Abyholm, Bergland and Semb, 1981). The optimal age for the graft is before the eruption of the permanent canine teeth (± 10 years of age). It involves the use of cancellous bone obtained from the iliac crest. The bone is placed in a pocket in the alveolar defect (it is important to have an intact nasal layer). The oral flap design is different from flaps previously used to repair alveolar fistulae in that it is of keratinized mucosa brought forward from the buccal gingivae. The dental advantages are:

1. an intact bony ridge is established;

2. depending on the timing of the procedure, unerupted teeth may migrate into the grafted area or, if erupted, can be moved into the grafted area, by orthodontic appliances; this in many cases avoids the need for a denture or bridge work;

3. the repair of the alveolar fistula excludes the need for an obturator-type denture, and facilitates bridgework construction, should it not be possible to bring anterior teeth into contact by orthodontic methods, that is the cleft segments are stabilized by the graft;
no reported interference with maxillary growth.

As in many handicapped patients, cleft lip and palate cases require the continued effort of a number of specialities in order to obtain a satisfactory result.

**Other orofacial anomalies**

**First arch or facial microsomia**

First arch anomalies affect the structures derived from the first branchial arch. They are now known as hemifacial microsomia - however, a number of cases are bilateral. There is a disturbance of the maxilla and mandible on the affected side(s). The severity varies from case to case. In the most severe, the ramus of the mandible may be absent. In the less severe, the mandible is reasonably formed, but diminished in size. The soft tissues are also affected, and some of the muscles of mastication may be absent, or only vestigial in form. Alveolar growth is also deficient, and molar teeth may be unerupted or only partly erupted. The mandible deviates to the affected side and there is quite a marked cant of the occlusal plane in the transverse direction.

Various procedures have been carried out in order to correct the asymmetry. In the growing child, bone grafting has been tried both by inserts to the ramus or body to increase the length and by costochondral rib grafts to the condylar region to encourage growth. The latter procedure is usually followed by orthodontic treatment to encourage the eruption of teeth on the affected side, following the rotation of the mandible into its more symmetrical position. The success of the graft and the improvement of the occlusion appear to depend on the severity of the deformity. Where there is adequate soft tissue and muscle the response is favourable. Where there is lack of soft tissue the results are less good.

It is difficult to measure growth changes accurately in these cases due to the degree of asymmetry. Rune, Sarnas and Selvik (1975) have developed a technique which allows three-dimensional movements of sections of the skeleton to be studied using X-ray stereometry. The technique involves the placement of small tantalum implants in the forehead, maxillae and mandible. (This is done at the time of a minor surgical procedure such as removal of accessory ear tags.) Lateral and posteroanterior facial radiographs are then taken simultaneously, with the patient’s head in a calibration cage. This allows the three-dimensional measurements to be made. The technique is most valuable as it is now possible to monitor growth for a period to assess the need for grafting and subsequently to measure the changes in growth following the costochondral grafts.

Bilateral cases may have respiratory problems which could need tracheostomies. Early intervention by way of bone grafting may be helpful in advancing the mandible and tongue, thus providing a larger pharyngeal space. Postoperatively, orthodontic methods are used to help maintain the mandible in its new position.

The more severe cases usually require further surgery at about the time of the completion of growth. The surgery involves maxillary and mandibular osteotomies to correct the asymmetry. Pre- and postsurgical orthodontic treatment is often necessary in order to obtain a satisfactory occlusion.
**Treacher Collins syndrome**

These patients are difficult to treat. The deformity of eyes, ears, zygoma, maxilla and mandible lead to a rather bird-like face. There is usually a small mandible with quite a steep gonial angle. This, together with the abnormal maxillary growth, results in an open bite which sometimes extends to the molar region.

Orthodontic treatment is limited to treating the crowding of the teeth which usually exists. The skeletal deformity cannot be helped by orthodontic methods. The child usually undergoes a number of surgical procedures. The most beneficial, from an aesthetic point of view, are those involving the bony framework by operations which follow the completion of growth.

The occlusion is the least important of the many problems found in this condition - hearing loss and facial deformity being the main problems.

**Infection and trauma to the mandibular condyles**

In the past, interference in growth to the mandibular condyles, resulting from infection in the middle ear, was not uncommon. This is now seldom seen in the UK, but is still occasionally seen in children born abroad. There is speculation as to whether the condyle is a true growth site - some believe that growth in this area merely represents a 'filling in' as the mandible is propelled downwards and forwards by the increase in size of the oral cavity (theory of functional matrices). However, infection in the condylar region may lead to ankylosis of the temporomandibular joint and, whether the resulting deformity is due to scarring or interference with a growth site, is only of academic interest.

In children where infection or trauma leads to ankylosis, surgery should take place as early as possible to release the ankylosis. Costochondral grafts are usually inserted, and early movement of the mandible encouraged to restore function. The occlusion in the late diagnosed case may be quite markedly disturbed, and will need adjustment following the treatment of the ankylosis.

The prognosis in respect of restoring function and aesthetics is more favourable in these cases than in the first arch syndrome. Here the soft tissues, although scarred, are otherwise normal.

**Conclusion**

Liaison between the specialists of otolaryngology and orthodontics has many advantages. Both groups see a large number of young patients. Recognition of problems of mutual interest, and early referral for advice, should provide a better service. If this is allied to well-planned research, this may in time lead to an improvement in the treatment of patients.