EARLY-AGE ORTHODONTIC TREATMENT

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Contents

Foreword

This book is a compendium of significant and pertinent information related to early-age orthodontic treatment, a subject that seems to have evolved into one of considerable controversy, with as many orthodontists expressing a negative reaction as a positive reaction to its benefits. Dr Bahreman is a believer in early-age orthodontic treatment, and he expresses some cogent arguments founded in years of experience in practice and teaching to back up his beliefs. In developing his treatise, Dr Bahreman outlines the development of the occlusion and/or malocclusion from the embryonic stages, when the foundation of the jaws and thereby the position of the dentition is first established.

Early-age orthodontics is not about the time it takes to orthodontically treat a problem; it is a story of growth, of variation in anatomy, and of muscle function and influences, a realization that it is the jaws that contain the teeth and that where the jaws go, the teeth will have to go, and both undergo varying influences as well as grow in varying directions. Early-age orthodontics necessitates recognition of this process and aims to alter and redirect it whenever feasible and possible. Dr Bahreman has undertaken a monumental effort in directing efforts along this path. An extensive exploration of the literature is an added bonus, as the mechanical approaches are based on this literature. In fact, the extensive review of the literature and its application to diagnosis and varying forms of therapy are worth a veritable fortune.

You may or may not agree with the basic premises, but you will have access to important information that will widen your scope of vision and thereby widen your treatment horizons. To my mind, an ounce of prevention, if possible, is worth a pound of cure. The reality of prevention can exist at the earliest stages of development.

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Preface

After obtaining a master's degree in orthodontics in 1967, I began my career at a newly founded dental school in Tehran. My responsibilities included teaching and administrative duties at the university and maintenance of a very busy private practice. In addition, I established both the orthodontic and pediatric dentistry departments at the university.

Many patients were being referred to the orthodontic department, and there were no qualified faculty members to help me provide care. To rectify the situation, I designed an advanced level, comprehensive curriculum in orthodontics for undergraduate students, including classroom instruction, laboratory research, and clinical demonstrations. Once the students completed the course, they could work in the clinic, thus temporarily solving the issue of the heavy patient load in the orthodontic clinic. With additional staff now available, I could select patients, mostly children in the primary or mixed dentition, for some interceptive treatment.

Despite my difficulties in performing all of the aforementioned duties, this situation had a fortunate outcome. It helped me to understand and discover the advantages of early-age orthodontic treatment, which was not common in those years. During my more than 40 years of practice and teaching, especially in early orthodontic treatment, I have accumulated a considerable amount of educational data for teaching purposes. I would like to share this experience and information with readers.

The public's growing awareness of and desire for dental services, especially at an early age, have encouraged our profession to treat children earlier. Despite the recommendation by the American Association of Orthodontists that orthodontic screening begin by the time a child is 7 years old, many orthodontists still do not treat children prior to the complete eruption of the permanent teeth. I believe that this inconsistency is due to the educational background of orthodontists as well as a lack of familiarity with recent technical advancements and the various treatment options that are available for young patients.

The therapeutic devices available for this endeavor are not complex, but deciding which ones to use and when to employ them are important steps. As we make these decisions, we should also remember not to treat the symptom but rather to treat the cause. My goal is to present the basic information necessary to understand the problems, to differentiate among various conditions, and to review different treatment options. Case reports are examined to facilitate clinical application of the theory in a rational way.

To understand the morphogenesis of nonskeletal and skeletal occlusal problems, to detect problems early, and to intervene properly, we must look at all areas of occlusal development, including prenatal, neonatal, and postnatal changes of the dentoskeletal system, and explore all genetic and environmental factors that can affect occlusion at different stages of development. In other words, we must have a profound understanding of the fundamental basis and morphogenesis of each problem and then apply this knowledge to clinical practice. Thus, the goals of this book are:

- To provide a comprehensive overview of all areas of dental development, from tooth formation to permanent occlusion, to refresh the reader's memory of the fundamentals necessary for diagnosis and treatment planning.
- To emphasize all the important points of the developmental stages that must be recognized during examination of the patient to facilitate differential diagnosis. Each tooth can become anomalous in a number of ways and to different degrees. Occlusion and maxillomandibular relationships can vary in the sagittal, transverse, and vertical directions.
- To discuss the application of basic knowledge to practice by presenting several cases with different problems and different treatment options.
- To demonstrate the benefits of early-age orthodontic treatment, achieved by intervention in developing malocclusion and guidance of eruption.

Materials are presented in three parts: In Part I, "Clinical and Biologic Principles of Early-Age Orthodontic Treatment," three chapters introduce and explain the concept of early-age treatment, describe its necessity and advantages, and discuss the controversies surrounding this topic; discuss the basic foundation of occlusal development, empowering the practitioner to detect anomalies and intervene as necessary; and illustrate the procedures, tools, and techniques available for diagnosis, emphasizing differential diagnosis and treatment planning for early-age treatment.

Part II, "Early-Age Orthodontic Treatment of Nonskeletal Problems," consists of seven chapters describing the nonskeletal problems that might develop during the primary and mixed dentitions. The chapters explain the ontogeny, diagnosis, and early detection of, and intervention for, these problems. Topics include space management, crowding, abnormal oral habits, abnormal frenum attachment, hypodontia, supernumerary teeth, and abnormal eruption problems.

Part III, "Early-Age Orthodontic Treatment of Dentoskeletal Problems," consists of three chapters on early intervention for the dentoskeletal problems that might arise during the primary and mixed dentitions in the three dimensions: sagittal problems (anterior crossbite and Class II and Class III malocclusions); transverse problems (posterior crossbites); and vertical problems (open bites and deep bites).

This book will provide the reader with a firm foundation of the basic science and case examples with various treatment options. It is my hope that the information provided will promote a better understanding of abnormalities and their causes and enable readers to recognize the clues for early detection and intervention.

Acknowledgments

First and foremost, I would like to gratefully acknowledge the valuable opportunity that was afforded me as a student in Dr Daniel Subtelny's orthodontic program. Between 1964 and 1967, I completed both my orthodontic specialty and master degree programs with Dr Subtelny as my mentor. As chairman and program director, researcher, and mentor, Dr Subtelny has dedicated over 57 years of his life to teaching, personally influencing the lives of over 350 students from around the world, myself included. In 1999, after over 32 years of teaching, practicing, and administrating in Tehran, I was fortunate enough to return to the Eastman Institute for Oral Health to work alongside Dr Subtelny as a faculty member in the Orthodontic and Pediatric Dentistry Programs.

In addition to Dr Subtelny, there are several individuals to whom I would like to express my deep gratitude for their help and encouragement in preparation of this book: the late Dr Estepan Alexanian, head of the Department of Histology at the Shahid Beheshti University Dental School in Tehran, whose dedication as an educator and preparation of superb histologic slides is remarkable and who allowed me to use his slides in my publication; Mr Aryan Salimi for scanning some of the slides and radiographs in this book; and Ms Elizabeth Kettle, Program Chair of the Dental Section of the Medical Library Association, head of Eastman's library, for her sincere help in editing this publication.

Finally, I wish to acknowledge the constant support of my family: Malahat, Nasreen, Saeid, Alireza, Tannaz, and Peymann Motevalei. Especially high gratitude goes to my wife, Malahat, for her tolerance, support, and encouragements. I also want to thank my son Alireza for his technical help and guidance in computer skills and my granddaughter Tannaz Motevalei for drawing some of the illustrations.

This publication is the product of 17 years spent organizing materials derived from my 45 years of practice and teaching as well as reviewing hundreds of articles and books. I herewith dedicate this book to the teachers, practitioners, residents, and students who are dedicated to treating malocclusion earlier in children, before it becomes more complicated and costly.

Introduction

Occlusal development is a long process starting around the sixth week of intrauterine life and concluding around the age of 20 years. This long developmental process is a sequence of events that occur in an orderly and timely fashion under the control of genetic and environmental factors. Dental occlusion is an integral part of craniofacial structure and coordination of skeletal growth changes. Occlusal development is essential for establishing a normal and harmonious arrangement of the occlusal system.

As we learn about craniofacial growth changes, the potential influences of function on the developing dentition, and the relationships of basal jawbones and head structure, we acquire a better understanding of when and how to intervene in the treatment guidance for each patient. It is more effective to intervene during the primary or mixed dentition period to reduce or, in some instances, avoid the need for multibanded mechanotherapy at a later age.

Untreated malocclusions can result in a variety of problems, including susceptibility to dental caries, periodontal disease, bone loss, temporomandibular disorders, and undesirable craniofacial growth changes. Moreover, the child's appearance may be harmed, which can be a social handicap. The benefits of improving a child's appearance at an early age should not be undervalued. The goals of many clinicians who provide early treatment are not only to reduce the time and complexity of comprehensive fixed appliance therapy but also to eliminate or reduce the damage to the dentition and supporting structures that can result from tooth irregularity at a later age. In short, early intervention of skeletal and dental malocclusions during the primary and mixed dentition stages can enable the greatest possible control over growth changes and occlusal development, improving the function, esthetics, and psychologic well-being of children.

For many decades, orthodontists have debated about the best age for children to start orthodontic treatment. While we agree on the results of high-quality orthodontic treatment, we often differ in our opinions as to how and when to treat the patient. Some practitioners contend that starting treatment in the primary dentition is the most effective means of orthodontic care. Others prefer to begin the treatment in the mixed dentition. There is also controversy about whether the early, middle, or late mixed dentition is preferable.

Despite the fact that the American Association of Orthodontists recommends that orthodontic screening be started by the age of 7 years, many orthodontists do not treat children prior to the eruption of permanent teeth, and some postpone the treatment until the full permanent dentition has erupted, at approximately 12 years. The controversy surrounding early versus late treatment is often confusing to the dental community; therefore, clinicians must decide on a case-by-case basis when to provide orthodontic treatment. Indeed, there are occasions when delaying treatment until a later age may be advisable.

The long-term benefits of early treatment are also controversial. The majority of debates seem to revolve around early or late treatment of Class II malocclusions. There is less controversy regarding many other services that can be performed for the benefit of young patients during the primary or mixed dentition, such as treatment of anterior and posterior crossbite, habit control, elimination of crowding, space management, and management of eruption problems.

Practitioners who are in favor of early treatment of Class II problems contend that early intervention is the best choice for growth modification when the problem is skeletal and especially when it results from mandibular retrusion. On the other hand, opponents believe that there is no difference in the final result and that a single-phase treatment approach is preferable because of the advantages that accompany the reduced treatment time.

Unfortunately, some practitioners, without a profound evaluation of the indications for early treatment, conclude that late treatment is always preferable. However, broad conclusions drawn from narrowly focused research can be misleading. One cannot conclude that no birds can fly by considering the flight characteristics of the ostrich.

To evaluate and demonstrate the benefits of early treatment, I aim to discuss and clarify available treatments and services and discuss cases with different problems and different treatment options. An understanding of all aspects of early treatment requires a thorough knowledge of the basics of embryology, physiology, and growth and development. This includes development of the dentition, tooth formation, eruption, exfoliation, and all transitional changes. Therefore, my other goal is to integrate the basic science and the clinical, in order to refresh the reader's memory on important points about the bases of nonskeletal and skeletal problems that can arise during the transitional stages of occlusion.

Each patient who enters our practice represents a new chapter and a new lesson that we can learn from. A thorough knowledge of the basis for early-age orthodontic treatment, an understanding of the proper treatment techniques, and a willingness to consider their appropriateness for each individual patient will allow us to intervene in ways that will provide the maximum benefit for a young and growing child.

PART

I

CLINICAL AND BIOLOGIC PRINCIPLES OF EARLY-AGE ORTHODONTIC TREATMENT

1 Rationale for Early-Age Orthodontic Treatment

In the past, orthodontic treatment has been focused mainly on juvenile and adult treatment. Treatment options for patients in these age groups often are limited by complex dental and orthodontic problems and the lack of sufficient future craniofacial growth.

During the later part of the 18th century, orthodontic treatment of Class II malocclusion was limited primarily to retraction of the maxillary anterior teeth to decrease excessive overjet. In 1880, Norman Kingsley[1] published a description of techniques for addressing protrusion. He was among the first to use extraoral force to retract the maxillary anterior teeth after extraction of the maxillary first premolars; the extraoral force was applied with headgear. Later, Case[2] continued to refine these methods.

Angle's classification[3] of malocclusion, published in the 1890s, provided a simple definition of normal occlusion and was an important step in the development of orthodontic treatment. Angle opposed the extraction of teeth and favored the preservation of the full dentition. His position against tooth extraction led him to depend on extraoral force for the expansion of crowded dental arches and retraction of the anterior segment. Later he discontinued the use of extraoral force and advocated the use of intraoral elastics to treat sagittal jaw discrepancies.

Because of Angle's dominating belief that treatment with Class II elastics was just as effective as extraoral force, the use of headgear was abandoned by the 1920s. Then, in 1936, Oppenheim[4] reintroduced the concept of extraoral anchorage, employing extraoral traction to treat maxillary protrusion. Accepting the position of the mandible in Class II malocclusions, Oppenheim attempted to move the maxillary dentition distally by employing a combination of occipital anchorage and an E-arch, allowing the mandible to continue its growth. This resulted in an improved relationship with the opposing jaw. In 1947, Silas Kloehn[5] reintroduced extraoral force, in the form of cervical headgear, for the treatment of skeletal Class II relationships.

In 1944, another student of Angle's, Charles Tweed,[6] was discouraged by the prevalence of relapse in many of his patients treated without extraction, so he decided to oppose the conventional wisdom of nonextraction.

In the early part of the 20th century, there was optimism about the influence of orthopedic force on skeletal growth. An almost universal belief was that orthodontic forces, if applied to the growing face, could alter the morphologic outcome. In the United States, headgear was the principal appliance used for facial orthopedic treatment, whereas in Europe the functional appliance was predominantly used.

In 1941, Alan Brodie,[7] one of Angle's students, concluded that the growing face could not be significantly altered from its genetically predetermined form and that the only option for the orthodontist in cases of skeletal malocclusion would be dental camouflage, or the movement of teeth within their jaws. This idea led to tooth extraction.

Panoramic radiographs

The panoramic radiograph is a common diagnostic tool in today's dental practice. It is a kind of radiograph that provides a full picture of the dentition and the complete maxilla and mandible.

Panoramic radiographs do not show the fine detail captured on intraoral radiographs and are not as specific as other intraoral radiographs, but in a single radiograph it provides a useful general view of all dentition, the maxilla and mandible, the sinuses, and both TMJs. This type of radiograph is very useful, especially during the mixed dentition, for early detection and prevention of all problems disturbing the normal development of occlusion.

Especially during the mixed dentition as a diagnostic tool for early-age orthodontic treatment, the following are important aspects that should be carefully evaluated on a panoramic radiograph before any orthodontic treatment:

- Position and pattern of fully emerged as well as emerging permanent teeth
- Sequence of permanent tooth eruption
- Asymmetric eruption
- Comparison of crown height levels on the left and right sides
- Obstacles preventing eruption
- Abnormal tooth malformations (gemination, fusion, dens in dente, or dilaceration)
- Exfoliation and pattern of primary teeth root resorption
- Tooth number and supernumerary teeth or congenitally missing teeth
- Eruption problems, such as impaction, ectopic, transposition, or ankylosis
- Bone density and trabeculation
- Cysts, odontomas, tumors, and other bone defects or pathologic lesions
- Third and second molar positions, inclinations, and relationships to the first molars and ramus edge
- Shape of the condylar head and ramus height
- Comparison of the left and right condylar heads and rami

The characteristics and management of these problems are discussed in their related chapters in part 2 of this book. Chapter 10 introduces a simple and practical technique for application of panoramic radiographs to assess canine impaction.

Longitudinal Panoramic Radiograph Monitoring

Over many years of teaching and practice, in both pediatric dentistry and orthodontic departments, the author became interested in conducting a retrospective evaluation of patients who were referred for some type of orthodontic problem and who had previous panoramic radiographs available. This retrospective evaluation led to the conclusion that the longitudinal monitoring of panoramic radiographs during the mixed dentition is a very valuable, easy technique that enables detection of developmental anomalies during the transitional dentition. Today the author strongly recommends this easy and very useful technique to all practitioners, especially pediatric dentists and orthodontists.

The transitional dentition is one of the most critical stages of the dentition, and many eruption problems, whether hereditary or environmental, emerge during this stage. Longitudinal panoramic radiograph monitoring is a careful serial monitoring technique that any practitioner can perform for young patients during transitional dentition to watch for developmental anomalies that may arise at these ages.

The technique the author recommends is to take one panoramic radiograph when the patient is around the age of 6 years (during the eruption of the permanent first molar) and then two more panoramic radiographs at 8 and 10 years of age. Careful comparison of two or three consecutive radiographs of a patient at this stage of the dentition can easily reveal any abnormal developmental processes emerging between radiographs and therefore can enable early detection and intervention. The following three cases illustrate the advantages of longitudinal monitoring of panoramic radiographs and proper intervention.

Case 3-1

This case confirms the importance of longitudinal radiographic evaluation, indicating how early intervention could have helped this little girl. Figures 3-23a to 3-23c are three consecutive radiographs found in her record. A periapical radiograph reveals the first sign of a problem, that is, asymmetric eruption of the central incisors at age 7 years. A panoramic radiograph taken about 15 months later shows the eruption of both central incisors and the asymmetric position of the lateral incisors. A third radiograph, a panoramic radiograph taken about 7 months later, reveals that the left lateral incisor had erupted while the right lateral incisor remained unerupted.

The important, detectable abnormal sign in this radiograph is the abnormal position of the maxillary permanent right canine in relation to the unerupted lateral incisor; unfortunately, no intervention was performed at this point, and the patient did not return until 3 years later. Figures 3-23d and 3-23e present the last panoramic and occlusal views, showing the complete resorption of the permanent lateral incisor root.

Possible intervention:
Assessment of the available serial radiographs indicates that the best treatment option was early intervention and extraction of the maxillary primary right canine when the first (see Fig 3-23b), or even the second (see Fig 3-23c), panoramic radiograph was taken. Extraction of the maxillary primary right canine would have facilitated and accelerated eruption of the permanent lateral incisor, moving this tooth away from the canine forces and preventing root resorption (see Figs 3-23d and 3-23e).

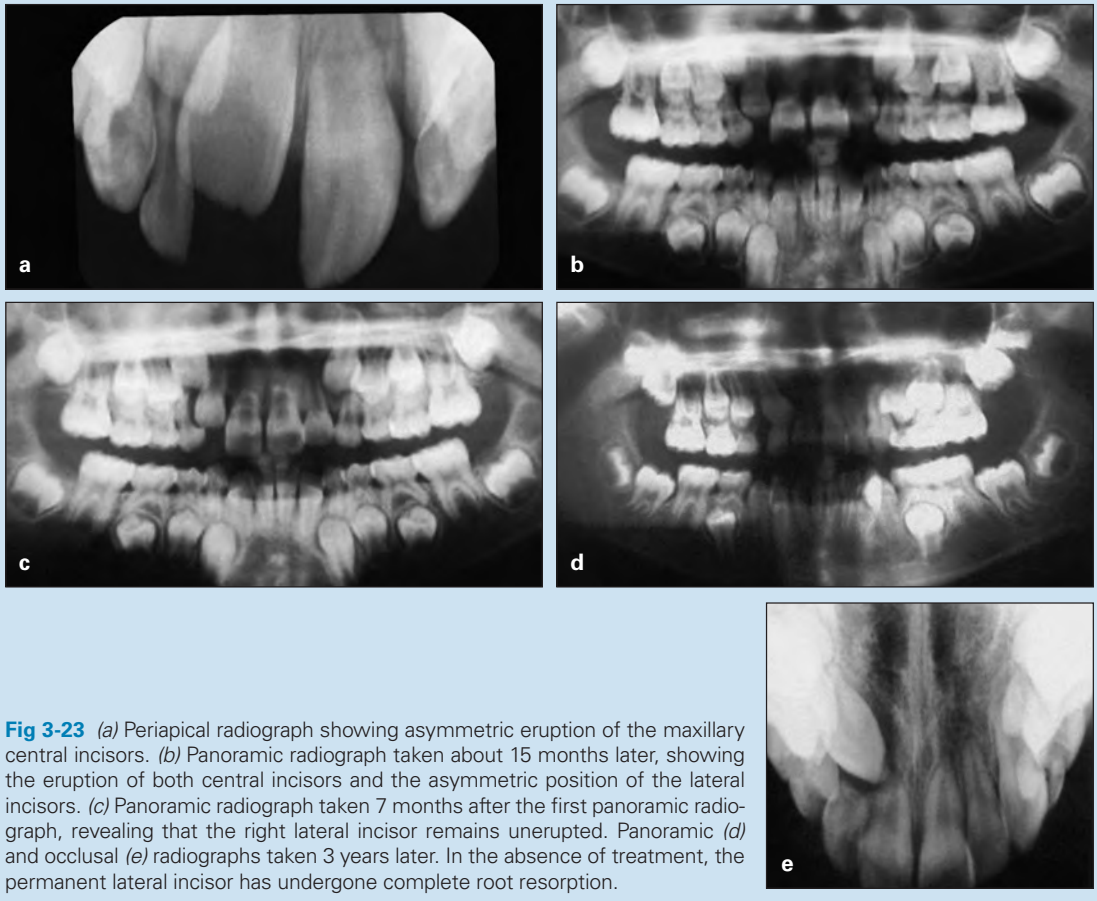

Fig 3-23 *(a)* Periapical radiograph showing asymmetric eruption of the maxillary central incisors. *(b)* Panoramic radiograph taken about 15 months later, showing the eruption of both central incisors and the asymmetric position of the lateral incisors. *(c)* Panoramic radiograph taken 7 months after the first panoramic radiograph, revealing that the right lateral incisor remains unerupted. Panoramic *(d)* and occlusal *(e)* radiographs taken 3 years later. In the absence of treatment, the permanent lateral incisor has undergone complete root resorption.

Fig 4-17 Fixed unilateral sliding loop space regainer.

Fig 4-18 Gurin lock space regainer.

Fig 4-19 Band and U-loop space regainer. (Courtesy of Great Lakes Orthodontics.)

Fig 4-20 Molar distalizer with Nance anchorage. *(a)* Space loss at the time of appliance placement. *(b)* Space regained at the end of treatment.

Fig 4-21 Mandibular molar distalizer. (Courtesy of Great Lakes Orthodontics.)

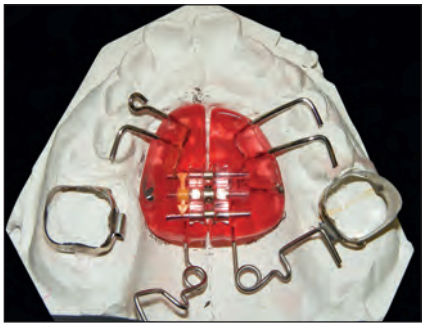

Fig 4-22 Pendulum distalizer with spring activation on the right molar. The distalizer in this image also includes a screw for expansion.

Fig 4-23 Distal jet appliance for molar distalization. (Courtesy of Great Lakes Orthodontics.)

This type of unilateral regainer is recommended in cases where the force is to be directed only to the molar in the maxillary dentition.

Sliding loop and lingual arch. This appliance is designed similarly to the sliding loop regainer, but it includes a lingual holding arch connected to the opposite molar band to provide anchorage and prevent adverse effects on the anterior component (Fig 4-21).

Pendulum appliance (molar distalizer). The pendulum appliance is a fixed bilateral or unilateral molar distalizer. It is designed with two bands cemented to the primary first molars or the premolars and an acrylic resin button touching the palate to provide good anchorage. One end of a β-titanium spring is embedded in acrylic and the other end is inserted in the palatal tube, making the spring removable (Fig 4-22). The appliance can be activated at each appointment. This type of distalizer is indicated for the permanent dentition, in cases of space loss or Class II molar correction.

Distal jet appliance. The distal jet appliance is also a fixed unilateral or bilateral distalizer with an acrylic resin button for anchorage. Bands are cemented to the anterior abutment, and two bars with open coil spring slide to embedded tubes for activation. The bars connected to the molar palatal tube can be removed, and the push coil can be reactivated (Fig 4-23).

2 × 4 bonding. Molar distalization and space regaining can be achieved as a part of 2 × 4 bonding in patients who need

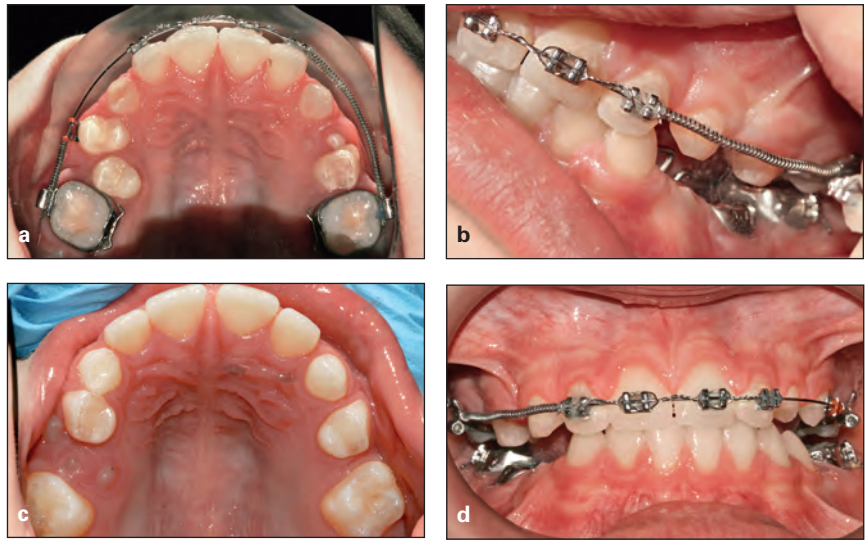

Fig 4-24 *(a to d)* Push coil and 2 × 4 bonding to regain space for the maxillary second premolars.

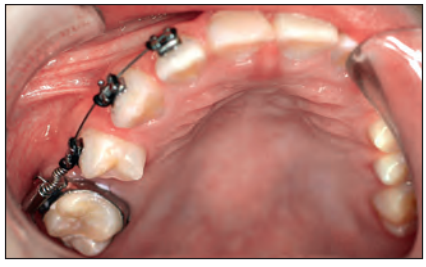

Fig 4-25 Sectional bracketing to open space for the maxillary right premolar.

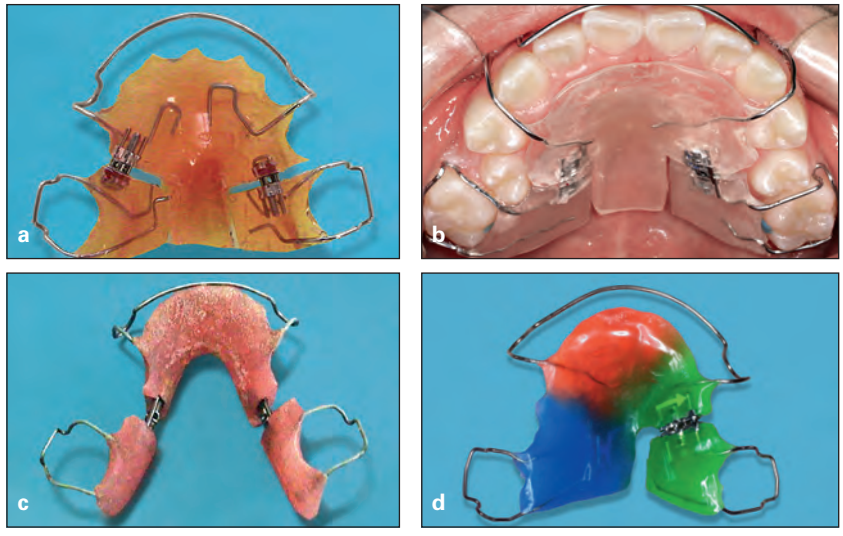

Fig 4-26 Hawley removable space regainers with jackscrews. *(a and b)* Bilateral removable regainers for the maxilla. *(c)* Bilateral removable regainer for the mandible. *(d)* Unilateral removable regainer for the maxilla.

incisor alignment (such as space closure, crossbite correction, or midline shift) during the early or middle mixed dentition. A light force can be applied to molars by a push coil inserted between lased incisors and the permanent molar tube (Fig 4-24).

Sectional bracketing. In patients with normal occlusion and space loss in one quadrant, minor tooth movement and space regaining can be achieved by sectional bracketing. Figure 4-25 shows a patient with a good Class I mandibular and maxillary left dentition. The problem is space loss at the maxillary right second premolar site that has resulted from mesial tipping of the molar and distal tipping of the first premolar. Sectional bracketing of this segment, leveling with a sectional archwire, and placement of a push coil between the tipped molar and premolar can open space and upright the adjacent teeth.

Removable space regainers

Removable appliances can also be used for space regaining as well as space maintenance. This can be accomplished by incorporating different springs or screws in the appliance, either unilaterally or bilaterally. A Hawley appliance with different modifications is a simple, effective appliance that can be used for all of these purposes (Fig 4-26).

Fig 8-5 *(a to h)* Various supernumerary teeth, affecting occlusion in many different ways.

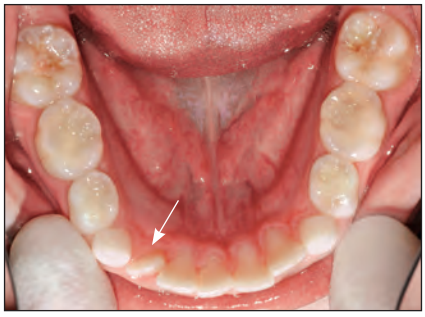

Fig 8-6 Supplemental mandibular supernumerary tooth *(arrow)* causing crowding, midline shift, and arch asymmetry.

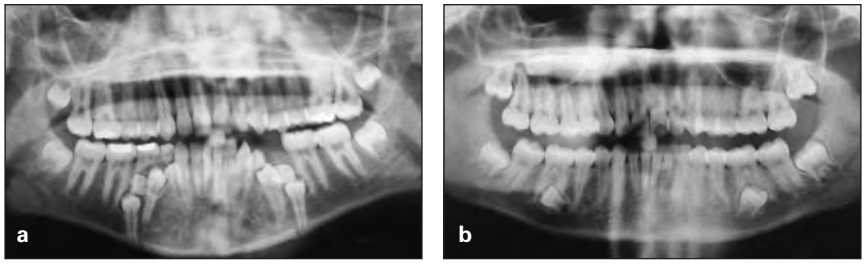

Fig 8-7 *(a)* Parapremolar supernumerary teeth preventing eruption of mandibular premolars. *(b)* Paramolar supernumerary teeth damaging the permanent first molar roots.

Early Recognition and Clinical Signs of Hyperdontia

Development of supernumerary teeth can occur any time during the primary dentition, mixed dentition, and the permanent dentition. They are almost always harmful to adjacent teeth and to the occlusion. Most cases of supernumerary teeth are asymptomatic and are usually found during routine clinical or radiologic investigations. Therefore, early recognition of and treatment planning for supernumerary teeth are important components of the preliminary assessment of a child's occlusal status and oral health, which is based on careful clinical and paraclinical examinations.

Clinical examination

Clinical examination of children during the primary or mixed dentition is discussed in detail in chapter 3. When assessing supernumerary teeth in the developing occlusion of a child, the clinician must consider the number, size, and form of teeth, the eruption time, the sequence of eruption, the position of each tooth, and local and general factors that can affect occlusion during transitional changes. The following are clinical signs of the presence of supernumerary teeth:

- Abnormal pattern and abnormal sequence of eruption
- Delayed eruption
- Absence of eruption

Case 9-2

A 10-year, 8-month-old girl exhibited a Class II division 1 malocclusion and maxillary and mandibular incisor protrusion. In addition, an invasive frenum attachment caused severe maxillary incisor crowding, displacement, and cystic formation (Figs 9-19a to 9-19e).

Treatment:
The treatment plan included removal of the frenum, the cyst, and all abnormal soft tissue attachment and extraction of the four first premolars, carried out as a serial step-by-step extraction.

After the surgical procedure and tissue healing, a removable maxillary Hawley appliance was inserted to achieve slow, minor incisor alignment, and use of a lower holding arch for about 1 year was followed by step 1 of the extraction series: removal of the maxillary primary canines, both maxillary primary first molars, and both mandibular primary first molars. Figure 9-19f shows alignment of the maxillary incisors and the canine bulges before serial extraction.

Step 2 was extraction of all four first premolars. Maxillary anchorage was prepared with a Nance appliance, and the lower holding arch was removed as reciprocal anchorage.

Step 3 of the extraction sequence was removal of the remaining primary second molars. This was followed by maxillary and mandibular bonding to start maxillary canine retraction. Then mandibular and later anterior retraction and space closure were accomplished. Some mesial movement of the mandibular molars was allowed, in order to achieve a Class I molar relationship (Figs 9-19g to 9-19k).

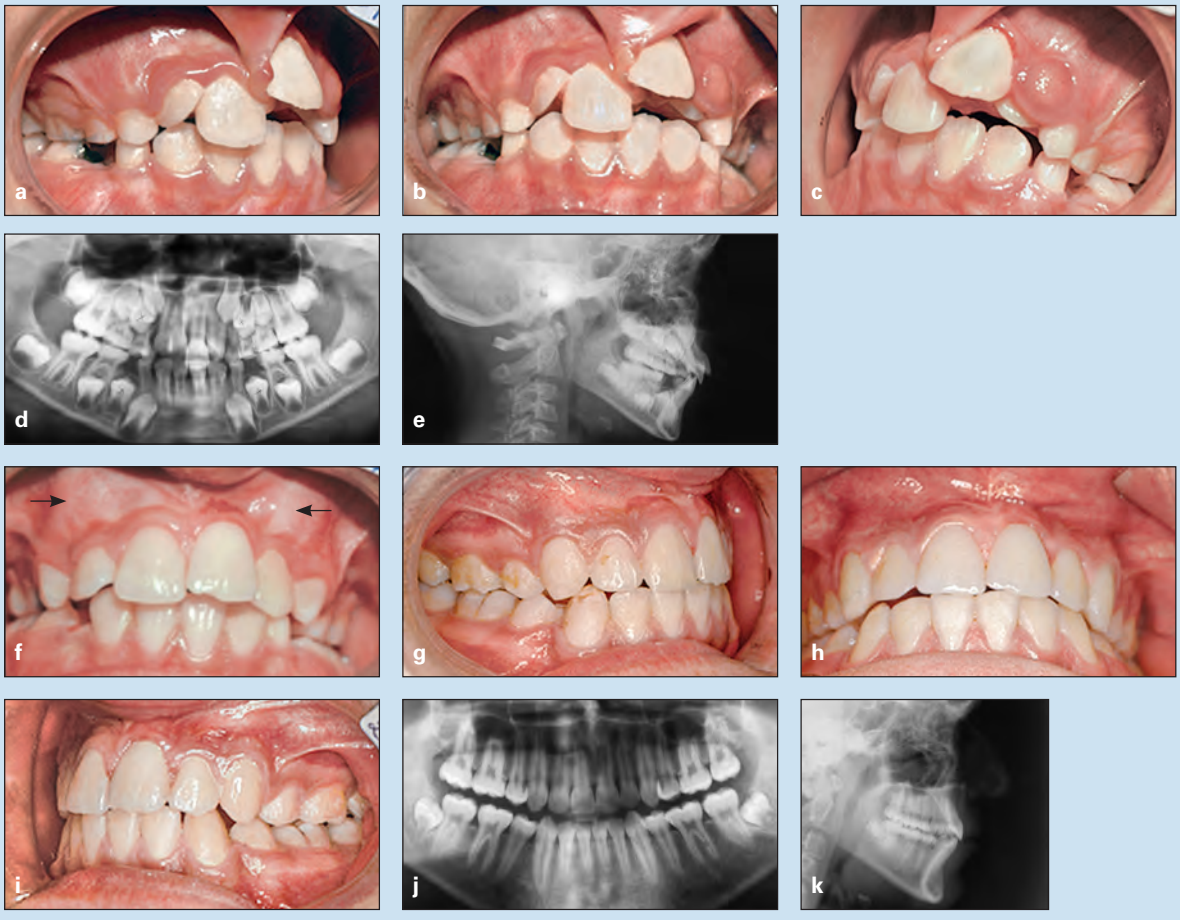

Fig 9-19 Treatment of a 10-year, 8-month-old girl with a Class II division 1 malocclusion and maxillary and mandibular protrusion. An invasive frenum attachment has caused tooth displacement, maxillary incisor crowding, and formation of a cyst. *(a to c)* Pretreatment occlusion. *(d)* Pretreatment panoramic radiograph. *(e)* Pretreatment cephalometric radiograph. *(f)* Tissue healing and some incisor alignment. The *arrows* show canine bulge. *(g to i)* Posttreatment occlusion. *(j)* Posttreatment panoramic radiograph. *(k)* Posttreatment cephalometric radiograph.

Fig 10-18 Management of an ectopic maxillary canine that has caused resorption of the permanent central incisor root and subsequent exfoliation. *(a to c)* Pretreatment occlusion. *(d)* Pretreatment panoramic radiograph. *(e to h)* Occlusion during active treatment and leveling. The canine bracket has a higher K distance to achieve elongation. *(i to l)* Posttreatment occlusion, after end of active treatment and reshaping of the canine to mimic the central incisor. 1—permanent central incisor; 2—permanent lateral incisor; 3—permanent canine; C—primary canine.

Tooth Transposition

Another kind of eruption disturbance is tooth transposition, or positional interchange of two adjacent teeth, especially their roots. Tooth transposition is a rare but clinically difficult developmental anomaly. Depending on the transposed teeth and their position, normal eruption of adjacent teeth can be affected, root anatomy can be damaged, and eruption of the affected teeth can be delayed. This eruption disturbance was first defined in 1849 by Harris,[50] who described tooth transposition as an "aberration in the position of the teeth."

Transposed teeth are classified into two types of tooth displacement: complete transposition and incomplete transposition (Fig 10-19). In complete transposition, both the crowns and the entire root structures of the involved teeth are displaced to abnormal positions. In incomplete transposition, only the crown of the involved tooth is transposed, and the root apices remain in place.

Transposition is sometimes accompanied by other dental anomalies, such as peg-shaped lateral incisors, congenitally missing teeth, crowding, overretained primary teeth, dilacerations, and rotation of adjacent teeth.

Displacement of one tooth from one quadrant across the midline to the other side of the arch has very rarely been reported, but according to Shapira and Kuftinec[51] these types of anomalies should be considered ectopically erupted teeth, not transposed teeth.

Case 11-9: Anterior dental crossbite

A 10-year-old girl in the middle mixed dentition presented with a Class III molar relationship on the right side because of space loss, 0- to 1-mm overbite and overjet, and three maxillary incisors in crossbite. Treatment had been delayed, causing severe crowding of the mandibular incisors and ectopic eruption of the mandibular right lateral incisor (Figs 11-18a to 11-18f).

Treatment:
Because of the severe crowding and displacement of incisors, the treatment plan incorporated fixed appliances with maxillary and mandibular 2 × 6 bonding. The first step in treatment was 2 × 4 maxillary bonding, mandibular first molar occlusal bonding to disocclude the anterior segment, and placement of 0.016-inch nickel-titanium maxillary arches (cinched back) for leveling and release of abnormal anterior contact. The second step was placement of 0.016-inch stainless steel maxillary arches with an open U-loop mesial to the molar tube (extended arch length) to procline the maxillary incisors out of crossbite. The third step was mandibular 2 × 4 bonding: first with 0.014-inch nickel-titanium archwire because of severe crowding and later with 0.016-inch nickel-titanium archwire for further leveling.

The fourth step was use of an open U-loop to place an extended-length stainless steel archwire against the mandibular molar tube to achieve minor mandibular incisor proclination in order to gain space and align the mandibular incisors. The final step was bonding the permanent canines after eruption for final anterior alignment. Figures 11-18g to 11-18k show the treatment outcome.

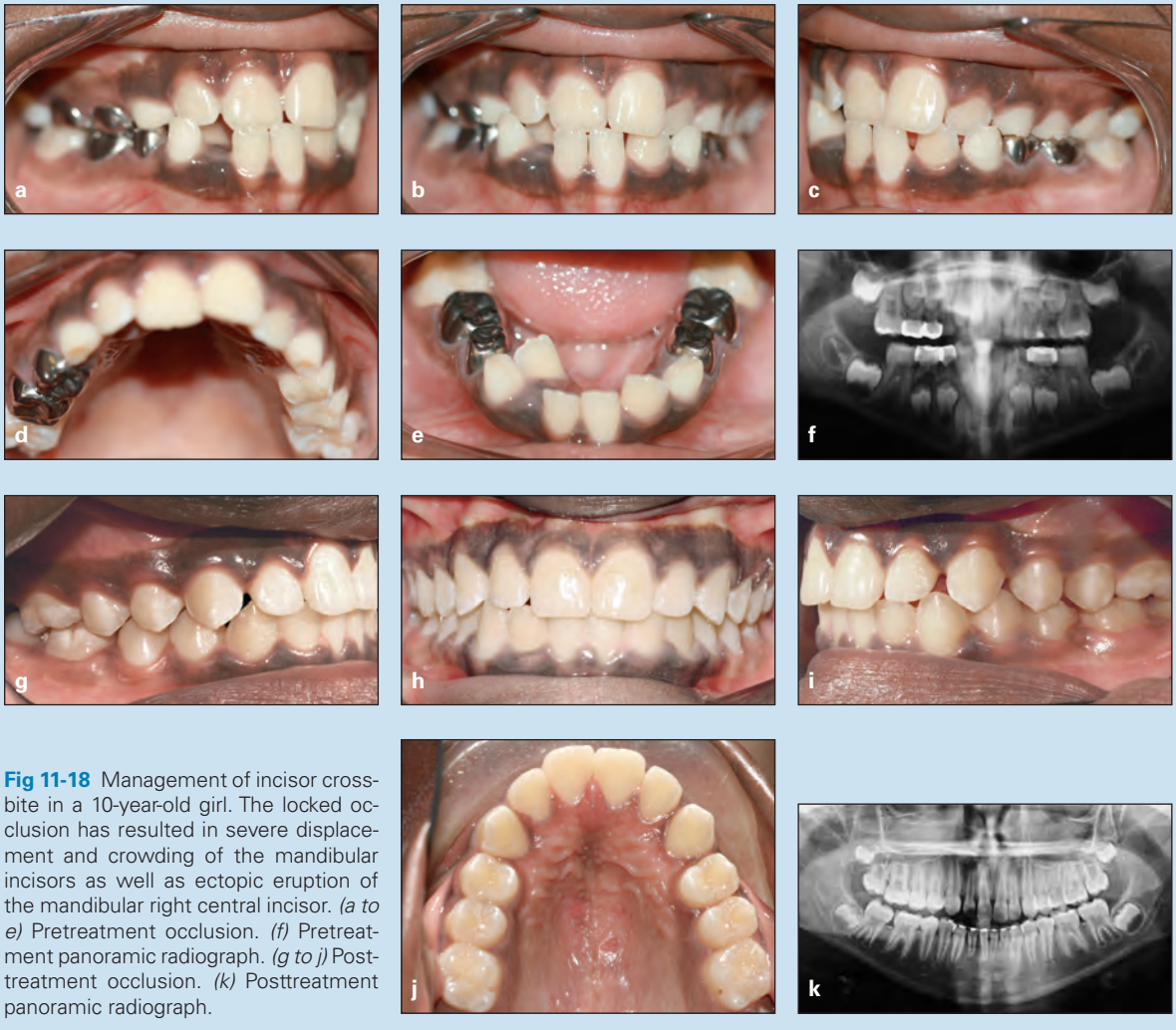

Fig 11-18 Management of incisor crossbite in a 10-year-old girl. The locked occlusion has resulted in severe displacement and crowding of the mandibular incisors as well as ectopic eruption of the mandibular right central incisor. *(a to e)* Pretreatment occlusion. *(f)* Pretreatment panoramic radiograph. *(g to j)* Posttreatment occlusion. *(k)* Posttreatment panoramic radiograph.

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