

CONTEMPORARY ORTHODONTICS

O Keith, Consultant Orthodontist
Morecambe Bay Hospitals

INTRODUCTION

Oral health is defined as 'a standard of health of the oral and related tissue which enables an individual to eat, speak and socialise without active disease, discomfort, or embarrassment, and which contributes to general wellbeing'⁽¹⁾. Orthodontic management includes the diagnosis, prevention, interception and treatment of all forms of malocclusion and dento-facial anomalies, in order to contribute to good oral health. An understanding of cranio-facial growth enables the clinician to assess the effects of normal growth on the facial skeleton and occlusion, and to recognise variations and abnormalities in the timing, extent and patterns of growth. Suitable treatment can therefore be prescribed at the appropriate stage of growth and development, leading to as stable an outcome as possible.

ORTHODONTIC TREATMENT

Historically, the majority of orthodontic treatment was carried out with removable appliances, but the results were of a very variable standard. Removable appliance therapy has largely been superseded, but is still very useful for a specific range of problems. Fixed appliance therapy can achieve tooth movement in three dimensions, providing far superior finished treatment

results (Figure 1a and 1b). Seventy-five percent of orthodontic cases require the use of fixed appliances and/or modern removable functional appliances to achieve the treatment outcome appropriate to contemporary standards⁽¹⁾. More training, expertise and clinical time are required to use these appliances than were required for the simple techniques used previously.

Functional appliance therapy aimed at 'growth modification' has gained widespread popularity, especially for the effective treatment of prominent upper anterior teeth (Figure 2a and 2b). This may be either as definitive treatment, or as the first phase of a staged treatment, which progresses on to a second phase of fixed appliance therapy to detail the occlusion. The treatment effects are a combination of dento-alveolar tooth movement, restriction of maxillary forward development and enhancement of mandibular growth⁽²⁾.

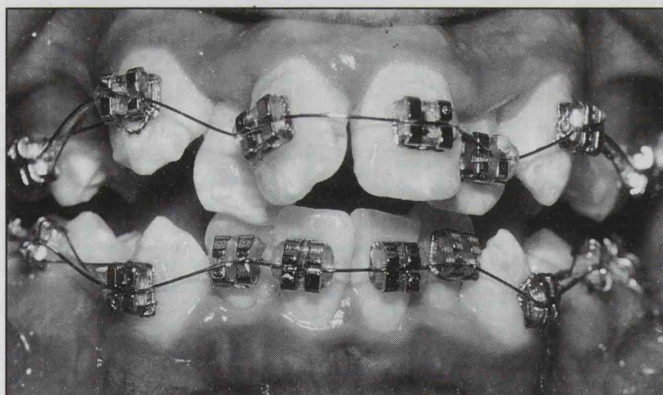


Figure 1a Fixed appliance therapy for a severe malocclusion, in a patient with amelogenesis imperfecta

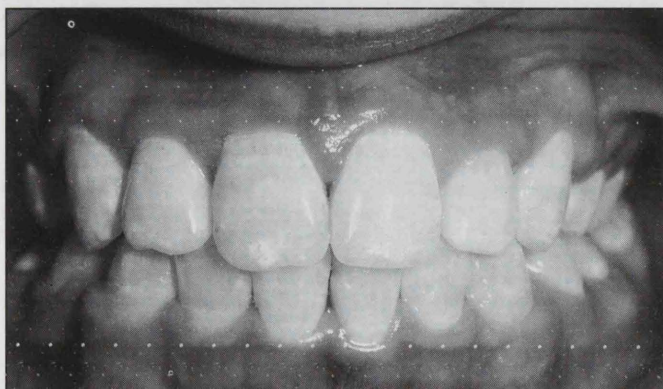


Figure 1b End of treatment, following microabrasion to improve enamel texture and appearance



Figure 2a Prominent upper anterior teeth, which were traumatically avulsed and successfully reimplanted two years previously. This child was the victim of severe teasing by his peers

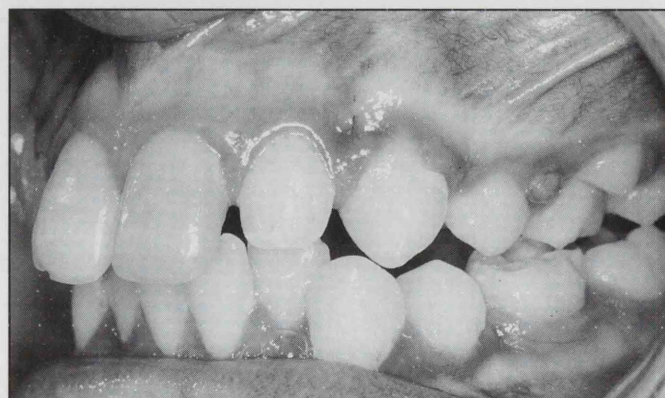


Figure 2b End of functional appliance therapy, overjet fully reduced

RISKS OF ORTHODONTIC TREATMENT

The commonest risk is enamel decalcification due to poor oral hygiene or inappropriate diet (Figure 3). Throughout treatment, good oral hygiene is required together with a daily fluoride mouthwash. Sticky and sweet substances should be avoided, as should concentrated fruit juice and all carbonated drinks

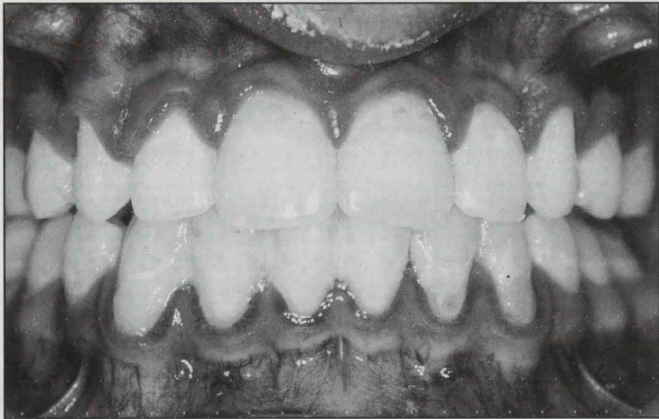


Figure 3 Marked enamel decalcification at the end of fixed appliance therapy, due to poor oral hygiene, inappropriate diet and failure to use fluoride mouthwash during treatment

including so-called "diet" drinks and mineral water. Their acid content can cause erosion and decalcification around the orthodontic appliances, resulting in permanent unsightly scarring of the tooth enamel. Less common risks are resorption of the tooth roots, transient temporomandibular joint discomfort and further loss of bone supporting the teeth where there is pre-existing periodontal disease. Root resorption is of particular significance when teeth have been traumatised, or where root shortening already exists. These factors can lead to severe root resorption during treatment, which may lead to tooth loss. The relative risks and benefits of the proposed treatment should be carefully considered prior to undertaking mechanotherapy

THE NEED AND DEMAND FOR ORTHODONTIC TREATMENT

The degree of social handicap suffered as a result of a severe malocclusion should not be underestimated. Not only is a

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pleasing dental and facial appearance significant for self-confidence and self-esteem, but facial appearance has a tremendous effect on how an individual is treated by peers and siblings (eg teasing), or teachers and employers (eg prejudice) (Figure 2a). Social responses conditioned by facial appearance can severely affect an individual's adaptation to life. Interestingly, the psychological difficulties produced by dental or

facial disfigurement are not proportional to the severity of the problem, ie a moderate degree of anatomic abnormality may be of little consequence to one individual, but a severe problem to another⁽³⁾. Severe malocclusion may compromise oral function (eg masticatory difficulties as a result of poor occlusion), in which very few teeth occlude together (Figure 4). Speech may be impaired in a variety of malocclusions, but is particularly problematic for patients with clefts of the lip and/or palate. Such patients are managed in conjunction with a speech therapist. The relationship between occlusal disharmony and temporomandibular joint dysfunction syndrome is controversial. TMJ pain may result from pathological changes within the joint, but is more often caused by muscle fatigue and spasm, which may be associated with clenching or grinding habits. These symptoms are often present in those with a nearly perfect



Figure 4 Severe vertical skeletal discrepancy producing anterior open bite in an adult patient with dentinogenesis imperfecta

occlusion. Conversely, patients with minimal occlusal interdigitation may be symptom-free⁽³⁾.

Longterm general dental health can be at risk for a variety of reasons related to malocclusion. Prominent upper anterior teeth (increased overjet) is a very common presenting problem, especially in childhood. Such patients are at great risk of trauma to their upper incisors during normal activities but especially sporting activities and accidents, the incidence being 35% of 9-year-old children⁽⁴⁾. The range of injuries varies according to the circumstances and tooth position, but may involve crown or root fracture, subluxation or avulsion, or dentoalveolar fracture (Figure 2a). Reduction of tooth prominence lessens the risk and extent of dentoalveolar trauma. An increased vertical overlap of the anterior teeth (increased overbite) can produce trauma to the maxillary palatal mucosa or mandibular labial gingivae, resulting from occlusal contact by the opposing incisors. Initially, this will produce intermittent soreness, but if left untreated can produce severe stripping of the gingival margins such that the anterior teeth may be severely damaged and ultimately lost due to lack of supporting tissue⁽³⁾. Impacted, displaced or malformed teeth may cause damage to adjacent structures either by direct contact or by pressure from an enlarging or cystic follicle around the crown of the unerupted tooth⁽⁵⁾ (Figure 5).

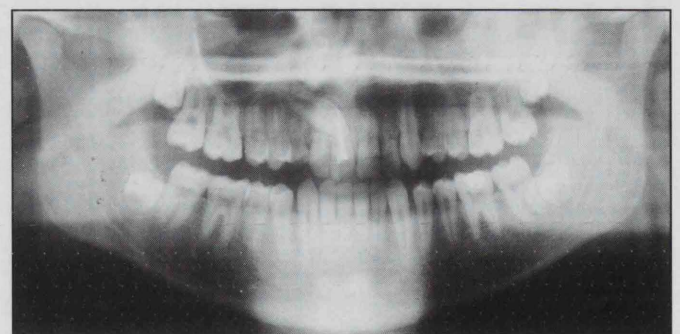


Figure 5 Panoramic tomographic radiograph showing impacted upper right canine tooth, root resorption of adjacent teeth, necessitating root canal therapy of the central incisor

Previously, malocclusion was perceived to be a cause of caries and periodontal disease, which if treated would reduce the risks of either situation occurring. However, the presence or absence of dental plaque is the major determinant of the health of the hard and soft tissues rather than any irregularities in their alignment. Therefore, immaculate oral hygiene in the presence of severe crowding should guard against hard and soft tissue damage, unless interproximal regions are impossible to access by the patient⁽⁶⁾.

Prioritisation of care

The demand for orthodontic treatment has risen dramatically in recent years, so that it now far outweighs the supply of specialist manpower and financial resources. Therefore, patients who are considered to be in the greatest need of treatment are targeted to receive it. The Index of Orthodontic Treatment Need (IOTN) was developed in an attempt to rank the severity of a

presenting malocclusion. It comprises two aspects, the 'dental health component'⁽⁷⁾ and the 'aesthetic component'⁽⁸⁾. The dental health component categorises the severity by identifying the most severe traits within the malocclusion, and categorises the problem into one of five categories, from Grade 1

“ Patients who are considered to be in the greatest need of treatment are targeted to receive it ”

– no need for treatment, to Grade 5 – very great need for treatment. Features which would define a malocclusion as very severe, and in great need of treatment, would include impacted teeth, cleft of the lip/palate, prominent anterior teeth at risk of trauma, soft tissue damage associated with a traumatic overbite, developmental absence of many teeth and malocclusion associated with masticatory or speech difficulties. The aesthetic component of IOTN is a visual ranking system from Grade 1–10, designed to complement the dental health component. It compares the presenting malocclusion to photographs of a range of increasingly severe malocclusions, to record the relative severity of anterior aesthetic tooth arrangement. Grade 1 would demonstrate no aesthetic need, whilst Grade 10 would be very great aesthetic need for treatment. This is often a helpful tool in communication with parents and patients.

A large proportion of patients would benefit from orthodontic treatment. In a typical twelve-year-old age cohort, approximately one third of children have a great or very great need for treatment, one third of children have a moderate need for treatment, and one third of children would not benefit from orthodontic treatment⁽¹⁾. In addition to the objective assessment of need, the perceived need by the patient and parents for treatment has increased dramatically in recent years. This is due to an increase in dental awareness by the general public, an increase in the acceptability of wearing orthodontic appliances, and an increase in media attention.

In addition to the objective assessment of need for orthodontic treatment, complexity and urgency are also taken into account in prioritisation. Severe complex handicapping malocclusions will require both upper and lower fixed appliance therapy, and may need to be preceded by a course of functional appliance therapy where there is a marked skeletal disharmony underlying the malocclusion. Complexity of treatment is increased greatly where a dento-facial problem requires an inter-disciplinary approach, and has a surgical and/or restorative component as part of the overall management. Complexity is reduced greatly where a single arch (upper or lower) fixed appliance is required, and a case would be considered very straightforward if removable appliance therapy only was required.

Urgency of treatment required depends upon the severity of the presenting problem, and also the presence or absence of active growth. Patients may require immediate treatment if there is an active pathological process ongoing, such as root resorption or cystic damage. Patients requiring growth modification treatment would have a reasonably high priority,

but this would be dependent upon the age of the patient, the timing of the pubertal growth spurt, and the patient's dental and psychological maturity. Growth is also important in cases where growth needs to have ceased before treatment can commence (eg patients requiring a combination of orthodontics and orthognathic surgery for severe skeletal discrepancies). A case would be classified as routine if no deterioration in dental health would be expected if treatment were to be delayed.

HOSPITAL ORTHODONTIC SERVICES

In a maxillofacial unit, the consultant orthodontist has a varied but clearly defined role, which is centred on clinical consultation, the treatment of severe and multi-disciplinary cases, service co-ordination and training.

Complex handicapping malocclusion

Hospital orthodontic departments are restricted to treating malocclusions of the greatest severity and greatest technical treatment complexity and those in high need of treatment, using IOTN as a guide⁽⁹⁾. Most cases are in Grade 5 and 4, although some Grade 3 cases can be technically very complex, with a high aesthetic need rating. A significant gain in dental health, function or psychological health would be anticipated, as a result of treatment.

Inter-disciplinary treatment

Patients may present via primary, secondary or tertiary referral, and may have problems requiring an inter-disciplinary team approach such as clefts of the lip and/or palate, dento-facial deformity, unerupted, impacted, displaced and malformed teeth, and the effects of trauma and pathology of the dento-alveolar structures. Such cases are treated in conjunction with the consultants in oral and maxillofacial surgery, restorative dentistry, and other hospital specialities such as plastic surgery, ENT, paediatric surgery and paediatric dentistry⁽⁹⁾. General dental practitioners (GDPs) play a key role when their patients require a combined orthodontic and restorative approach.

i) Combined orthodontic/restorative treatment

Orthodontic treatment may be required to facilitate restorative procedures necessary to control disease, restore function or improve aesthetics. Such cases may be those patients with hypodontia, traumatic loss of or damage to teeth, teeth of microdont, megadont or other abnormal morphology, and tooth movement as a result of disease or pathology. Improving tooth position and occlusion may enable ideal restorative techniques such as bridges or implants to be used. Periodontal, conservative or preventive treatment may be required before correction of a malocclusion to restore dental health to a level compatible with successful orthodontic treatment. Patients may require a combination of orthodontics, maxillofacial surgery and restorative treatment such as the case illustrated in Figure 4, an adult male presenting with a severe skeletal anterior open bite and dentinogenesis imperfecta. Preliminary restorative treatment was required to conserve his posterior teeth and his third molars were surgically removed. Pre-surgical orthodontics was undertaken, a bimaxillary osteotomy (differential maxillary impaction, mandibular advancement) was performed, followed by post-surgical orthodontics and retention. A final phase of restorative treatment was required using veneers on his anterior teeth to disguise the marked discolouration.

ii) Orthodontic and orthognathic surgical treatment

Patients presenting with a malocclusion involving a severe underlying skeletal discrepancy, may benefit functionally and psychologically from a combination of fixed appliance therapy and orthognathic surgery (Figure 6a and 6b). Such patients may present with antero-posterior, vertical or transverse discrepancies. Antero-posterior discrepancies may include patients with either a very prognathic mandible or a very retrognathic mandible. This may occur in combination with a horizontal or vertical malposition of the maxilla. Skeletal discrepancies often represent the extremes of normal facial variation, or may be associated with an identifiable syndrome or combination of presenting features (eg Crouzon's syndrome, Apert's syndrome, Pfeiffer's syndrome or Treacher-Collins syndrome), and may be associated with oral or facial clefting (eg Pierre Robin Sequence or Stickler's Syndrome)⁽¹⁰⁾. Transverse skeletal discrepancies produce facial asymmetry, often mandibular, but occasionally pan-facial. This may be of unknown aetiology, or there may be a history of facial trauma during growth, or a cranio-facial syndrome may be identified such as cranio-facial microsomia or first arch syndrome.

Historically, patients with facial disharmony may have been treated with either orthodontics only, accepting the underlying skeletal discrepancy, or possibly orthognathic surgery in the absence of associated orthodontic treatment. Neither approach produces a satisfactory result, as tooth position may have adapted to an underlying skeletal discrepancy, due to the effects of the superimposed soft tissues, thus disguising the severity of the skeletal discrepancy. Pre-surgical orthodontic treatment aligns, levels and coordinates the teeth in preparation for the surgical procedure. The osteotomy may involve maxillary movement (impaction or advancement), mandibular repositioning (advancement, set-back or rotation), bimaxillary surgery and occasionally segmental procedures. Post-surgical orthodontic treatment enables detailing of the final occlusion, maximising post-treatment stability. Secondary surgery such as genioplasty or rhinoplasty may be required later⁽¹¹⁾.

iii) Cleft lip and palate

Clefts of the lip and/or palate are the most common presenting cranio-facial abnormality, and affect 1 in 700 live births in the United Kingdom. Presentation may vary from a unilateral cleft lip and palate (40%), cleft palate only (30%), bilateral cleft of the lip and palate (10%), and cleft of the lip only (10%), with other variations such as sub-mucous cleft, or incomplete cleft comprising the remainder (10%)⁽¹²⁾. The aetiology is polygenic and multifactorial, with certain recognised environmental factors affecting gene expression. Patients born with clefts may encounter problems with feeding, hearing, speech, disruption of facial growth and dental development, dental anomalies and psycho-social difficulties associated with dento-facial appearance. Patients are managed by an inter-disciplinary team, and require a series of surgical and other procedures from birth to adulthood. The orthodontist forms a key part of the multi-disciplinary team, and has involvement with cleft patients from birth to adulthood. The team also includes a cleft surgeon, oral and maxillofacial surgeon, ENT surgeon, speech therapist, audiologist and psychologist. Other specialists may be consulted for their expertise with certain aspects of care. Good general dental care is of paramount importance, therefore close liaison with the GDP is essential from an early stage^(13, 14).

Primary lip repair is carried out at approximately three months, and palate repair at 6-12 months. Grommets are often required later as the majority of cleft patients develop hearing difficulties associated with glue ear. At approximately nine

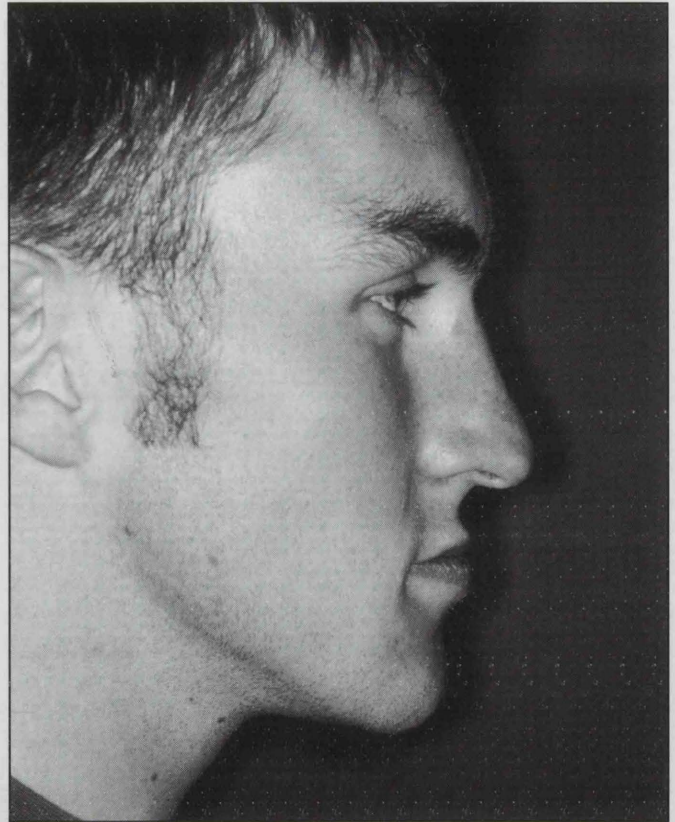


Figure 6a Adult male with class III skeletal discrepancy – maxillary hypoplasia, mandibular prognathism, at end of presurgical orthodontics

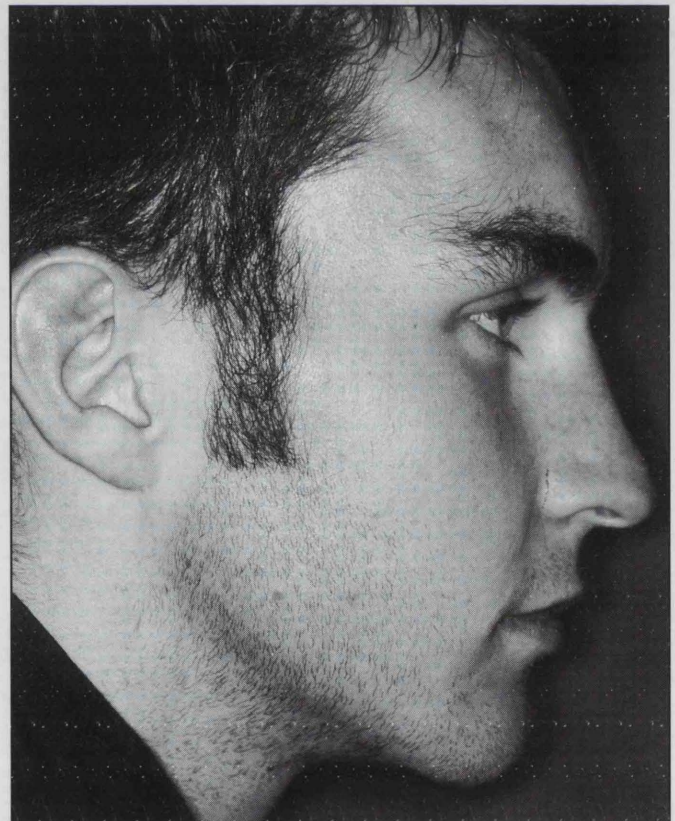


Figure 6b Two weeks following bimaxillary orthognathic surgery – maxillary advancement, mandibular setback

years (depending on dental development) patients with an alveolar cleft will require an alveolar bone graft. This is done following a preliminary period of orthodontic treatment to expand the greater and lesser segments of the maxillary arch, which have often been subject to some collapse due to palatal

scarring (Figure 7). In the permanent dentition (12-14 years), definitive orthodontic treatment is carried out. If there is a severe underlying skeletal discrepancy (often seen in patients with clefts), orthodontic treatment may be delayed until facial growth has almost ceased, and is then carried out in conjunction with orthognathic surgery, to achieve facial harmony and good occlusion. The consultant in restorative dentistry will be consulted at an early stage to advise on and eventually provide fixed or removable prostheses. Revisionary surgery may be required to the lip, nose or palate.

To increase the quality of care provided for patients in the UK to the highest possible standard, the Clinical Standards Advisory Group made a number of recommendations, the 'minimum standards for cleft lip and palate', which are currently being implemented⁽¹⁵⁾. Previously, 57 centres nationally were managing patients with clefts, but their recommendations suggested the creation of 10 national specialist centres coordinating and providing care for cleft patients. These will facilitate the concentration of expertise, standardisation of surgical technique, availability of appropriate supporting services and facilities, and the collection of standardised records for single-centre and multi-centre national audit.

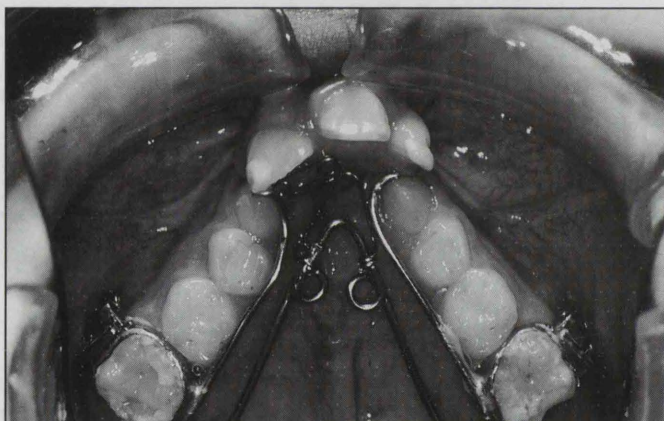


Figure 7 Bilateral cleft lip and palate, prior to bilateral alveolar bone graft orthodontic expansion

ORTHODONTICS IN THE GENERAL DENTAL SERVICES

Specialist practitioners and GDPs provide orthodontic treatment in the general dental services. Specialist practitioners are the largest group of trained orthodontists, and provide over 50% of NHS orthodontic treatment in the UK⁽¹⁾. This group provides treatment for those patients with less severe orthodontic problems than those treated in the hospital services, and is in general not of a complex inter-disciplinary nature. GDPs carry out a significant proportion of simple treatments in the general dental services, but this pattern is variable, and often depends upon whether or not their undergraduate training equipped them with the knowledge and skills to proceed confidently with orthodontic treatment. They may also undergo additional training as a clinical assistant in a hospital department, enabling them to treat straightforward cases to a high standard, with continuing advice and guidance from their consultant colleague. In some areas, specialist services are limited, and GDPs may provide the majority of orthodontic treatment.

SUMMARY

There is a tremendous imbalance between the number of trained orthodontic specialists available to treat patients, and the number of patients in need of treatment. This is compounded by the limited number of postgraduate training places available, and the fact that trained specialist manpower tends to be concentrated in the southeast of England. In the Morecambe Bay area the patient population is 350,000 for whom the orthodontic specialist provision currently consists of one fulltime consultant, two specialist orthodontic practitioners (one in Lancaster, one in Kendal), and a senior dental officer in the community dental service. It is hoped that the SpR based in Morecambe Bay and linked with the University of Manchester postgraduate training programme will develop a specialist orthodontic practice in southwest Cumbria, at the end of her training. GDPs will continue to play a key role in the recognition of orthodontic problems in their patients and making appropriate referrals to specialist services when required, to ensure the most efficient use of the skill mix in the region.

Acknowledgements

I would like to thank Barbara Dack, my Lancaster secretary, for her assistance with the preparation of this article, and Susie Matthew, my registrar, for providing the photographs for Figure 2.

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